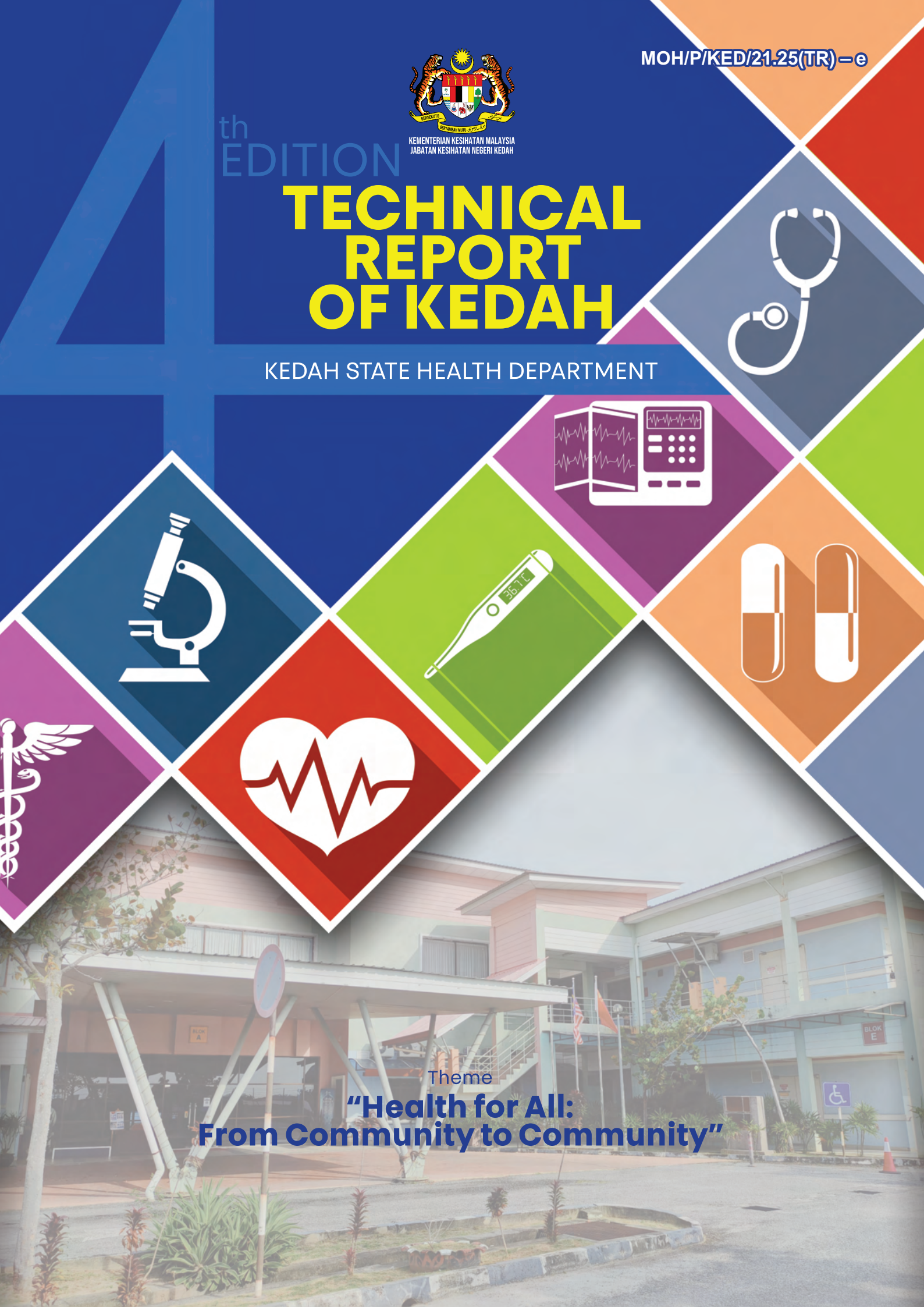
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KEMENTERIAN KESIHATAN MALAYSIA
JABATAN KESIHATAN NEGERI KEDAH

4th EDITION

TECHNICAL REPORT OF KEDAH

KEDAH STATE HEALTH DEPARTMENT



Theme

**"Health for All:
From Community to Community"**

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KEDAH STATE HEALTH DEPARTMENT

2025

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This publication is the result of collective effort—from data collection and analysis, to documentation, review, and final editing. The commitment and professionalism of our officers, healthcare staff, and the Editorial Board have been instrumental in ensuring the quality and integrity of this report.

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May this report serve not only as a record of achievements but also as a source of inspiration to continue striving for excellence in healthcare delivery

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FOREWORD

What is the true measure of a state's health? It is not found only within the walls of a clinic, but in the resilience of every village and neighborhood across Kedah. This core belief, that health progress must be community-driven and inclusive, is the urgent foundation of the 2025 Technical Report of the Kedah State Health Department.

I present this annual publication not just as a record, but as a roadmap. Our theme, "Health for All: From Community to Community," is more than a slogan; it is the recognition that true public health success cannot be realized through clinical services alone. It demands strong, sustained collaboration, a deep understanding of local needs, and the collective efforts of multiple sectors.

Within these pages, we document the evidence of our shared commitment: the key accomplishments, data, and innovations undertaken throughout 2025. These achievements are powered by the unwavering dedication of our healthcare professionals and the trust of our partners—from local communities to governmental bodies and non-governmental organizations.

Through this shared responsibility, we continue to build a health system that is not only capable of addressing current challenges but is fundamentally resilient against future demands.

Finally, I extend my heartfelt gratitude to the authors for their exceptional contributions and to the Editorial Board for ensuring this report upholds the highest standards of scientific rigor.

It is my sincere hope that this report serves as a source of insight and inspiration for all stakeholders. Let it be our clear guide as we move forward—together—toward building a truly healthier, more equitable future for every *rakyat* of Kedah.

DR. NOR'AISHAH BINTI ABU BAKAR
Senior Consultant Public Health Physician
State Health Director
Kedah State Health Department

PREFACE

It is my privilege to present the **Kedah State Health Department Technical Report 2025**, prepared under the guidance of the Editorial Board. This annual publication reflects our ongoing commitment to accountability, transparency, and the pursuit of improved health outcomes for the people of Kedah.

The theme, **"Health for All: From Community to Community",** underscores that meaningful progress in healthcare is achieved not only within our facilities but also through active engagement with every community we serve. Our mission is to ensure that quality health services are accessible, equitable, and responsive to the needs of all-reaching from rural villages to urban centers.

This report highlights key achievements, data, and initiatives that showcase the dedication of our healthcare workforce and the strong partnerships we have built with communities, organizations, and stakeholders. It also provides insights that will inform future strategies for strengthening our health system.

On behalf of the Editorial Board, I extend our sincere appreciation to all who contributed to this effort. May this report inspire continued collaboration and commitment as we work together towards a healthier Kedah.

DR SHAREH AZIZAN BIN SHAREH ALI
Chairman, Editorial Board of Technical Report 2025
Kedah State Health Department

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KNOWLEDGE, ACCEPTANCE AND PERCEPTION IN COVID-19 VACCINATION FOR CHILDREN AMONG PARENTS IN JITRA: A CROSS SECTIONAL STUDY

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ABSTRACT

Background

Coronavirus disease (COVID-19) Vaccination remains the most effective way to prevent the spread of the disease. However, hesitancy and negative perceptions may decrease the success rate of vaccination programs which aim to achieve at least 70% coverage of the population. This study aimed to determine the knowledge, acceptance and perception of parents in Jitra regarding COVID-19 vaccination for children.

Methods

An online survey was conducted among 377 parents in Jitra from February 2023 till December 2023. The structured questionnaire was set up using Google Form and distributed via social media. The collected data were analysed using SPSS version 29.0. The association between knowledge, acceptance and perception towards COVID-19 vaccines in children were evaluated using Spearman Correlation.

Results

A total of 377 respondents participated, majority were 31-35 years old (32.9%), female (81.2%), with children aged 7-12 years old (38.5%) and completed two doses of vaccination with booster (53.3%). Our study reveals that 88.1% of the respondents had good knowledge. There was no significant association between demographic data and the knowledge scores.

Conclusion

The study revealed that most parents in Jitra, Kedah had good acceptance and perceptions towards COVID-19 vaccination, however, the side effects was the major concern. Additional evidence and clinical studies on the safety and effectiveness of vaccination are essentials to increase parental acceptance to lead herd immunity against COVID-19.

Keywords: COVID-19, vaccine, knowledge, acceptance, perceptions, children

INTRODUCTION

Coronavirus disease or COVID-19 is an infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This infection was believed to have started from Wuhan, Hubei, China on December 31 2019. The disease was then spread to other countries such as Malaysia, Thailand, South Korea, Philippines and Singapore (Chi et al, 2020). There have been over 562 million cases documented globally in July 18, 2022 including deaths (WHO, 2020). The COVID-19 pandemic in Malaysia began on January 25, 2022 when three Chinese tourists entered the country via Singapore (Hashim et al, 2021). There have been 4 million cases reported as of July 18, 2022 in Malaysia, including cases involving deaths (COVIDNOW, 2022).

Based on safety and efficacy evidence from randomized, controlled, blinded clinical trials conducted on thousands of individuals, this vaccine was authorized for use in adults 16 years of age and older. The programme was first started in healthcare workers and frontliners. As of July 21, 2022, there have been 71 million doses given to adults aged 16 years old and older (COVIDNOW, 2022). Despite development of safe and effective vaccines, vaccine hesitancy defined as delayed acceptance or refusal of vaccination despite availability of vaccination services, remains a significant challenge (MacDonald, 2015).

On February 3, 2022, COVID-19 vaccination for children aged 5 to 11 years old was started due to rising school clusters among children (Cheah et al., 2022). While in Malaysia only 43.3% children were vaccinated up until October 2022. On the other hand, only 29.2% of children in Kedah aged 5-11 years old received the COVID vaccine, making Kedah one of the five states with the lowest rates of vaccination uptake within this age group (COVIDNOW, 2022). Because of this issue, it is important for health care personnel to act as advocates to promote childhood vaccination. Vaccination programs are effective in preventing infectious diseases and controlling epidemics; however, the effectiveness of this program depends on the public's comprehension and acceptance of the benefits of vaccination (Kaur et al., 2024).

Therefore, this study aimed to determine the knowledge, acceptance and perception of parents specifically in Jitra regarding COVID-19 vaccination for children.

METHODS AND MATERIALS

This cross-sectional study was conducted in 2023 involving parents with children aged less than 12 years old residing in Jitra, Kedah. The study sample was estimated using the Raosoft sample size calculator. A minimum of 377 respondents were required with a 5% margin error, 95% confidence level and 50% response distribution.

The questionnaire was in English adopted from Reiter et.al. (2020). To accommodate the local population, it was translated to Malay using a forward and backward translation process. The pilot study was conducted among 20 participants of various age, gender, professions and educational backgrounds to ensure the questions were clearly understood. The reliability of the questionnaire was determined using Cronbach's alpha and the value of Cronbach alpha for questions on knowledge, perceptions and acceptance were found to be greater than 0.6 respectively.

The questionnaire was set up using Google Forms and the access link was distributed via Whatsapp and Facebook. The inclusion criteria for respondent's eligibility include parents with children aged 1 to 12 years old, residing in Jitra, Kedah and able to understand Malay and English language. Respondent's consent was obtained before they answered the questionnaire. This research was approved by Medical Research Ethics Committee, Ministry of Health Malaysia (NMRR-22-02548-0UL). The study was conducted in compliance with ethical principles outlined in the Declaration of Helsinki and Malaysian Good Clinical Practice Guideline.

Data Collection

The questionnaire consisted of four sections: Section A covered Demographic Data and vaccination status, Section B focused on knowledge of COVID-19, Section C on Perception towards COVID-19 vaccine and Section D on the acceptance towards COVID-19 vaccination in children.

Section B (knowledge) consisted of 7 questions assessing the knowledge on COVID-19 infections where the respondents were provided with five options (1=strongly disagree, 5= strongly agree). One Mark was given for a correct answer (strongly agree and agree) while zero marks were given for wrong answer (neutral, disagree and strongly disagree). Maximum score is seven and those who obtained marks above median of total score (4 and above) will be categorized as having good knowledge. Section C included five questions on perception towards COVID 19 vaccine while Section D included the question on the acceptance of COVID 19 vaccination in children.

Data Analysis

Data was imported into a Microsoft Excel spreadsheet and coded in SPSS version 29.02.0 in Windows for final analysis. Basic descriptive analyses were performed on the demographic features, the knowledge, acceptance and perception scores. These analyses included frequencies and percentages. The Kolmogorov-Smirnov test and a histogram with a normality curve were employed in this investigation to ensure that the data had a normal distribution. For inferential analysis, non-parametric tests were employed since the data were not normally distributed. The association between knowledge score and demographic data was analysed using Mann-Whitney and Spearman rank correlation test. A *p*-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic Data

A total of 377 respondents participated in this online survey. Table 1 shows that the majority of the respondents were from 31-35 years old (32.9%) followed by 25-30 years old (31.8%). Most of the respondents were female (81.2%) as compared to male (18.8%). The children were mostly from the age 7-12 years old (38.5%) and most of the parents that participated in this study have completed their vaccination with two doses and booster (53.3%), followed by two doses only (45.6%).

Table 1: Distribution of demographic data (N=377)

Characteristics	**Frequency n (%)**
Age	
25-30 years old	120 (31.8)
31-35 years old	124 (32.9)
36-40 years old	90 (23.9)
More than 40 years old	43 (11.4)
Gender	
Male	71 (18.8)
Female	306 (81.2)
Children's Age	
1-4 years old	134 (35.5)
5-6 years old	98 (26.0)
7-12 years old	145 (38.5)
Parents' Vaccination Status	
Received only one dose	2 (0.5)
Completed two doses	172 (45.6)
Completed two doses with booster	201 (53.3)
Not applicable	2 (0.5)

Knowledge regarding COVID-19 infection

Knowledge of COVID-19 infections consisted of seven items with a 5-point Likert scale (5=strongly agree, 1=strongly disagree). Table 2 presented the questions and the results of the knowledge on COVID-19. The main clinical symptom of COVID-19 had the highest percentage of correct answers (97.0%) while the item regarding isolation period had the lowest where only 27.9% agreed that individuals who tested positive should be quarantined for 7 days. The maximum score was 7 and participants who scored above the median of total score (≥4) were categorized as having good knowledge. As shown in table 3, 88.1% of participants had good

knowledge (knowledge score ≥4) regardless of the age group. There was no significant association between demographic factors and knowledge scores.

Table 2: Knowledge on COVID-19 infection (N=377)

Statements	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
The main clinical symptoms of COVID include fever, cough, runny nose, shortness of breath	323 (85.6)	43 (11.4)	5 (1.5)	2 (0.5)	4 (1.0)
The person with COVID can infect the virus to others if they do not have a fever	179 (47.5)	33 (8.8)	7 (1.9)	38 (10.0)	120 (31.8)
COVID 19 viruses transmitted through airborne and droplets only	191 (50.7)	43 (11.4)	18 (4.8)	37 (9.8)	88 (23.3)
Currently no effective treatment for COVID 19 but early treatment could help most patients recover from the infection	284 (75.3)	41 (10.9)	27 (7.2)	17 (4.5)	8 (2.1)
One of the preventions against COVID 19 is using hand sanitizer or washing hand using soap with running water	315 (83.6)	51 (13.5)	8 (2.1)	2 (0.5)	1 (0.3)
Not everyone who is infected with COVID 19 develops severely. This only occurs for children, elderly and people with chronic diseases	222 (58.9)	40 (10.6)	22 (5.8)	56 (14.9)	37 (9.8)

Table 3: Association between demographic factors and knowledge score by demographic data (N=377)

Statement	n (%)	Knowledge score		*p*-value
		≥4	<4	
Age Group				[a]**0.155**
25 - 30 years old	120 (31.8)	106 (28.1)	14 (3.7)	
31 - 35 years old	124 (32.9)	107 (28.4)	17 (4.5)	
36 - 40 years old	90 (23.9)	79 (21.0)	11 (2.9)	
> 40 years old	43 (11.7)	40 (10.6)	3 (0.8)	
Gender				[b]**0.831**
Male	71 (18.8)	62 (16.4)	9 (2.4)	
Female	306 (81.2)	270 (71.6)	36 (9.5)	

Children's Age				**[a]0.485**
1-4 years old	134 (35.5)	118 (31.3)	16 (4.2)	
5-6 years old	98 (26.0)	87 (23.1)	11 (2.9)	
7-11 years old	145 (38.5)	127 (33.7)	18 (4.8)	
Parents' Vaccination status				**[a]0.247**
Received only one dose	2 (0.5)	1 (0.3)	1 (0.3)	
Complete two doses	172 (45.6)	153 (40.6)	19 (5.0)	
Complete two doses with booster	201 (53.3)	176 (46.7)	25 (6.6)	
Not applicable	2 (0.5)	2 (0.5)	0	

[a] Spearman rank correlation bMann Whitney U test (Significant level p<0.05)

Perception towards COVID-19 vaccine for children

About 58.6% perceived that there is no harm in taking COVID–19 vaccine in children and 64.7% agreed that COVID-19 vaccine will be useful for protecting their family from COVID-19 infections (Table 4). 50.9% of parents disagreed on the statement "I feel taking vaccines has more benefits than outweighs the risk for children".

Table 4: Perceptions on COVID-19 vaccination (N=377)

Statements	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
I think there is no harm in taking COVID-19 vaccine in children	158 (41.9)	63 (16.7)	34 (9.0)	22 (5.8)	100 (26.5)
I feel taking vaccine have more benefit outweigh risk for children	121 (32.1)	64 (17.0)	63 (16.7)	34 (9.0)	95 (25.2)
I believe COVID-19 vaccine will be useful for protecting my family from COVID infection	175 (46.4)	69 (18.3)	49 (13.0)	24 (6.4)	60 (15.9)
COVID-19 vaccine will prevent my children from getting infected with COVID-19 viruses.	144 (38.2)	54 (14.3)	64 (17.0)	43 (11.4)	72 (19.1)

Acceptance towards COVID-19 vaccine for children

The study showed that the majority of participants (63.1%) agreed that everyone including children can receive COVID 19 vaccine regardless of the age group range. However, despite the participant's willingness, the majority of participants admitted that they were concerned if their children will get the side effects upon receiving COVID-19 vaccine (Table 5).

Table 5: Acceptance on COVID 19 vaccination in children by age group and parents' vaccination status (N=377)

Statement	Demographic data	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
Everyone including children can receive COVID 19 vaccine	**Age**					
	25 - 30 years old	55 (14.6)	18 (4.8)	14 (3.7)	3 (0.8)	30 (8.0)
	31 - 35 years old	52 (14.0)	27 (7.2)	17 (4.5)	5 (1.3)	23 (6.1)
	36 - 40 years old	40 (10.6)	17 (4.5)	9 (2.4)	3 (0.8)	21 (5.6)
	> 40 years old	17 (4.5)	12 (3.2)	5 (1.3)	3 (0.8)	6 (1.6)
	Parents					
	Vaccination status	1 (0.3)	0	1 (0.3)	0 (0)	0 (0)
	Received only one dose	66 (17.5)	38 (10.1)	19 (5.0)	7 (1.9)	42 (11.1)
	Complete two doses	97 (25.7)	34 (9.0)	25 (6.6)	7 (1.9)	38 (10.1)
	Complete two doses with booster	0 (0)	2 (0.5)	0 (0)	0 (0)	0 (0)
	Not applicable					
I concern if my children will get side effects from COVID 19 vaccine	**Age**					
	25 - 30 years old	85 (22.5)	11 (2.9)	13 (3.4)	6 (1.6)	5 (1.3)
	31 - 35 years old	89 (23.6)	9 (2.4)	20 (5.3)	1 (0.3)	3 (0.8)
	36 - 40 years old	54 (14.3)	15 (4.0)	13 (3.4)	4 (1.1)	4 (1.1)
	> 40 years old	26 (6.9)	6 (1.6)	10 (2.7)	1 (0.3)	0
	Parents					
	Vaccination status	0 (0)	0 (0)	2 (0.5)	0 (0)	0 (0)
	Received only one dose	121 (32.1)	16 (4.2)	21 (5.6)	8 (2.1)	6 (1.6)
	Complete two doses	132 (35.0)	25 (6.6)	32 (8.5)	4 (1.1)	8 (2.1)
	Complete two doses with booster	1 (0.3)	0 (0)	1 (0.3)	0 (0)	0 (0)
	Not applicable					

DISCUSSION

The findings indicated a generally high level of knowledge about COVID-19 among participants. However, there were some misconceptions, as well as varying degrees of acceptance and differing perceptions regarding the COVID-19 vaccine for children. The majority of respondents (88.1%) demonstrated good knowledge of COVID-19 infection. Specifically, 97% of parents correctly identified the primary clinical symptoms of COVID-19 infections which included fever, cough, runny nose, and

shortness of breath. Furthermore, 97.1% acknowledged that hand hygiene practices, such as the use of hand sanitizer or washing hands with soap and running water, as effective preventive measures. These results suggested that public health messaging efforts had been effective in disseminating basic COVID-19 knowledge within the community. In contrast, the study conducted in 2021 reported that more than half of the respondents exhibited poor knowledge regarding COVID-19 infection. With the advancement of technology and social media, excess information may lead to media fatigue, misinformation and the spread of false information that potentially influenced parental hesitancy or refusal regarding COVID-19 vaccination for children. (Mohamed et al., 2021).

The results revealed that knowledge was not significantly associated with gender. This study was inconsistent with the findings from a study conducted in Bangladesh which reported that males showed higher scores of knowledges as compared to females (Islam et al., 2021). No differences were found between parents' and children's age and also parents' vaccination status in relation to the knowledge. This meant that concerns about the vaccine were likely due to general beliefs or fears, not due to personal background or experiences.

The study found that most parents had positive perceptions towards COVID-19 vaccine. Approximately 64.7% perceived that COVID-19 vaccine would be useful in protecting their families from COVID-19 infection and 58.6% believed there is no harm in administering the vaccine to children. However, only 49.1% believed that the benefits of vaccinating children outweighed the associated risks. One study reported that the majority of respondents were concerned about the limited experience with COVID-19 vaccine which were new and rapidly developed (Adhikari et al., 2022). Compared to parents who had received only one dose of vaccine, those who had received two doses and had completed with a booster dose demonstrated a higher acceptance rate (62.3%) similar to a study conducted in New York (Kainth et al., 2024). This finding was further supported by an earlier study in China which indicated that individuals who had previously received the COVID-19 vaccine were more likely to accept it (Islam et al., 2021).

Our study showed that 63.1% of participants were willing to vaccinate their children. The acceptance rate was higher than those reported in the United States (49.4%), England (55.8%) and Turkey (62.6%) but lower than in countries such as Saudi Arabia (64.7%) and Brazil (91%) (Bagateli et.al., 2021). In a recent pan-Canadian survey, half of the parents were concerned about the safety of the new vaccine and one-third believed that children today receive too many vaccines (Dubé et al., 2013). Parental reluctance to vaccinate their children may have been driven by fears of the potential side effects. For example, a study conducted in Dubai, one-third of the participants admitted to having such fears. Notably, fear was reported by 82.5% of the hesitant group compared to only 0.1% among those who accepted vaccination for their children (AlKetbi et al., 2022). Similarly, another study found that more than half of the respondents (51.6%) stated that concerns about side effects would prevent

them from taking a COVID-19 vaccine and 52.1% refused to take COVID-19 vaccine (Mannan & Farhana, 2020). Overall, parental vaccine hesitancy is often rooted in safety concerns, particularly when it involves younger populations.

One of the primary limitations of this study was the data collection method which relied heavily on social media platforms. As a result, the majority of respondents were young adults with strong digital literacy leading to a sample that may not fully represent the broader population in Jitra, Kedah. This sampling bias limits how well the findings reflect the overall populations. We recommend a more extensive study including participants from diverse backgrounds and socioeconomic levels. Expanding data collection to include face-to-face interviews, phone calls and community outreach would likely result in more comprehensive insights.

CONCLUSION

This study offered preliminary insights on the knowledge, perception and acceptance of the COVID-19 vaccine among children in Jitra, Kedah. Most parents in Jitra, Kedah had good knowledge, acceptance with vary degree of perceptions towards COVID-19 vaccination in children, however, the side effects remained a major concern. Good knowledge and better perception on COVID-19 vaccine among the parental population can aid in controlling the COVID-19 pandemic. Additional evidence and clinical studies on the safety and effectiveness of vaccination are essential to increase parental acceptance to achieve herd immunity against COVID-19.

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ORAL HEALTH, NATIONAL WEALTH: EMPOWERING YOUNG ADULTS FOR A HEALTHIER FUTURE

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ABSTRACT

Background: The National Oral Health Survey of Adults (NOHSA) 2010 reported a high percentage of young adults with oral diseases. This indicates alarming signs that an enhancement of oral health education is crucial among young adults. Hence, Kubang Pasu Dental Health District Office took initiative to conduct a Healthy Setting Project involving 42 students from the Bandar Darulaman Community College 2023/2024 intake. This project aimed to produce young adults with the knowledge, awareness and skills to maintain oral healthcare and the ability to educate the society about its importance.

Methods: This project was carried out in 3 phases with a pre and post-test questionnaire. A series of educational activities, including dental check-ups and treatments, and the appointment of Gen-Z influencers to promote oral health messages were conducted. Additionally, a dental health video-making workshop was held, with the resulting content shared on social media to further disseminate key oral health information to their peers and public.

Results: There was an increase in the participants' oral health status, knowledge and their ability to share dental health information to the public after the intervention. Participants with a Basic Periodontal Examination (BPE) score of 0 increased from 42.9% to 78.6%. Comparison of the pre and post test results showed an 18% increase of their overall knowledge, attitude and practice. The trained Gen Z influencers also successfully obtained an exceptional engagement from their social media postings.

Discussion: The success of this project acts as a catalyst in cultivating productive youth with excellent oral health standards and who can then become oral health ambassadors in the community.

Conclusion: Optimum oral health status and awareness create a productive youth who can become dental icons within society.

Keywords: Young Adults, Gen Z, caries, plaque, mouth, health, nation

INTRODUCTION

Oral health is a vital aspect of overall well-being and significantly contributes to an individual's quality of life. A healthy, productive, and competent youth population is crucial for a national development (Ministry of Health Malaysia, 2019). There is a transition stage for a young adult characterized by a shift from school life to workspace and from parental dependence to independent living. These transitions have a profound impact on their future lives. According to the World Health Organization (2024), young adults are defined as individuals aged 12 to 24 years. In the Malaysian context, however, the category of young adults includes those aged 15 to 29 years (Ministry of Health Malaysia, 2019).

Based on the National Oral Health Survey of Adults (NOHSA) 2010, oral health problems among young adults in Malaysia are alarming. Periodontal disease was found in 90.4% of young adults aged 15–19, 95.3% of those aged 20–24, and 97.3% of those aged 25–29 (Ministry of Health Malaysia, 2022). Dental caries is another common problem faced by young adults. NOHSA 2010 reported that 21.5% of young adults aged 15–19, 24.9% of those aged 20–24, and 31.4% of those aged 25–29 required single-surface dental fillings (Ministry of Health Malaysia, 2019).

Due to this concerning trend, the Kubang Pasu Dental Health District Office has initiated a project named 'Oral Health, National Wealth: Empowering Young Adults for A Healthier Future' with the aim of identifying the participants' knowledge, attitude and practice (KAP) regarding oral healthcare and to improve optimal oral health standards among young adults by equipping them with the awareness, and skills necessary to maintain oral healthcare. The project was implemented at Bandar Darulaman Community College and involved 42 students from the 2023/2024 intake. The project was designed based on the data obtained from the Transformation With 1 Smile Together (TW1ST) program conducted in 2022, which revealed that 61.2% of students were affected by gum disease and 23.5% of them had dental caries. This alarming prevalence underscored the need for targeted intervention to promote better oral healthcare practices among youth.

This project was also carried out to develop individuals who are able to utilize various mediums including digital platforms such as social media to spread oral health awareness to the community through the formation of Gen-Z influencers. These Gen-Z influencers will be trained and empowered to serve as oral healthcare communicators in delivering accurate oral health messages to the community.

METHODOLOGY

This project was conducted in three phases over a period of one year and involved 42 students from Bandar Darulaman Community College 2023/2024 intake.

Phase 1 (May 2023)

A pre-test was conducted at the start of the programme. Oral examination, diagnosis and treatments such as filling and scaling was conducted by five dental officers who have been calibrated. Treatment referral to Klinik Pergigian Jitra was done for participants who required dental extraction, root canal treatment and other complex treatments. Oral healthcare talk, quiz and Toothbrushing drill or *Latihan Memberus Gigi* (LMG) were performed to improve their knowledge and awareness of oral health. Then, a group of participants, known as Gen-Z influencers, was trained to use social media to motivate and educate the public and their community, as well as to empower themselves in maintaining good oral health.

Phase 2 (October 2023 - March 2024)

Periodic monitoring was carried out through two visits to the college. During the first visit, an oral health screening was conducted to reassess the current oral health status. It was done to ensure that all the participants maintained consistent oral health and no new dental problem was developed. In the second visit, a dental health related video-making workshop was conducted for the participants whereby five groups were formed and assigned with different topics such as toothbrushing techniques, dental myths and good oral healthcare practices. Videos were produced and uploaded to their social media accounts such as TikTok using the hashtag #genzjagagigi. One student who was chosen by the community college to become Ikon Gigi Remaja (IGGR) was presented with a certificate of officiation.

Phase 3 (May 2024)

An oral health screening was performed to reassess the oral health status one year after the project's implementation. This evaluation was conducted to ensure that participants' oral health was maintained at an optimal level. During the visit, students were also reminded about the importance of practicing good oral hygiene and encouraged to continue their role as consistent influencers in promoting accurate oral health information.

RESULTS

All participants were Malay, with the majority being males (n=34,81%) and the remaining females (n=8,19%). The participants were aged between 18 and 25 years, with a mean age of 19 years (SD = 1.75). This demographic reflects a typical cohort of community college students in Malaysia, particularly those enrolled in certificate-level programs. The focus on this age group was intentional, as they are in a transitional stage where establishing lifelong oral health habits is critical.

Figure 1 presents a comparison of pre-test and post-test scores across three domains: knowledge, attitude, and practice towards oral health. The data shows a notable improvement in all areas following the implementation of the oral health project. Specifically, students' knowledge of oral health increased from 59.5% in the

pre-test to 83.3% in the post-test, representing a 23.8% improvement. Similarly, practice scores increased from 47.6% to 71.4%, reflecting another 23.8% gain. On the other hand, attitude scores rose from 76.2% to 83.3%, indicating a 7.1% increment post-intervention.

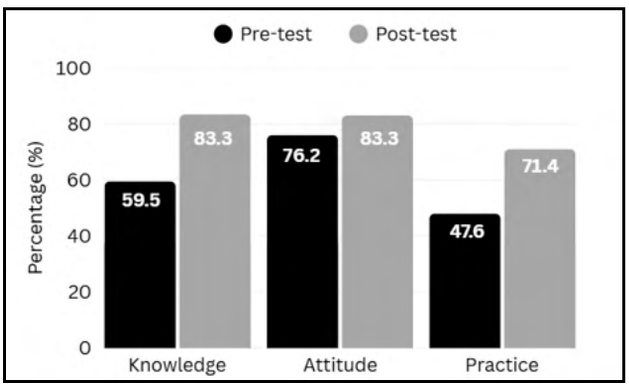


Figure 1: Comparison of pre- and post-intervention scores.

Figure 2 illustrates the changes in Basic Periodontal Examination (BPE) scores among participants before and after the intervention. At the initial stage of the project, only less than half of the participants (42.9%) presented with a healthy periodontium (BPE 0). Meanwhile, 9.5% of them presented with BPE 1, reflecting the presence of gingival bleeding, and 47.6% scored BPE 2, which signifies calculus deposits and the need for professional cleaning.

After the intervention, the proportion of students with a BPE 0 rose markedly to 78.6%, indicating a substantial increase in the number of students with healthy gums. The percentage of students with BPE 1 increased from 9.5% to 21.4%. This is likely due to students previously in the BPE 2 category who had improved but still exhibited mild gingival inflammation. No students scored BPE 2, suggesting successful elimination of calculus and prevention of more severe periodontal problems.

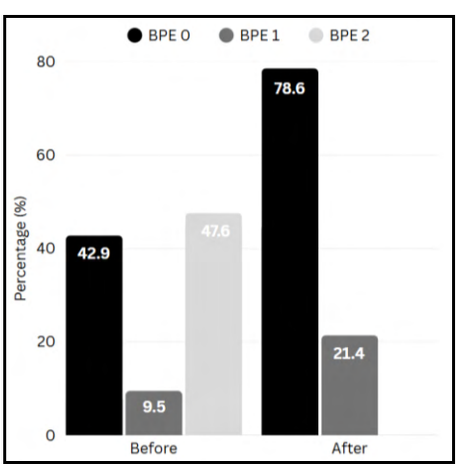


Figure 2: Improvement of basic periodontal examination (BPE) score.

Figure 3 illustrates four creative dental health videos produced by the students for TikTok under the hashtag #genzjagagigi. The videos achieved a maximum engagement of 318 views.

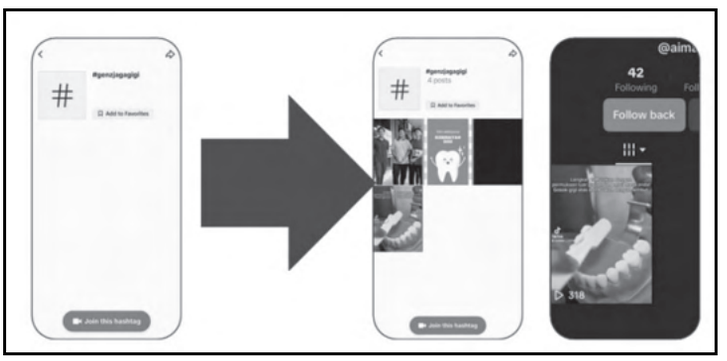


Figure 3: Production of dental health videos with high engagement value.

DISCUSSION

The effectiveness of this project was monitored and evaluated based on three indicators which include the increase of post test scores compared to pre test scores, the improvement of the participants BPE scores and the production of dental health videos with high engagement value. The findings from this project indicate a notable increase in post-test scores compared to pre-test scores across the domains of knowledge, practice, and attitude toward oral health care following a year-long educational intervention among 42 community college students. This finding was supported by a meta-analysis conducted by Xiang et al (2020) which reported that oral health KAP improved after 6–9 months of behavioral interventions. The findings underscored the effectiveness of structured oral health education in promoting better understanding, enhancing practices, and shaping positive attitudes toward oral hygiene.

The comparison between pre and post-test scores revealed substantial improvement in oral health knowledge (OHK) among the participants. Initially, the pre-test results indicated a limited understanding of basic oral health principles which relatively aligns with the OHK score amongst Nigerian adolescents ranging between 0-60% (Lawal et al, 2020). Most of the participants in this project were not aware of the recommended frequency of dental visits and the definition of dental calculus. After a variety of oral health education interventions, participants demonstrated a marked increase in knowledge, suggesting that the information provided was clearly communicated and effectively absorbed.

The study further identified a positive shift in participants' attitudes toward oral health care. Following the intervention, there was a clear increase in positive attitudes, including a greater appreciation of the importance of fluoride and oral health, and a

willingness to seek regular dental care. A positive attitude is critical in sustaining long-term oral health practices, and the results indicate that the intervention successfully cultivated this mindset among the participants. This is consistent with a study by Nakre & Harikiran (2013) which concluded that oral health education is effective in improving the attitude of the participants. However, the relatively lower increase in attitude scores suggests that translating knowledge into a change in attitude remains a challenge. This trend has also been observed in another study among college students whereby although their oral health knowledge improved markedly, motivation to bring a change in their attitude and practices were still lacking (Subburaman et al, 2021). Sustained interventions, such as peer mentoring or reinforcement through digital reminders, may be necessary to create lasting attitude shifts.

Furthermore, our findings showed a notable increase in self-reported oral health practices. Before the intervention, only 38.1% of the participants used fluoridated toothpaste and 30.9% used dental floss which was similar to University of Calabar students which reported only 30.5% of their students were using dental floss regularly (Okoroafor et al, 2023). However, after the intervention, more than half of our participants reported adopting the use of fluoridated toothpaste, increasing the frequency of tooth brushing to at least twice daily, and incorporating additional oral hygiene measures such as flossing and the use of mouth rinses. The behavior-focused strategies, including talks and demonstrations, contributed to this positive shift. The improvement in practices suggests that the intervention not only provided knowledge but also motivated them towards behavioral changes.

The Basic Periodontal Examination (BPE) scores further support the effectiveness of our intervention program whereby the participants were educated with proper tooth brushing techniques and dental flossing techniques. Based on the oral examination in Phase 3, all the participants with BPE 0 in pre-intervention were able to maintain their oral health throughout the one-year period. A total of 33 participants presented with BPE 0 and none of the participants presented with BPE 2 at the end of the programme. The reduction in participants with higher BPE scores which indicates having periodontal problems signifies that the improved knowledge and practices led to health benefits. Personal meetings, regular repetition, periodic check-ups of the individual’s dental status, and the reinforcement in oral hygiene seemed to be important factors in helping the patients to maintain their oral health and cleanliness (Egelberg, 1999). This was supported by a study by Hugoson et al (2007) who reported that the improvement of oral health in young adults was found in the group who visited the dentist and received individualised information and instruction in oral hygiene. Thus, this shows the importance of regular dental checkups and tailored oral hygiene instructions in maintaining optimal oral health.

To sustain these efforts, the participants were empowered to become oral health advocates. In addition to being able to spread knowledge about dental health among

their social media followers and peers, they can also spread oral health related information to the general community. According to a review by Murugeshappa et al (2025), social media serves as a significant source of oral health education for adolescents, influencing their knowledge and behaviors. Furthermore, a study by Subburaman et al (2021) evaluated the effect of social media-based oral health promotion programmes in improving oral health among 18-20-year-old college students and concluded that the intervention given through social media significantly improved the oral health status and KAP among its users. This further solidifies the impacts of social media in improving oral health.

This study has its limitations in which it relied on self-reported behavior, which may be subjected to reporting bias. Additionally, while knowledge and practice improved markedly, the gap between knowledge acquisition and attitude change suggests that it requires more persistent reinforcement beyond a one-year intervention.

Based on the findings and outcomes of this project, some recommendations can be made in order to enhance the effectiveness and sustainability of oral health initiatives at Bandar Darulaman Community College. A Dento-Bud system can be established to foster continuous engagement and communication between the students and dental health professionals. Under this system, each student can be paired with a dental buddy who acts as a point of contact for questions, reminders and motivation regarding oral health.

Collaboration with other external agencies such as health authorities is essential to broaden the scope and impact of oral health promotion initiatives. Involving relevant authorities such as other local health departments and non-governmental health organizations can provide access to a wider range of expertise, materials, and technical support. These agencies can contribute professional experience, supply educational resources and assist in organizing health campaigns or screenings.

Besides that, by strengthening the Smoke-Free Facility Policy at Bandar Darulaman Community College, this effort may contribute to promoting a healthier and more supportive learning environment. A stricter enforcement of the smoke-free policy can help reduce students' exposure to secondhand smoke and discourage tobacco use, which is a major risk factor for both oral and general health problems. Implementing clear signage, regular awareness campaigns, and designated monitoring teams can ensure better compliance among students and staff.

The results of this project have elicited important information that could serve as a basis for future planning in increasing oral health KAP among young adults attending other tertiary education institutes through oral health educational promotional strategy.

CONCLUSION

The result of this project shows that long-term, interactive oral health education can effectively improve knowledge, practice, attitudes, and clinical oral health outcomes. The integration of high-engagement strategies, such as the production and dissemination of dental health videos on social media platforms can contribute to a wider spread of oral health education promotion by increasing accessibility and relevance for young adults.

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ASSESSING THE GOVERNMENT'S ECONOMIC BURDEN ON MANAGING DIABETIC FOOT-RELATED LOWER LIMB AMPUTATIONS: INPATIENT TREATMENT AND PROSTHETIC RESTORATION COSTS IN A TERTIARY HOSPITAL FACILITY

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ABSTRACT

Background: Diabetes mellitus is a major global health concern with severe complications, including diabetic foot related infection resulting in lower limb amputation. This study aims to assess the economic burden on the government in managing diabetic foot-related lower limb amputations, focusing on inpatient treatment and prosthetic restoration costs from the healthcare provider's perspective, as well as identifying the funding sources patients use to obtain prostheses.

Methodology: Data were collected from patients hospitalized at Hospital Sultanah Bahiyah (HSB) and amputees receiving rehabilitation at the Prosthetic and Orthotic Clinic, Rehabilitation Medicine Department, HSB, between 2022 and 2024.

Results: More than 80% of lower limb amputees had diabetes mellitus. The average annual inpatient treatment cost was RM1,826,799, while government spending on prosthetic devices averaged RM411,753 per year. The combined average annual cost of inpatient care and prosthetic restoration was RM2,238,552. Most patients received prostheses through government-funded programmes.

Discussion and Conclusion: The government allocates substantial financial resources for managing diabetic foot-related amputations and rehabilitation. There is a need to explore and expand alternative funding options, such as private insurance and charitable organizations to reduce the strain on public healthcare resources. Comprehensive diabetes management is also essential to prevent complications and reduce associated treatment costs. A limitation of this study is that prosthetic restoration costs include only the device cost, without outpatient care and other rehabilitation services cost. This is the first local study evaluating government expenditure on inpatient care and prosthetic provision for diabetic foot amputations. Further research is recommended to assess long-term economic impacts and potential cost-saving strategies.

Keywords
Diabetic foot, lower limb amputation, prosthesis funding

INTRODUCTION

Diabetes mellitus remains a major global health concern. According to the World Health Organization, the global prevalence of diabetes among adults increased from 4.7% (108 million) in 1980 to 8.5% (422 million) in 2014 (World Health Organization [WHO], 2016). In Malaysia, the National Health and Morbidity Survey 2023 reported that 15.6% of adults or approximately 1 in 6 are living with diabetes. Among the various complications, diabetic foot ulcers were reported in 1.0% of cases, while 0.61% of patients underwent amputations (WHO, 2016). This serious diabetic complication not only impacts the patient and their family, but also results in significant treatment costs covered by the government for inpatient care and rehabilitation, placing a burden on the healthcare system.

This study was conducted to assess the economic burden on the government in managing diabetic foot-related lower limb amputations, with a focus on the costs associated with inpatient treatment and prosthetic restoration from the healthcare provider's perspective. Additionally, the study aims to identify the sources of funding utilized by patients to obtain prosthesis.

METHODOLOGY

Data were collected from records of patients hospitalized at Hospital Sultanah Bahiyah (HSB) from 2022 to 2024. The inclusion criteria consisted of all adult patients who underwent lower limb amputation. Costing data for hospital admission were calculated based on the Price Per Case (PPC) for the Amputation Diagnosis Related Group (DRG) as defined in 2020 from the Casemix system.

The data on prosthesis costs were obtained from lower limb amputees who underwent rehabilitation treatment at the Prosthetic and Orthosis Clinic, Department of Rehabilitation Medicine, HSB, from 2022 to 2024. The reported costs cover prosthetic restoration only and do not include outpatient treatment or any additional expenses incurred during rehabilitation follow-up.

RESULTS

More than 80% of patient who underwent lower limb amputation had Diabetes Mellitus. A total of 474 patients with diabetes underwent lower limb amputation between 2022 and 2024. The average annual cost of inpatient treatment was RM 1,826,799. The graph below illustrates the total inpatient costs incurred each year

from 2022 to 2024.

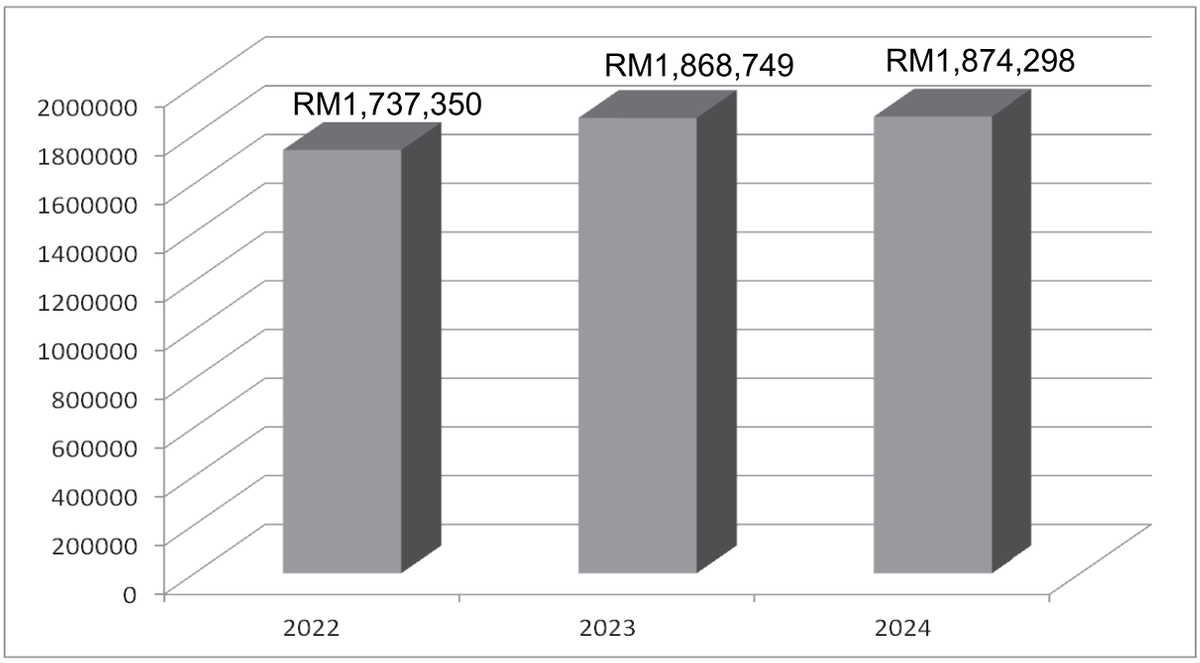


Figure 1: Annual Inpatient Expenditure for Lower Limb Amputation (2022 – 2024)

Based on data from patients attending the Prosthesis and Orthosis Clinic at HSB between 2022 and 2024, a variety of funding sources were utilized to assist patients in obtaining prosthetic devices. The majority of patients received financial support from the government, while a smaller proportion were funded by Pertubuhan Keselamatan Sosial (PERKESO/SOCSO). Only a minority of patients self-financed their prostheses or received assistance from other sources (Tabung Amanah Warisan Polis and Jabatan Hal Ehwal Veteran ATM). The graph below presents the number of prostheses obtained according to the source of funding.

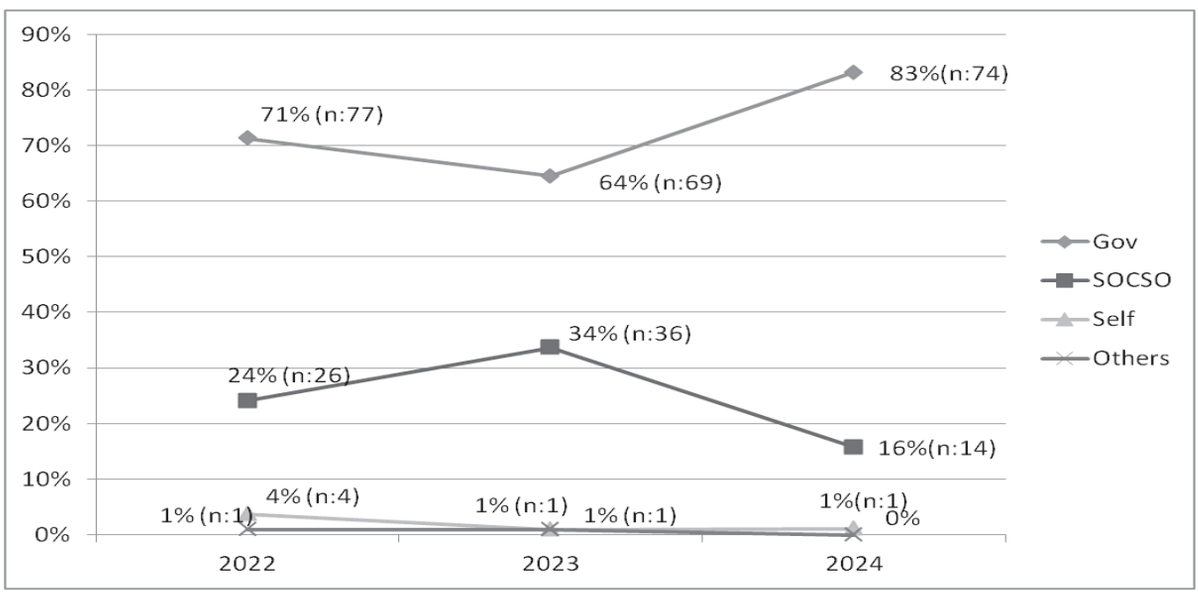


Figure 2: Sources of Prostheses Funding by Year (2022 – 2024)

Correspondingly, the average annual expenditure on government-funded prostheses was approximately RM411,753. The graph below demonstrates the percentage of prostheses provided by each funding source (PekaB40, JPA, Pensioner and TBP) and annual expenditure from 2022 to 2024.

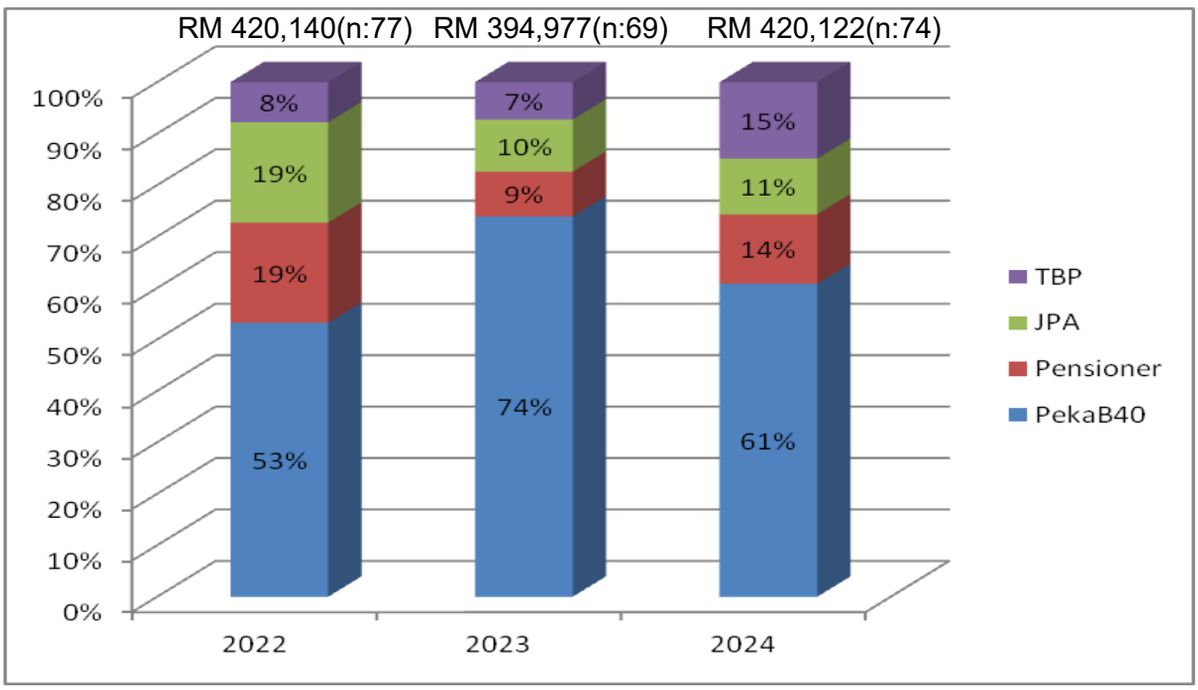


Figure 3: Government-Funded Prosthesis: Percentage by Funding Source and Yearly Expenditure (2022 – 2024)

Figure 4 illustrates the yearly government spending on inpatient treatment and prostheses restoration for patients with diabetic foot related lower limb amputation from 2022 to 2024. The average total cost was RM2,238,552 per year.

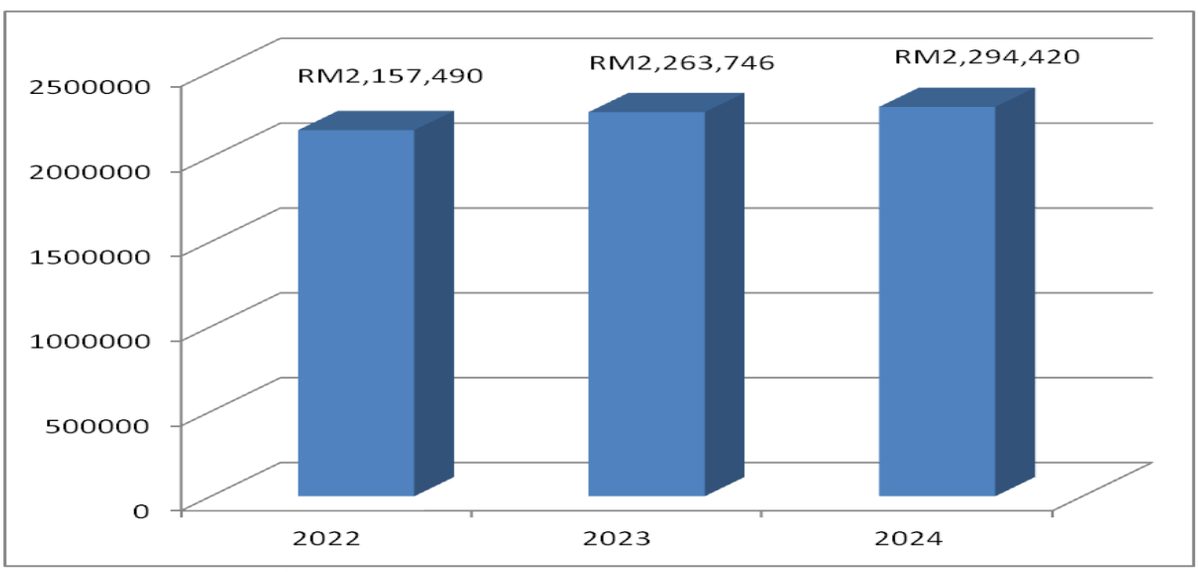


Figure 4: Annual Government Expenditure on Inpatient Treatment and Prosthesis Restoration (2022 – 2024)

DISCUSSION AND CONCLUSION

There was a steady increase in government expenditure on inpatient treatment and prosthetic restoration for patients with diabetes-related lower limb amputations over the three-year period from 2022 to 2024. This upward trend reflects the growing burden of diabetes-related complications on the healthcare system, particularly the rising number of patients requiring surgical interventions and subsequent rehabilitative support such as prosthetic devices.

The increasing prevalence of diabetes in Malaysia, as observed in many other countries, demands urgent attention and strategic resource allocation to effectively manage its associated complications. Without timely and adequate intervention, the economic impact of diabetes driven by prolonged hospitalizations, complex surgical procedures, and extended rehabilitation will continue to escalate. The increasing costs observed in this study further emphasize the need for a dual approach: strengthening both acute care and rehabilitation capacity to manage current cases, while also implementing robust, community-based preventive strategies to reduce future incidence. Such integrated efforts are essential to ensure the long-term sustainability and resilience of the healthcare system in addressing the rising tide of diabetes-related complications.

The data on sources of funding indicate that patients relied on multiple sources of funding to obtain prosthetic devices. This highlights the importance of diversified financial support systems in improving access to rehabilitation services. The predominance of government-funded programmes, particularly PEKA B40, demonstrates their critical role in facilitating prosthetic care. However, the absence of alternative funding mechanisms, such as those available in countries like Canada where private insurance, disability support, and charitable organizations contribute suggests a need to explore and expand funding avenues within the local context to reduce the strain on public healthcare resources (Biddiss, McKeever, Lindsay, & Chau, 2011).

A limitation of this study is that the estimated cost of prosthetic restoration is limited to the cost of the prosthesis and does not include costs related to outpatient care, such as follow-up clinic visits, physiotherapy sessions, adjustments or replacements of the prosthesis, or any other services required during the rehabilitation period. These components are essential for a patient’s functional recovery and long-term mobility, and excluding them may lead to an underestimation of the actual economic burden borne by the government in managing diabetic foot-related lower limb amputations.

This is the first local study to evaluate government expenditure on inpatient treatment and prosthetic restoration for diabetic foot amputations. Further research is

warranted to assess the long-term economic impact and identify potential cost-saving strategies.

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FOOD SAFETY SURVEILLANCE AND COMPLIANCE TRENDS DURING BAZAR RAMADAN 2023–2025 IN LANGKAWI: A RETROSPECTIVE REVIEW

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ABSTRACT

Background: Langkawi, a globally renowned tourist destination under Kedah's jurisdiction, experiences a surge in food transactions during Bazar Ramadan, where temporary food establishments serve thousands of domestic and international visitors. In this tourism-sensitive ecosystem, food safety is not merely regulatory—it is reputational. This study aims to elucidate compliance and contamination trends over three consecutive Bazar Ramadan periods (2023–2025), identifying gaps and public health vulnerabilities in a high-impact setting.

Methods: A retrospective cross-sectional study was conducted using inspection records and food sampling results from three Bazar Ramadan sites (Kuah, Ayer Hangat, Padang Matsirat) in Langkawi between 2023 and 2025. Variables included food handler training, typhoid vaccination status, and laboratory-confirmed food contamination. Z-tests for proportions and Fisher's exact test were performed using SPSS v26.

Results: Among 738 food premises, training compliance dropped from 100% (2023) to 95.8% (2024, $p < 0.001$), with partial rebound in 2025 (98.4%, $p = 0.003$). Vaccination rates improved marginally from 97.1% to 99.4% in 2024 ($p = 0.013$). Pathogenic contamination was absent in 2023 but emerged in five samples across 2024–2025, involving S. aureus, B. cereus, and coliforms. Although not statistically significant ($p = 0.555$), these findings align temporally with reduced training rates.

Discussion: Findings suggest that even marginal declines in training adherence may compromise hygiene standards and trigger pathogenic risks—particularly in densely populated, event-based settings. In Langkawi, where tourism and public trust intersect, intensified pre-Ramadan interventions, targeted refresher training, and risk-based monitoring must be institutionalized as strategic imperatives.

Keywords: Food safety compliance, Bazar Ramadan, Langkawi tourism, foodborne pathogens, public health surveillance, Kedah

INTRODUCTION

Langkawi, an internationally recognized UNESCO Global Geopark and major Malaysian tourist destination, attracts a high volume of domestic and international visitors annually (Figure 1). During the month of Ramadan, the surge in food traffic is amplified by the presence of temporary food establishments, particularly Bazar Ramadan stalls. These bazaars, often operating under minimal infrastructure, cater to thousands of consumers daily. In this context, food safety is not only a regulatory concern but a vital public health priority with reputational and economic implications.

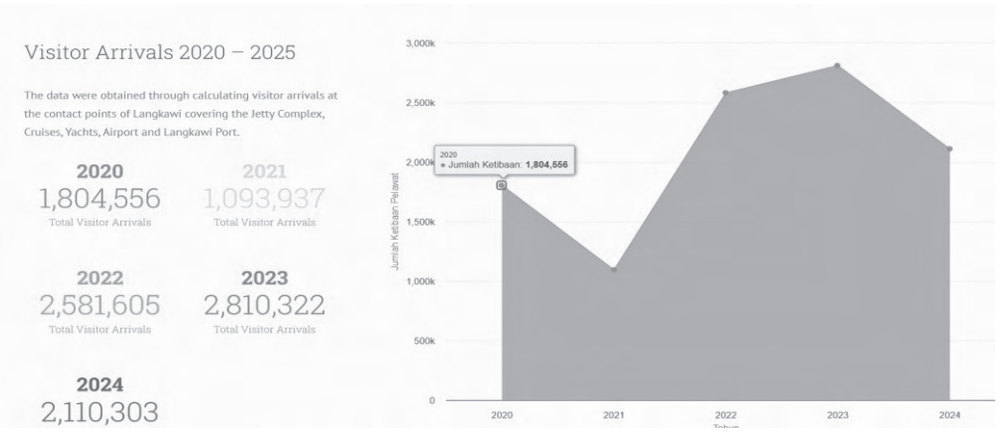


Figure 1. Annual Visitor Arrivals in Langkawi (2020–2024)

Recent foodborne illness incidents across Malaysia, including outbreaks in Terengganu (2022), Kota Kinabalu and Segamat (2023), and contamination cases in Kuala Lumpur (2024), highlight persistent vulnerabilities in temporary food environments. These cases involved improper cooking practices, poor hygiene, and the presence of foreign objects in food, all of which undermine public trust and emphasize the need for proactive enforcement strategies.

Despite Langkawi recording no outbreak-level cases between 2023 and 2025, proactive food safety surveillance remains essential. Silent contamination such as elevated levels of *Staphylococcus aureus* and *Bacillus cereus* was detected in food samples from local bazaars. This underscores the critical need for continuous monitoring and enforcement, particularly during high-risk, high-traffic food events. This study aims to examine food safety compliance trends and microbial contamination findings from Bazar Ramadan operations in Langkawi over a three-year period, with a view to informing scalable, preventive strategies.

METHODOLOGY

A retrospective cross-sectional study was conducted utilizing surveillance data collected by the Food Safety and Quality (FSQ) Unit of the Langkawi District Health Office between 2023 and 2025. The study focused on three officially registered Bazar

Ramadan locations: Kuah, Ayer Hangat, and Padang Matsirat. Data sources included field inspection records, food handler documentation (training and typhoid vaccination), and laboratory-confirmed food sample results.

The variables analyzed were: (1) compliance with certified food handler training; (2) possession of valid typhoid vaccination; (3) types and frequency of violations observed; and (4) results of food sample testing for microbial contaminants such as Staphylococcus aureus, Bacillus cereus, coliforms, and aerobic plate count.

Descriptive analysis was conducted to identify compliance trends and contamination patterns. Z-tests for proportion differences were applied to assess year-on-year shifts in training and vaccination rates. A Fisher's Exact Test was used to evaluate the association between hygiene violations and the presence of microbial contamination. Statistical analysis was performed using SPSS v26.

Additionally, case observations were included for five contaminated food samples to further contextualize the enforcement findings, allowing for comparative risk profiling based on hygiene scores and common violations.

RESULTS

A total of 738 premises were inspected from 2023 to 2025: 329 in 2023, 200 in 2024, and 209 in 2025. Training compliance was recorded at 100% in 2023, dropped to 95.8% in 2024 ($p < 0.001$), and partially recovered to 98.4% in 2025 ($p = 0.003$). Typhoid vaccination compliance improved slightly from 97.1% in 2023 to 99.5% in 2025 ($p = 0.013$).

The number of compounds issued over the years, which increased sharply in 2024 (21 compounds) and remained elevated in 2025 (19 compounds), compared to zero in 2023. The most frequent violations were improper PPE usage (face masks, aprons), absence of food handler certification, and missing vaccination documentation and Table 1 summarises the contamination findings.

Table 1 : Summary of Contaminated Food Samples and Detected Pathogens (2024–2025)

Year	Food Sample	Detected Pathogen(s)	CFU/g Values	Risk Interpretation
2024	Nasi Lemak Bilis Telur	*Staph. aureus*, Coliform	44,000 / 750	Toxin risk / Fecal indicator
2024	Daging Masak Lemak Salai	Coliform, APC, *Staph. aureus*	460 / 290,000 / 650	Poor hygiene, high load

2025	Qasidah	*Bacillus cereus*, *Staph.*	14,000 / 150	Emetic risk, toxin-producing
2025	Nasi Ayam Penyet Sambal Hijau	*Staph. aureus*, Coliform	75 / 160	Low–moderate concern
2025	Popia Basah	Coliform, APC	1400 / 260	Wet food, hygiene-sensitive

Footnote: Significant contamination is defined as CFU/g values exceeding national safety limits for ready-to-eat food as per MOH guidelines (2022)

While 2023 recorded no unsatisfactory food samples, 2024 and 2025 had 2 and 3 contaminated samples, respectively. Detected pathogens included *Staphylococcus aureus* at 44,000 cfu/g in nasi lemak (2024), *Bacillus cereus* at 14,000 cfu/g in qasidah (2025), and consistently elevated coliform levels (up to 1400 cfu/g).

A Fisher's Exact Test conducted on 2024–2025 data revealed a p-value of 0.053, indicating a marginally significant association between hygiene violations and food contamination. Notably, all contaminated samples were associated with premises that had recorded one or more violations.

These findings suggest that even small declines in training compliance or hygiene enforcement can contribute to significant public health risks in temporary food settings such as Bazar Ramadan.

DISCUSSION

The findings from this retrospective review highlight key trends and vulnerabilities in temporary food establishments during Bazar Ramadan. Despite achieving a full compliance rate in 2023, the decline in training and enforcement indicators in 2024 coincided with a surge in food hygiene violations and microbial contamination. This correlation highlights the importance of sustained and visible enforcement, even in the absence of reported outbreaks.

Contamination was observed in both high-traffic items (e.g., nasi lemak, popia basah) and niche traditional foods (e.g., qasidah), suggesting that risk is not limited to any specific food category. Furthermore, high hygiene scores above 94% were observed in most contaminated premises, indicating that numerical ratings alone may mask critical non-compliance areas, such as the absence of PPE or unclean preparation zones.

While the *p*-value of 0.0528 suggests marginal significance, the fact that all contaminated items came from stalls with recorded violations reinforces the importance of targeting high-risk premises with focused inspections. The findings support existing literature that links poor enforcement, lack of training, and insufficient hygiene practices with increased food contamination risk.

From a public health standpoint, the absence of outbreaks should not be equated with safety. The detection of high CFU levels and toxin-producing bacteria in ready-to-eat foods presents a latent hazard that warrants urgent mitigation. Investing in training compliance, rigorous monitoring, and capacity-building for enforcement personnel is critical to preventing silent contamination events.

Furthermore, it is recommended that the current hygiene checklist be reviewed to better capture critical control violations, such as lack of pest control, ineffective garbage disposal, and preparation zone cleanliness. Enhanced scoring rubrics and digitalized audit systems may improve objectivity and data utility in future inspections. Partnerships with academic institutions can also help validate indicators and co-develop predictive risk models.

To further strengthen Bazar Ramadan food safety, it is crucial to understand the underlying factors contributing to repeated violations. Many vendors are seasonal operators with limited access to training or updates in regulatory standards. Implementing pre-season briefings, food safety workshops, and mandatory refresher training sessions may help address these knowledge gaps. Additionally, public health inspectors require continuous professional development and logistical support to maintain consistency in enforcement across different bazaars.

Moreover, digital tools such as mobile inspection apps and real-time data dashboards can facilitate faster reporting and accountability. When paired with community awareness campaigns, these innovations can foster a culture of food safety not only among vendors but also among consumers, who play a role in reporting unsafe practices.

The study also suggests exploring risk-based inspection models, which prioritize resources for high-risk vendors identified from past non-compliance patterns or specific food types prone to contamination. By aligning enforcement with risk stratification, the impact and efficiency of food safety surveillance can be maximized during Ramadan and beyond.

CONCLUSION

This study revealed that food safety compliance during Bazar Ramadan fluctuated over the 2023–2025 period, with lapses in 2024 contributing to elevated contamination risks. While recovery in training rates was noted in 2025, the consistent presence of hygiene violations underscores the need for continuous

improvement. Future interventions must not only target food handlers but also prioritize the upskilling and empowerment of public health enforcement officers. Sustaining a food-safe culture during mass gatherings requires vigilance, evidence-based enforcement, and policy commitment.

Moving forward, policymakers should consider embedding food safety strategies within broader disaster preparedness and tourism resilience frameworks, especially in regions like Langkawi that rely heavily on seasonal food markets and tourist influxes. Such integration ensures that public health protections are not compromised during peak periods. Ultimately, protecting consumer trust and reducing foodborne disease burden demands an ecosystem-wide approach — from vendor training and regulation to consumer empowerment and robust enforcement systems.

ACKNOWLEDGEMENT

The authors would like to thank the Director of the Langkawi District Health Office for permission to conduct this study. Special appreciation goes to the Food Safety and Quality Unit team for their dedication and cooperation throughout the surveillance and sampling process. We also acknowledge the contribution of our laboratory partners at the Perlis Food Safety and Quality Laboratory for timely microbiological analysis.

Sincere gratitude is extended to our co-authors, supervisors, and data entry officers who supported the compilation and interpretation of results. We would also like to thank the organising committee of the 1st Kedah International Health Conference 2025 for the opportunity to present and disseminate this study.

Finally, heartfelt appreciation goes to all public health inspectors and enforcement officers who worked tirelessly during the Bazar Ramadan period to safeguard food safety and public health in Langkawi.

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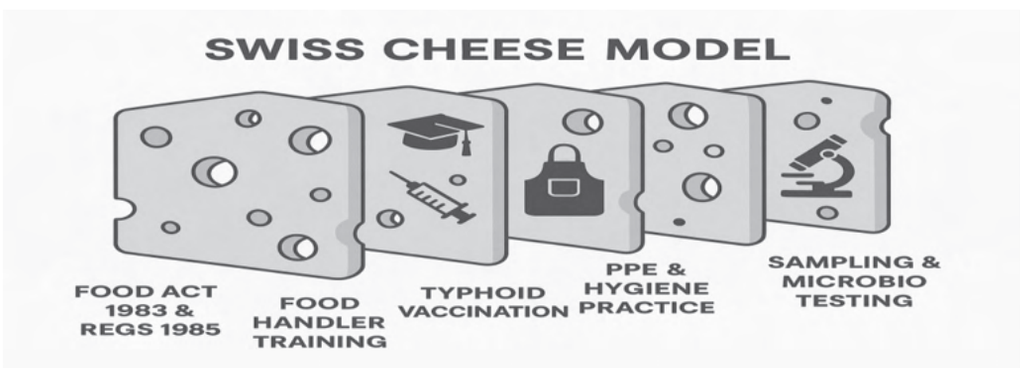
APPENDICES

Appendix 1: Hygiene Findings for Contaminated Samples (2024–2025)

Food Item	Hygiene Score (%)	Key Violations
Nasi lemak & Daging Salai	87.5	No food handler training, no vaccination
Popia Basah	94.26	No PPE, unclosed dustbin, ineffective pest control
Nasi Ayam Penyet Sambal Hijau	94.26	Unsanitary prep area, lack of training, wearing accessories
Qasidah	94.26	Unsanitary prep area, no training documentation

Footnote: Significant contamination is defined as CFU/g values exceeding national safety limits for ready-to-eat food as per MOH guidelines (2022).

Appendix 2: Swiss Cheese Model Representing Multi-Layered Food Safety Enforcement Barriers. Adapted from the Swiss Cheese Model by James Reason (1990)



NURSES' KNOWLEDGE, ATTITUDE AND PRACTICE ON FALL PREVENTION STRATEGY IN PUBLIC HOSPITAL

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ABSTRACT

Background: Increasing trend of patient fall and injury related to fall may indicate flaws among nurses' knowledge, attitude and practice towards fall prevention. Improving nurses' knowledge subsequently change their attitude and practice towards patient care.

Method: A cross-sectional study was conducted in public hospital among 140 nurses in Medical, Obstetrics & Gynecology and Surgical & Orthopedic Department. Proportionate stratified random sampling applied and questionnaire distributed in June 2024. The questionnaire included demographic and working characteristics, knowledge, attitude and practice questionnaire which adopted from previous authors.

Results: 46.4% shows high knowledge level, 50.7% shows negative attitude and 62.9% shows good engagement practice in fall prevention strategy. Number of patients fall experienced showed association with nurses' knowledge level in fall prevention strategy. Years of working experiences showed association with nurses' knowledge level and practice engagement in fall prevention strategy. Knowledge on fall prevention strategy significantly affected nurses' attitude (p = 0.01) and attitude on fall prevention strategy significantly affected nurses practice in preventing fall (p = 0.02). There is no significant different of knowledge, attitude and practice on fall prevention strategy among Medical, Obstetrics & Gynecology and Surgical & Orthopedic Department.

Conclusions: Years of working experience plays an important factor influencing knowledge and practice towards fall prevention strategies. Even though knowledge shows no significant association towards practice of fall prevention strategies but knowledge does influence nurses' attitude and thus affecting the practice towards fall prevention strategies.

Keywords: Fall, nurses, knowledge, attitude, practice, prevention

INTRODUCTION

Falls among patients are a significant concern in healthcare, often leading to injuries and complications. This is the serious issue, particularly among the elderly and those with underlying health conditions. According to the World Health Organization (WHO), an estimated 646,000 individuals die from falls each year, making it the second leading cause of unintentional injury death worldwide. In the United States, falls are the most common cause of nonfatal injuries and hospital admissions for trauma (World Health Organization, 2021). These statistics underscore the importance of effective fall prevention strategies in healthcare facilities.

Several studies have been conducted on the knowledge, attitude, and practice of fall prevention among nurses. A study published in AIMS Medical Science revealed that the correlation between fall knowledge, attitude toward falls, and awareness of fall risk factors among nurses was highly significant (James, et al., 2022). Wulandari et al., (2019) also found that nurses' knowledge, attitudes and practices significantly correlate with effort to prevent patient from falling. Factors associated with an increased risk of patient fall include longer length of stay, using certain medications, poor visual acuity, balance condition, manual transfer aid, urinary incontinence and cancer (Najafpour et al., 2019).

Additionally, another study found that nurses generally possess moderate knowledge and positive attitudes towards fall prevention, with high reported practice of fall prevention measures (Alrimali, et al., 2023). The perceived knowledge of fall prevention in nurses is an important factor that can influence their fall prevention activities (Wang, et al., 2022; Han, Kim, & Hong, 2020). One systematic review found that fall prevention programs with an education component led by nurses might be effective for older adults (Ojo & Thiamwong, 2022). Another study identified unintended consequences of fall prevention messages on nurses and older adult patients, highlighting the need for additional research to gain a better understanding ofcare delivery for fall risk patients (King et al., 2018).

Nurses' attitudes toward patient falls vary based on their experience, knowledge, and awareness of fall risk factors. Several studies have found that nurses with more experience tend to have a more positive attitude toward falls (James, et al., 2022). Malaysian nurses have a good attitude towards the management and prevention of falls, and their attitude is correlated to their knowledge about falls (Chong et al., 2019). However. Cho & Jang, (2020) found that nurses attitudes regarding patient falls are positively correlated with fall-prevention activities but knowledge does not. Fall prevention programme will not succeed without engagement from patient itself. Kang and Song (2018) found that the fall prevention program improved fall-related attitude and satisfaction among elderly inpatients, with video plus leaftlet education being most effective in improving prevention behaviors.

A clinical practice guideline of fall prevention in hospital and nursing homes strongly recommended measures for fall include multifactorial interventions, professionally supported by body exercise interventions and education and counseling interventions (Schoberer et al., 2022). Study done in one of the ICU in India found that 60% of nurses had a moderately favorable attitude towards patient falls and 95.7% had adequate practice (Lakiang, Das & Saikia, 2022). In contrast, nurses who's aware of effective fall prevention strategies may face barriers to implementing them in their practice (Garcia et al., 2021). Involving patient in fall safety combine with evidence-based fall prevention measures can reduce the number of inpatient falls by 55% and improve patient safety (Bargmann & Brundrett, 2020).

Nurses are considered to play a critical role in fall-prevention activities, including assessing risk factors for falls at patients' bedsides, and regular and recurrent fall-prevention education targeted at small- and medium-sized groups of nurses has been found to increase fall-prevention activities (Cho & Jang, 2020). Overall, nurses' attitudes, knowledge, and awareness play a crucial role in the prevention of patient falls.

SIGNIFICANCE OF THE STUDY

Nurses are at the forefront of patient care and are often responsible for implementing fall prevention measures. Their roles are from completing patient fall risk screening, documenting prevention practices, monitoring patient's medical condition, reporting falls to physician and educating patients and their families to prevent fall. Therefore, this study will explore the factors influencing nurses' knowledge, attitude and practice towards fall prevention program. Study in the United State shows that one-third of falls can be prevented, highlighting the significant impact nurses can have in this area (*Fall Prevention Precautions: The Nurse's Role*, n.d.).

Increasing trend of patient fall may indicate flaws among nurses' knowledge, attitude and practices towards fall prevention. James et al., (2020) found that nurses in tertiary care hospitals have a favorable attitude towards patient falls, but only 38.2% have adequate knowledge on fall risk factors, highlighting the need for extensive education and training programs. Through this study, nurses with lack of knowledge on fall prevention will be identified. Information and training will be provided to the nurses related to fall prevention. After receiving training on patient fall prevention, nurses' attitude became more positive regarding organization in teams and the importance of fall prevention measures (Ieva, 2022). The fall prevention program educated physical and occupational therapists increased their attitude towards falls and knowledge towards fall prevention activities, leading to a decrease in the rate of falls from 4.2 to 1.4 (Kim et al., 2019). A report published by Scientific Research Publishing pointed out that it is more necessary to change nurses' attitude rather than to improve their knowledge and competency to prevent falls (Han et. al., 2020). Furthermore, nurses' attitudes regarding falls were influenced by their nursing

experience and fall prevention education, as highlighted in a study published by Cho & Jang (2020). Under reporting fall incident among nurses and lack of published study related to fall prevention drive intention of conducting this study. Result found will be use to compare with previous study locally and internationally.

Research in this fields helps identify effective interventions such as exercise programs, medication management and environmental modifications. Furthermore, by synthesizing and analyzing existing evidence, research contributes to the ongoing efforts to enhance the quality of care and promote safety for individuals at risk of falling. Result found from this study will help healthcare policymaker and improve current practice for better patient satisfaction. Heinze et al., (2007) as cited in (Breimaier et. al., 2015) found that between 3.2% and 37% of patients fell during a hospital stay, depending on the department. The differences in staff background, patient condition, department management and environment might influence risk of fall among patients. Thus, this study will identify the differences between three department chosen in preventing and reducing patient's fall.

In conclusion, equipping nurses with the necessary knowledge and fostering a positive attitude towards fall prevention is essential to minimize patient harm, reduce healthcare costs and improve the overall quality of patient care.

METHODOLOGY

Design, setting, participant

This cross-sectional study was conducted from April to August 2024 in one of the specialized government hospitals with 703 official beds in the northern region of Malaysia. A total of 140 nurses were selected from 341 population by proportionate stratified simple random sampling to ensure each ward in Medical, Surgical and Obstetrics & Gynecology department adequately represented the whole population. To facilitate participants selection, a computer-based random name generator was used to select participants from the list name obtained. The inclusion criteria were nurses working in Medical, Surgical and Obstetrics & Gynecology ward. Community nurses' grade U26 and below and nurses from multidisciplinary ward and labour room were excluded in this study.

Study instruments

A self-administered questionnaire was used in this study. It contains four sections: Section A has 8 questions on demographic and working characteristics, Section B has 16 questions on knowledge of fall, Section C has 13 questions on attitude towards fall prevention strategy and Section D has 20 questions on practice towards fall prevention strategy.

Section A: Demographic and working characteristics

This section encompasses demographic and working characteristics including age, sex, educational level, years of working experience, working department, experienced of patient fall, number of patients fall experienced and previous fall prevention education attended.

Section B: Knowledge

Knowledge on fall questionnaire was adopted from (Sang-Hee & Ji-Min, 2017) which consists of 16 items of Yes, No and Don't Know options. 'Yes' was the correct answer and scored as 1 point, while 'No' and 'Don't Know' was the wrong answer and scored as 0. Score of ≤9 was considered low knowledge level, score 10-12 was considered moderate knowledge level and score 13-16 was considered high knowledge level. Pilot study shows Kuder-Richardson of 0.73.

Section C: Attitude

Hospital Falls Attitude Scale was adopted from (Cho & Jang, 2020) which consists of 13 items with 5-point Likert scale (1: strongly disagree, 5: strongly disagree). Higher score indicates positive attitude and lower score indicate negative attitude. Pilot study shows Cronbach's alpha of 0.73.

Section D: Practice

Practice on fall prevention strategy questionnaire was adopted from (Hwang, 2011) which consists of 20 items with 4-point Likert scale (1: never, 4: always). Higher score indicates good practice engagement and lower score indicate poor practice engagement. Pilot study shows Cronbach's alpha of 0.85.

Data collection and ethical consideration

This study was conducted from April 2024 until August 2024 after obtaining ethical approval from MREC and the Director of Hospital Sultan Abdul Halim. The pilot study was conducted in May 2024. Result from pilot study shows high internal consistency and reliability of the questionnaires. Researchers distributed the questionnaire to the participants at the beginning of the shift and collected it back at the end of participants shifts to prevent missing questionnaires. Participants were informed of the study's background and purpose and consent was taken prior to data collection. Information obtained in this study will be kept private and confidential.

Data analysis

Statistical analyses were performed using SPSS version 27 software at a significance level of 0.05. The categorical variables were expressed as frequency and percentage and the quantitative ones as mean and standard deviation (SD). 2 outliers or extreme values seen and were removed prior to data analysis. Knowledge and practice were not normally distributed but attitude was normally distributed. Chi-square test, Kruskal-Wallis H and Mann-Whiteny U test were used to find the association of independent and dependent variables in this study.

RESULTS

Demographic and working characteristics

The researcher approached 142 nurses (response rate is 100%). But the final sample was 140 which 44 from Surgical, 54 from Medical and 42 from Obstetrics & Gynecology department. The mean age of participants was 40.19 years (SD= 6.05) and 97.1% were female nurses. Most participants have a diploma (94.3%) and 83.6% had works more than 10 years. 58.6% nurses had experience of patient falling with mean number of patient fall was 1.03 (SD=1.34). Majority of the participants had attended fall prevention education (95.7%) (Table 1).

Table 1: Demographic and working characteristics of nurses (N=140)

Demographic and working characteristics	**n**	**%**
Age (M = 40.19, SD = 6.05 years	Min: 30	Max: 55
30-39	64	45.7
40-49	68	48.6
50-59	8	5.7
Sex		
Male	4	2.9
Female	136	97.1
Educational level		
Diploma	132	94.3
Degree	8	5.7
Working experience		
Less than 5 years	2	1.4
5-10 years	21	15
More than 10 years	117	83.6

Department		
Surgical & Orthopedic	44	31.4
Medical	54	38.6
Obstetrics & Gynecology	42	31.4
Experience of patient falling		
No	58	41.4
Yes	82	58.6
Number of patients fall experienced (M = 1.03, SD = 1.34)	Min: 0	Max: 6
Attended fall prevention education (CNE/Courses/RCA)		
No	6	4.3
Yes	134	95.7

Knowledge, attitude and practice of fall prevention strategy

The average score for knowledge is 12.02 (SD = 2.54) with a range of score between 6 to 16. Table 2 shows 46.4% (n= 65) participants has high knowledge level. The average score for attitude is 50.49 (SD = 6.47) with a range of score between 37 to 65. Negative attitude shows 50.7% among participants. The average score for practice is 74.51 (SD = 6.30) with a range of score between 42 to 80. 62.9% participants show good practice engagement towards fall prevention strategy.

Table 2: Knowledge, attitude and practice levels on fall prevention strategy (N = 140)

Variables	n	%
Knowledge		
Low (≤ 9)	27	19.3
Moderate (10-12)	48	34.3
High (13-16)	65	46.4
Attitude		
Negative	71	50.7
Positive	69	49.3
Practice		
Poor engagement	52	37.1
Good engagement	88	62.9

Association between demographic and working characteristics with knowledge, attitude and practice towards fall prevention strategy

Table 3 shows that knowledge of fall shows significantly association with working experience (p=0.041) and number of patient fall (p=0.014). 37.9% respondent with more than 10 years working experience has higher level of knowledge as compared to those with less than 10 years of working experience. As the number of patients fall experienced, so does the level of knowledge on fall prevention strategy. Attitude towards fall prevention strategy had no statistically significant association with any demographic and working characteristics. Practice towards fall prevention strategy shows statistically significant association with years of working experience (p = 0.018). Result showed 56.4% respondent with more than 10 years of working experience has good engagement of practice as compared to those with less than 10 years of working experience. As the years of working experience increase, so does the engagement of fall prevention practice.

Table 3: Association between knowledge, attitude and practice on fall prevention strategies with demographic and working characteristics (N = 140)

Characteristics	Knowledge (p-value)	Attitude (p-value)	Practice (p-value)
Age	0.196[a]	0.588[a]	0.306[a]
Sex	0.444[a]	0.620[a]	0.628[a]
Educational level	0.321[a]	1.000[a]	1.000[a]
Working experience	0.041[a]*	0.094[a]	0.018[a]*
Department	0.332[a]	0.674[a]	0.830[a]
Experience of patient falling	0.112[a]	0.375[a]	0.383[a]
No. of patient falls	0.014[b]*	0.313[c]	0.671[d]
Attended fall prevention education	0.980[a]	0.681[a]	0.670[a]

[a]Pearson Chi Square [b]Kruskal-Wallis H [c]Two Independent T-Test [d]Mann-Whitney U *Significant at the level 0.05

Association between knowledge, attitude and practice

Table 4 show findings from this study shows that 29.3% respondents with high knowledge have positive attitude. A Chi-square test showed that the association between knowledge and attitude was statistically significant (p = 0.010) suggesting that as knowledge increases, so does the attitude on fall prevention strategy. 29.3% respondents with high knowledge have good practice engagement but the association between knowledge and practice was not statistically significant (p = 0.998) suggesting that knowledge does not influence practice of fall prevention strategy. While 35.7% respondents with positive attitude have good practice

engagement and the association between attitude and practice was statistically significant (p = 0.020) suggesting that as the attitude increase, so does the practice of fall prevention strategy.

Table 4: Association between knowledge, attitude and practice towards fall prevention strategies (N = 140)

Association	Chi-square	p-value
Knowledge ↔ Attitude	9.234	0.010*
Knowledge ↔ Practice	0.004	0.998
Attitude ↔ Practice	5.378	0.020*

*Significant at the level 0.05

DISCUSSION

This study found only 46.4% of respondents have high knowledge. This is contradicted with a study done in Selangor and using the same questionnaire. Their study recorded 78% of good knowledge. Less than 80% of respondents answered nine questions regarding disease condition, treatment-related and medication-related risk of fall correctly. This could be attributed to not incorporating multidisciplinary evidenced-based training on fall with a new perspective. Our result of association of working experience and knowledge was supported by study by Hasim et. al. (2023) and Han et. al (2020) with majority of 3-5 years and more than 20-year experience respectively. However, Han et. al., (2020) found no significant association of number of patients fall with nurses' knowledge in comparison to this study.

Attitude towards fall prevention strategy among nurses in this hospital showed almost neutral attitude. This is contrary with study in China using the same questionnaire (Cho & Jang, 2020). Their study reported relatively high positive attitude toward fall prevention strategy. Differences might be due to their study were done in small sized hospital compared to this hospital. This study found that attitude on fall prevention strategy has no statistically significant with any demographic or working characteristics. James et. al., (2022) found 57.2% had favourable attitude towards fall and statistically significant relationship with age, education and experience in nursing and previous fall experience. The similarities in attitude may be due to the social and cultural empathy incorporated in training. In contrast to study by Alrimali et al., (2023) which found significant association between attitude on fall prevention with gender, place of work, recent fall prevention education, fall training duration, training source and experience of falling accidents.

Practice of fall prevention strategy in this study shows good engagement but relatively lower to the score from previous study in China using the same questionnaire (Hwang, 2011). Out of 20 questions on practice, two questions on

encouraging high-risk patients to exercise regularly unless it is contraindicated and placing a non-slip mat on the floor when taking a barrel bath or shower recorded less than 70% response of ‘always’. This might be because most of high-risk patient were encouraged to rest in bed and exercise in the presence of company and there was no non-slip mat provided for patient during shower. The association of practice with years of working experience was supported by Ghanim et. al., (2023) which found 61% of competent practice among nurses and statistically significant relation between fall prevention practices with years of experience. As other demographic and working characteristics shows no association with practice, this was supported by study by Hasim et. al., (2023) which found similar results.

The association of knowledge and attitude towards fall prevention strategy found from this study was supported by Hasim et. al., (2023) and Han et. al., (2020) which found that there was positive correlation between knowledge and attitude of fall preventive activities. Nurses with high level of knowledge will lead to favorable attitude towards fall prevention strategies. To increase nurses’ knowledge of fall prevention and transform their attitude towards patients fall, fall prevention education should be conducted often and efficiently. This study found no association between knowledge and practice on fall prevention strategy as in line with study done in university hospitals, long-term care hospital and elderly nursing facilities which identified that there was no significant correlation between fall knowledge and preventive activities (Leone & Adams, 2016; Oh, 2014).

Limitations of the study

Cross-sectional study design precludes establishing the temporal connection between the independent and dependent variables.

Implications and recommendations

The study highlights the importance of continuous professional development for nurses. Findings on gaps in knowledge suggest the need for tailored training programs to ensure nurses are well-informed about evidence-based fall prevention strategies. Findings related to nursing practices can inform the development or refinement of institutional policies. Hospitals can implement standardized fall risk assessment tools and monitoring systems, ensuring uniformity and adherence to best practices. The study underscores the need for adequate resources, such as fall prevention equipment, staffing, and time allocation for risk assessments. Healthcare administrators can use these findings to justify investments in tools like bed alarms, non-slip flooring, and patient monitoring technologies. Nurses can empower patients and their families to participate in fall prevention strategies, leading to improved engagement and outcomes. The study’s findings may serve as a baseline for further research on fall prevention. It can also guide quality improvement projects, allowing

healthcare institutions to measure progress in knowledge, attitudes, and practices over time.

CONCLUSION

Result from this study shows that working experience plays an important factor influencing knowledge and practice towards fall prevention strategies. Even though knowledge shows no significant association towards practice of fall prevention strategies but knowledge does influence nurses' attitude and thus affecting the practice towards fall prevention strategies. By addressing the study's implications, healthcare systems can create a safer environment, enhance nursing care quality, and reduce the personal and financial burdens associated with patient falls.

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INVESTIGATION OF FOOD EXPORT REJECTION TO THE EUROPEAN UNION DUE TO THE PRESENCE OF MINERAL OIL AROMATIC HYDROCARBONS (MOAH) IN HIGH-FAT POWDER

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ABSTRACT

Introduction: This report presents the findings of the investigation conducted following the rejection of high-fat powder products exported to the Netherlands, which contained 3.5 mg/kg of mineral oil aromatic hydrocarbons (MOAH) produced by ABC Company, located in Kulim, Kedah. High-fat powders are used as ingredients to enhance the texture, mouthfeel, or flavor of various food products, including baked goods, dairy alternatives, and nutritional supplements. MOAHs contain polycyclic aromatic hydrocarbons (PAHs), which are known to be genotoxic and potentially cancer-causing even at low exposure levels. The investigation aims to identify the possible routes of contamination from these carcinogenic compounds.

Methodology: Investigation was performed based on Hazard Analysis Critical Control Point (HACCP) principles involving five (5) affected batches of high-fat powder. Hazard analysis was conducted using the raw material decision tree and process step decision tree to identify possible routes of MOAH contamination. Four samples of high-fat powder and one sample of raw material (RBD) palm oil were analyzed for MOAH by using online-coupled high-performance liquid chromatography-gas chromatography-flame ionization detection (HPLC-GC-FID).

Results: The analysis showed that all five samples confirmed for MOAH with a value exceeding 0.5 mg/kg. The HACCP hazard analysis indicates that the potential contamination of mineral oil aromatic hydrocarbons (MOAH) may result from (i) the packaging material (from printing inks), (ii) lubricants in food processing machinery, (iii) food-grade mineral oils (poor refining process), and (iv) environmental exposure.

Discussion: The presence of MAOH in food products can be attributed to several contamination pathways throughout the food supply chain. The three main routes identified are the use of mineral oil-based additives or processing aids, migration from food contact materials, and incidental contamination from sources such as lubricants.

Conclusion: Standard and legislation for MOAH contamination in food products should be established in Malaysia to protect public health by limiting exposure to potentially carcinogenic compounds, ensure food safety, and provide clear regulatory guidance for manufacturers and food producers.

Keywords: Food export rejection, high-fat powder, mineral oil aromatic hydrocarbon, carcinogenic

INTRODUCTION

Mineral oil hydrocarbons (MOH) include a diverse array of products obtained from the distillation of petroleum fractions. The composition primarily consists of mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH). MOAH is a fraction of mineral oils containing aromatic compounds, some of which are potentially carcinogenic and mutagenic. These compounds can make their way into food products and are a cause for concern due to their persistence in the environment and possible health risks ("MOSH/MOAH Contaminants," 2022). In recent years, the food industry has faced increasing scrutiny regarding the safety and quality of its products. Among the various contaminants that have raised concerns are mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH), which can inadvertently find their way into food processing. Since the 1900s, the presence of MOAH in food and its potential risk to human health have been known.

Traces of MOAH have been found in various foods, including bread and baked goods (through contact with baking paper or cardboard packaging), sweets and confectionery (from oil migration during packaging), cereals and grains (stored or transported in mineral oil-treated containers), as well as oils and fats (Moret, 2016). The environment, crop harvesting, and the harvesting process are all potential sources of MOAH contamination (Stauff, Schnapka, Heckel, & Matissek, 2020). Although there is no global regulatory standard setting maximum levels for MOAH, European authorities provide a recommended limit for MOAH in food products based on fat/oil contents. Table 1 summarizes the general maximum levels of MOAH for food products in the European Union. These levels are used to calculate maximum levels for dried, diluted, processed, and compound foods by Article 3 of Regulation (EU) 2023/915

Table 1: General maximum levels of mineral oil aromatic hydrocarbon (MOAH) for food in Europe (European Commission, 2012).

Percentage of fat/oil	Limit
Product with ≤ 4% fat/oil	0.5 mg/kg
Product with > 4% and ≤ 50% fat/oil	1.0 mg/kg
Product with > 50% fat/oil	2.0 mg/kg

Both the EFSA and the German Federal Institute for Risk Assessment (BfR) suggest that the migration limits for hydrocarbons in paper packaging should be 12 mg/kg for C10-C16 and 4 mg/kg for C17-C20. Recycled paper food packaging often contains significant levels of Mineral Oil Hydrocarbons (MOH). According to the 22nd draft ordinance by the Federal Ministry of Nutrition and Agriculture (BMEL), the presence of MOAH (derived from MOH) is prohibited in recycled Food Contact Materials (FCM). However, this restriction may be waived if packaging manufacturers can ensure that MOAH levels remain within acceptable limits (Smart Tbk., 2022).

More studies on MOSH and MOAH toxicological relevance and the legislation of their presence in food have been conducted in European Union countries. According to EFSA, recent studies confirm that the genotoxicity of MOAH is linked to the presence of compounds with three or more aromatic rings. However, robust data on the oral toxicity of MOAH are still missing, as well as information regarding the impact of ring alkylation and the genotoxicity of MOAH with only one or two rings. Due to the limited information on the occurrence and composition of MOAH in food, experts used two different prediction models. Both exposure scenarios (MOE-Margin of Exposure) suggest a potential health risk associated with MOAH in food. While a fundamental concern for human health has been raised, further research is needed, particularly regarding the composition of MOAH in food by ring number and the sources of food contamination.

METHODOLOGY

Investigation according to Hazard Analysis Critical Control Point (HACCP) principles

Investigation was performed based on Hazard Analysis Critical Control Point (HACCP) principles involving five (5) affected batches of high-fat powder product. Hazard analysis for raw materials/packaging materials and process steps was

conducted using the raw material decision tree and process step decision tree to identify possible routes of MOAH contamination that can occur.

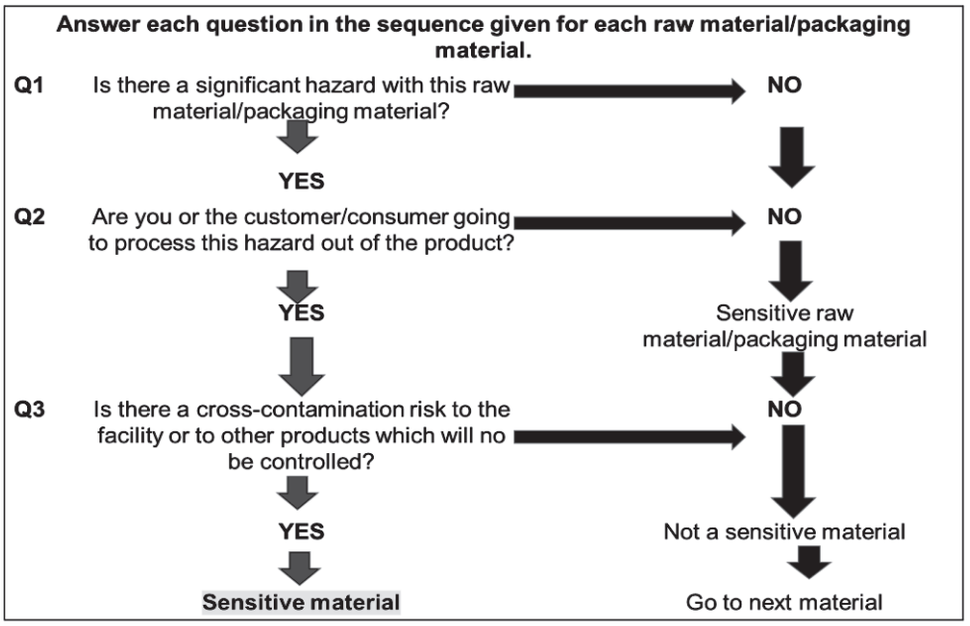


Figure 1a: Raw material decision tree (Department of Standards Malaysia, 2019).

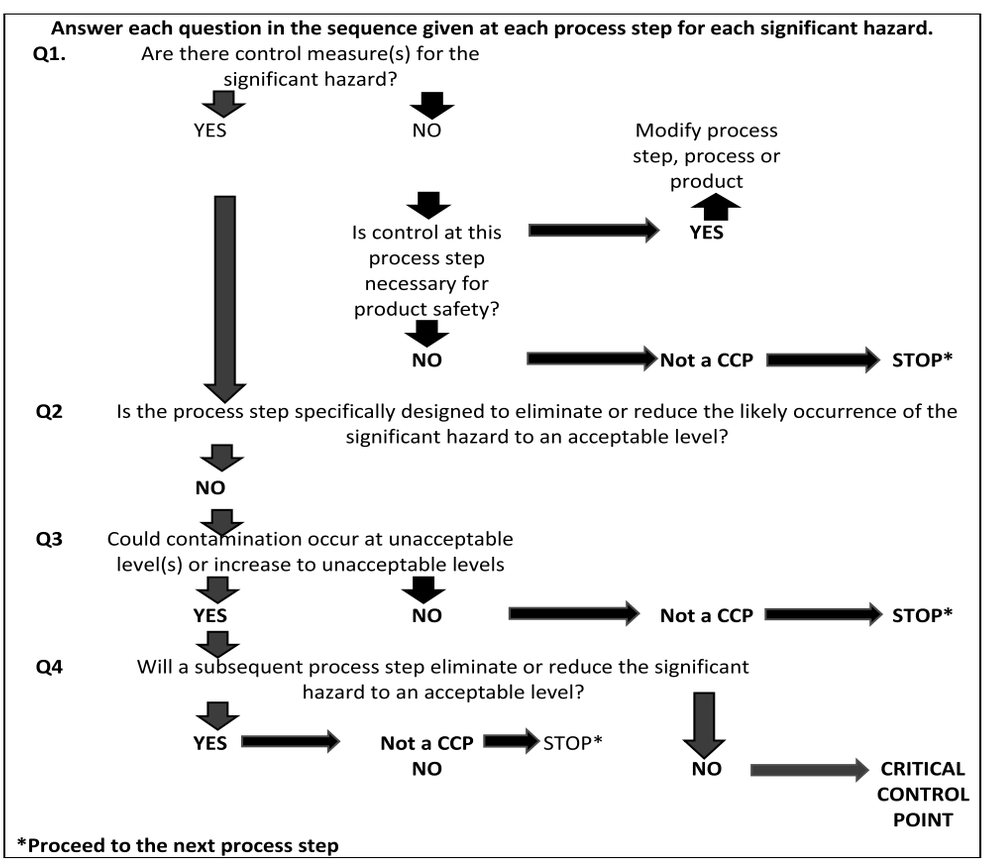


Figure 1b: Process step decision tree (Department of Standards Malaysia, 2019).

Sample collection

Samples collection involved four high-fat powder products with different batch numbers and one raw material, palm oil, at the factory located in Kulim, Kedah. All samples were sealed in a box with aluminum foil and transported to the Malaysian Palm Oil Board laboratory in Bangi, Selangor.

Mineral of aromatic hydrocarbon (MOAH) analyses

Samples were analyzed by online-coupled high-performance liquid chromatography-gas chromatography-flame ionization detection (HPLC-GC-FID) analysis. The LC column used was 25 cm × 0.3 mm i.d. (Lichrospher Si 60, 5 µm) and could retain 20 mg of fat. The separation of MOSH and MOAH was carried out using a gradient that began with hexane (0.1 min) and reached 30% dichloromethane within 2 minutes at a flow rate of 300 µm/min. At the end of the MOAH fraction, the column was backflushed with dichloromethane (CH_2Cl_2) and subsequently reconditioned with hexane (Biedermann, Fiselier, & Grob, 2009).

Result interpretation

Descriptive data analysis was conducted, and the results were interpreted based on the quantified mineral oil aromatic hydrocarbon (MOAH) in the samples (Biedermann, Fiselier, & Grob, 2009).

RESULT AND DISCUSSION

Hazard analysis was conducted for the raw material/packaging material and process step based on the raw material decision tree and process step decision tree. The HACCP Hazard analysis indicates that the potential contamination of mineral oil aromatic hydrocarbons (MOAH) may result from (i) the packaging material (from printing inks), (ii) lubricants in food processing machinery, (iii) food-grade mineral oils (poor refining process), and (iv) environmental exposure. Figure 2 summarizes the possible route of MOAH contamination.

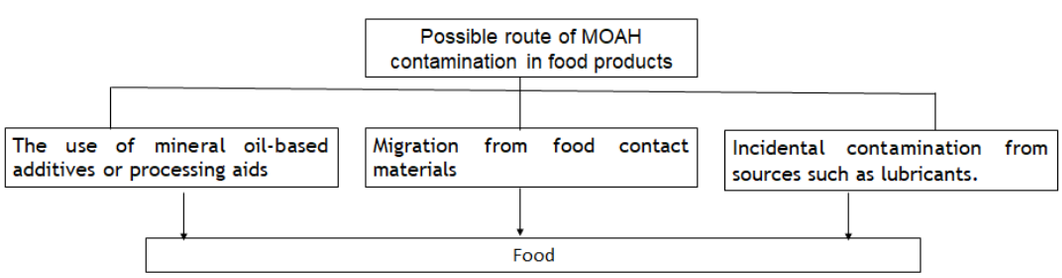


Figure 2: Possible route of MOAH contamination in food products.

According to a 2012 report by the European Food Safety Authority (EFSA), elevated levels of MOAH were particularly associated with oilseeds and vegetable oils (European Food Safety Authority, 2012). The presence of MOH in food products can be attributed to several contamination pathways throughout the food supply chain. The three main routes identified include: (i) migration from food contact materials (FCM), (ii) the use of mineral oil-based additives or processing aids, and (iii) incidental contamination from sources such as lubricants or exhaust gases. Notably, migration from FCM has been documented since the early 1990s, when Grob et al. detected MOSH and MOAH in cocoa beans and hazelnuts stored in jute sacks (Grob, Biedermann, Caramaschi, & Pacciarelli, 1991). More recently, research has focused on the migration of these substances from recycled cardboard, with successful mitigation strategies implemented in many cases. These findings underscore the need for stringent monitoring and control measures across the entire food production process to minimize MOH contamination (Stauff, Schnapka, Heckel, & Matissek, 2020).

Online-coupled high-performance liquid chromatography-gas chromatography-flame ionization detection (HPLC-GC-FID) was carried out to analyze the possible occurrence of mineral oil aromatic hydrocarbons in the samples. The samples exceed the permitted level of MOAH in food for European Union Countries, 0.5 mg/kg (product with ≤ 4% fat/oil) and 2 mg/kg (product with > 50% fat/oil). However, due to the absence of MOAH analysis in packaging materials and lubricant oils, the investigation was unable to identify the source of contamination in the final product. Table 2 shows the results for four high-fat powder samples and one palm oil sample.

Table 2: The results for high-fat powder samples and palm oil samples analyzed for mineral oil aromatic hydrocarbon (MOAH).

Sample description	Sampling date	Analysis date	Result
High-fat powder (Affected batch)	22.08.2024	09.10.2024	3.55 ± 0.04 mg/kg
Refined palm oil (Not affected batch)	22.08.2024	19.09.2024	22.23 ± 3.89 mg/kg

High-fat powder (Not affected batch)	22.08.2024	10.12.2024	2.23 mg/kg
High-fat powder (Not affected batch)	22.08.2024	16.12.2024	23.12 mg/kg
High-fat powder (Not affected batch)	22.08.2024	16.12.2024	24.16 mg/kg

The deodorization process of vegetable oil during refining is an essential step for reducing or eliminating mineral oil aromatic hydrocarbon compounds. Focusing on this stage enhances the safety and quality of the final product ("MOSH/MOAH Contaminants," 2022). Therefore, an effective method should be established and implemented in the vegetable oil refinery to ensure that no residue of mineral oil aromatic hydrocarbons carries over into the final product.

In the context of food safety, the mitigation plan of MOAH (Mineral Oil Aromatic Hydrocarbons) contamination can involve the use of highly refined food-grade mineral oils, improvement of food-contact packaging materials that can prevent MOAH migration, and the implementation of monitoring and traceability systems across all stages of the food supply chain.

CONCLUSION

The investigation concludes that the presence of mineral oil aromatic hydrocarbons (MOAH) in the high-fat powder may result from migration via packaging materials, contamination from lubricants used in processing equipment, or insufficient purification during the refining of food-grade mineral oils.

However, there is currently no legislation or regulatory authority in Malaysia to control mineral oil hydrocarbon contaminants. Studies on these compounds and their toxicological effect on humans are limited, and no data are available for reference. MOAH contaminant is not just a technical challenge; it is a public health and consumer trust issue. With increasing scrutiny from regulators and consumers, industries must act decisively to minimize MOAH exposure, particularly in food products.

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CASE REPORT ON EARLY INTERVENTION OF AN ECTOPIC MAXILLARY INCISOR CAUSED BY AN ERUPTED MESIODENS

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ABSTRACT

Background: Mesiodens is a type of supernumerary tooth that is commonly found in the premaxilla region. The presence of mesiodens may cause complications such as an ectopic eruption of the maxillary permanent incisors, leading to aesthetic and functional concerns. Early intervention is crucial to facilitate normal occlusion and prevent complex orthodontic treatment in the future.

Case Presentation: A 10-year-old male presented with an erupted mesiodens at the anterior maxillary region, causing a displacement of the right maxillary permanent central incisor. Radiographic investigation revealed an additional impacted supernumerary tooth located near the root of the left maxillary permanent incisor. The patient's mother addressed her concern regarding the child's malaligned teeth and requested a minimal intervention approach due to financial constraints. Considering the patient's age and favourable growth rate, the erupted mesiodens was extracted, and the patient was placed under review for the spontaneous alignment of the displaced maxillary permanent incisor. After 5 months, the displaced incisor realigned into the dental arch without active orthodontic intervention. Both the parents and patient were advised for continuous monitoring of the remaining impacted supernumerary.

Conclusion: This case highlighted the importance of early detection and intervention in managing ectopic eruptions of teeth caused by erupting mesiodens. The effectiveness of minimal intervention by extraction of the mesiodens and spontaneous alignment of the displaced tooth reduced the need for complex orthodontic treatments. This further emphasizes the importance of timely assessment and conservative management in paediatric patients with supernumerary teeth.

Keywords: Mesiodens, ectopic eruption, maxillary incisor, conservative management

INTRODUCTION

Mesiodens is a type of extra tooth in the human dentition and commonly located in between the central incisors. The formal dental term for an excess tooth is called a supernumerary. According to Meighani & Pakdaman (2010), the supernumerary tooth can typically be found in the central area of the maxilla and mandible, with the maxilla being the more common occurrence. Supernumerary can appear in many forms be it singular or multiple, and they can also be found either on one side of the jaw or both (Garvey et al., 1999). Amongst the many kinds, Alberti et al. (2006) stated that mesiodens is the most common type of supernumerary.

The prevalence of dental anomalies is higher in some ethnicities (Meighani et al., 2010). A report by Mighani (2006) shows that the prevalence of supernumerary in the Asian and sub-Saharan African populations is approximately 3.4% and 2.7%. The presence of supernumerary has shown significant complications to dental occlusion. A survey conducted on Brazillian children and adolescents reported several complications which include tooth crowding, delayed eruption, abnormal eruption of tooth, impaction, spacing, and cyst formation (De Oliveira Gomes et al., 2008).

Although the theory of supernumerary development is yet to be clear to this day, certain studies have shown that there are possible factors that may contribute to its occurrence, one being the most common is the genetic predisposition. Other than that, the presence of supernumeraries may also be linked to syndromes as a result of an environmental factor (Rao & Chidzonga, 2001; Díaz A et al., 2009).

CASE REPORT

A 10-year-old male patient was referred to the orthodontic unit with a chief complaint of an extra tooth on the upper frontal region. In addition to the complaint, the patient’s mother addressed her concern regarding the child’s malaligned teeth. The patient showed no notable medical or dental history. Upon intraoral examination, an erupted mesiodens was noted between teeth 11 and 21, causing tooth 11 to be displaced labially (Figure 1). The child was in the late mixed dentition stage in which the upper deciduous molars had exfoliated, and the successor's bicuspids were seen erupting.

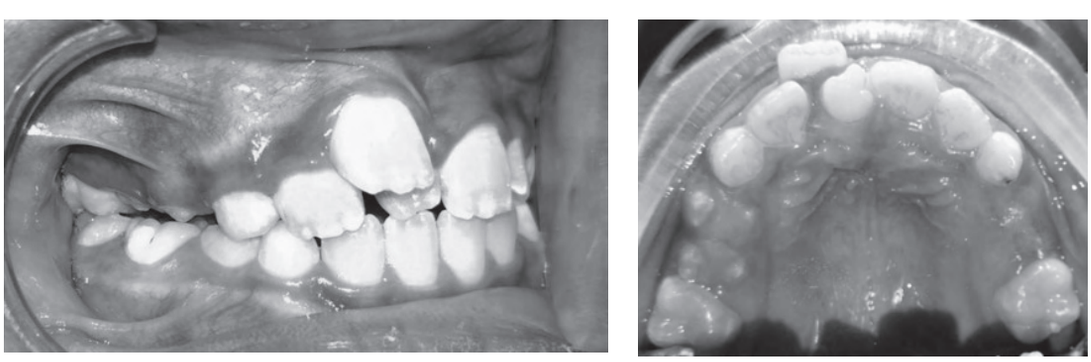


Figure 1: Preoperative photographs showing the presence of erupted mesiodens

Radiographic examination

The dentopanoramic radiograph taken showed the presence of an erupted supernumerary between 11 and 21 (Figure 2). In addition to that, the presence of another impacted supernumerary near the tooth 21 region was also noted. This was further investigated by using cone beam computed tomography (CBCT) imaging. From an axial view of the CBCT, the impacted supernumerary was located palatal to tooth 21, horizontally oriented with the root facing labially.

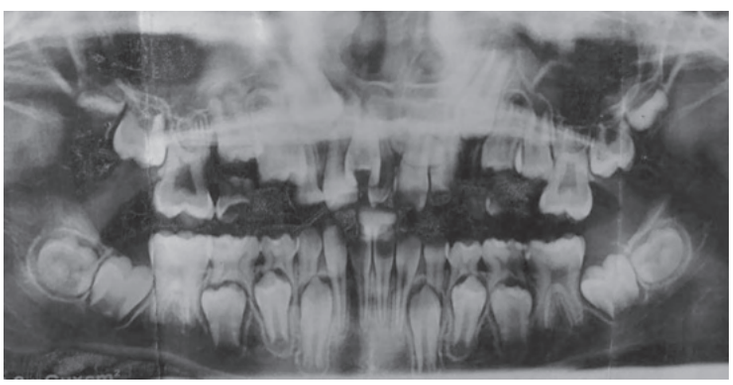


Figure 2: Preoperative dentopanoramic radiograph showing the erupted mesiodens and impacted supernumerary

TREATMENT AND MANAGEMENT

A treatment plan was made, and consent was taken. The parents had expressed a preference for a passive approach instead of an early orthodontic treatment due to financial constraints. As requested by the parents, a simple intervention was conducted. The erupted mesiodens was extracted and the patient was put under regular review for spontaneous alignment of 11. The erupting upper permanent bicuspids were also monitored.

After 5 months post-extraction, tooth 11 can be seen to move spontaneously into the arch alignment (Figure 3). The upper permanent premolars had erupted and aligned well along with the growth of the maxilla. The patient's occlusion had improved significantly. The parent and child were satisfied with the teeth alignment.

The patient was given a routine follow-up to review the eruption of the remaining permanent teeth. Close monitoring of the impacted supernumerary is to be made every 3 months and any future need for surgical removal is to be kept in view. Due to the close proximity of the impacted supernumerary with the root of tooth 21, a routine radiographic investigation of an intra-oral periapical and upper standard occlusal view every 6 months is planned to monitor any signs of root resorption on tooth 21. The treatment plan also included a referral to the Dental Paediatric department for the management of the impacted supernumerary once all the permanent teeth, except

for the third molars, have erupted. The parents were informed regarding the matter and agreed to continue for further reviews.



Figure 3: Post-operative photographs showing spontaneous alignment of 11

DISCUSSION

Based on Andrew's six keys of ideal occlusion, the mesiobuccal cusp of the upper first molar must occlude with the groove between the mesiobuccal and midline buccal cusp of the lower first molar, all the teeth must be angulated mesially, the anterior teeth have to incline labially while the buccal segment teeth are to incline lingually, all teeth in the arches are not rotated, no spacing is to be seen, and the occlusal plane is flat. Jacob et al (2018) define tooth eruption as the movement of teeth into the dental arch involving complex multi-factorial phenomenon leading to the achievement of ideal occlusion. However, malocclusion is rather common, and ectopic eruptions are not foreign. As both genetics and environmental factors contribute to normal eruption patterns, deviation from these factors may lead to dental anomalies and malalignments.

Ectopic eruption is defined as the abnormal eruption of a tooth into the dental arch (Barberia-Leache et al., 2005). A literature review by Huber et al. (2008) reported that the common cause of disturbance in the eruption of maxillary permanent incisors is the presence of supernumerary. The most common region in which a supernumerary appears is in the premaxilla region, with a 90% to 98% prevalence (Huber et al., 2008). As reported in this present paper, the erupted mesiodens have altered the eruption pattern of the permanent maxillary incisor and give rise to the displacement of the incisor from the normal eruption pathway. Similar to the reported review done by Huber et al. (2008), the permanent maxillary central incisors are the most common to be subjected to ectopic eruptions with a prevalence of 5.6%.

In the science of physics, an equilibrium is achieved when an object at rest is subjected to forces from opposite directions creating a zero net force thus placing the object in a balanced state. This phenomenon can also be applied to the position of teeth in the dental arch. A tooth's position is influenced by the surrounding alveolar

bone, tissues, and muscle factors. The theory of equilibrium suggests that a consistent resting pressure from the tongue and lips is crucial in determining a tooth's position (Proffit, 1978). In this case report, the theory of equilibrium was applied. As the patient is at an age at which rapid bone growth and muscle activities are favourable, it was prudent to extract the mesiodens to allow the ectopic maxillary incisor to align within the dental arch. The authors would like to highlight the importance of interceptive orthodontics at this stage as minimal intervention such as a simple extraction may give rise to a significant improvement in the patient's malocclusion. This intervention has been mentioned for its possibility of allowing the natural eruption of the ectopic maxillary incisor into its normal position (Huber et al., 2008).

By understanding the basic nature of tooth eruption, factors influencing the eruptions, aetiology of malocclusions, and patient growth phases, simple intervention is sufficient to achieve a favourable outcome. This case report has proven that simple mesiodens extraction has yielded a positive outcome in enhancing the patient's malocclusion. The aim of this case report is to raise awareness among clinicians about the importance of early detection and intervention in similar cases, potentially preventing or lessening the severity of the developing malocclusion. As the patient will be under review for the eruption pattern of the remaining permanent teeth, the probability that the patient will have to undergo any future orthodontic treatment modality may be lessened. This will altogether improve the patient's quality of life.

CONCLUSION

The anterior teeth are an important aspect of the facial feature as their alignment is crucial in determining the aesthetics of an individual. Malocclusions involving the anterior teeth are best treated as early as possible. As the deviation of maxillary incisor eruption is common, it is prudent for a dental practitioner to detect and diagnose it early. This will reduce the probability of patients to undergo complex treatment modalities. The early detection and simple intervention conducted in this case have greatly improved the patient's occlusion and will reduce the need for future orthodontic treatment. The patient has benefited in terms of self-esteem improvement and a cost-effective treatment.

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PREVALENCE OF HERBAL AND DIETARY SUPPLEMENTS INTAKE AND ITS ASSOCIATION WITH MEDICATION ADHERENCE AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN KUBANG PASU PRIMARY HEALTH CARE CLINICS

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ABSTRACT

Background: Diabetes mellitus (DM) is currently the leading health issue in Malaysia. Herbal and dietary supplements (HDS) is commonly used in DM patients. Patients often use unreliable HDS information sources, lack of knowledge on HDS products, and self-administer prescribed medicines and HDS concomitantly.

Methodology: A cross-sectional study was conducted among 290 patients with type 2 diabetes mellitus (T2DM) registered at primary healthcare clinics in Kubang Pasu. Data were collected using an interviewer-administered questionnaire. Statistical analyses included descriptive statistics, Chi-square test, Fisher's Exact test, and Kruskal-Wallis test, with significance set at $p \leq 0.05$.

Results: The prevalence of HDS use was low, at 35.8%. Majority aged more than 50 years, female (53.2%), unemployed (40.5%) and consumed HDS for general health and wellbeing. Medication adherence levels were generally moderate to poor. No significant association was found between the use of HDS and conventional medication adherence.

Conclusion: HDS use among T2DM patients was low, possibly due to underreporting and limited awareness of drug–HDS interactions. No significant association was found between HDS use and medication adherence, indicating it does not necessarily lead to non-adherence. The increasing use of HDS by individuals with DM is a public health concern due to potential adverse effects, drug interactions, and possible benefits. Healthcare professionals need to consider HDS use in clinical practice.

Keyword: Herbal and dietary supplements, diabetes mellitus, conventional medication adherence, primary healthcare, complementary medicine

INTRODUCTION

Herbal medicine is a practice which includes herbs, herbal materials, herbal preparations and finished herbal products, that contain active ingredients parts of plants, or other plant materials, or combinations (WHO, 2019). A dietary supplement is defined as a product intended for ingestion that, among other requirements, contains a "dietary ingredient" intended to supplement the diet. The term "dietary ingredient" includes vitamins and minerals; herbs and other botanicals; amino acids; "dietary substances" that are part of the food supply, such as enzymes and live microbials (commonly referred to as "probiotics"); and concentrates, metabolites, constituents, extracts, or combinations of any dietary ingredient from the preceding categories. (FDA,2024).

Herbal and dietary supplements (HDS) is the main type of complementary and alternative medicines (CAM) used in T2DM (Ching, Zakaria, Paimin & Jalalian, 2013). It is found that the prevalence of HDS use in patient with chronic diseases ranges from 32% to 77% in Thailand, the US and Malaysia (Sripa, 2005; Jiaranaikajorn, Panthawangkul & Thamlikitkul, 2002; Stys, Kelly & Lawson, 2004; Hasan, Ahmed, Bukhari & Loon, 2009). The use of HDS was significantly the highest among patients with hypertension (49.4% to 85.1%) and diabetes (31.7% to 62.7%) (Hasan et al.,2009). People with T2DM often use unreliable HDS information sources, have a lack of knowledge about the HDS products they are taking, and self-administer prescribed medicines and HDS concomitantly (Chang, Wallis & Tiralongo, 2010). Most patients believed that dietary supplements are meant to be safer and more effective than the conventional medicine (Açıkgöz et al., 2014; Bebeçi, Papajani & Risto, 2015). In contrast, more than half of the patients with chronic diseases, such as diabetes, are deemed to underuse the prescribed medications, leading to medication adherence problems (Steinman et al., 2006).

The use of CAM, including HDS use has been shown to be related to poor adherence to conventional medication (Krousel-Wood et al., 2010; Gohar, Greenfield, Beevers, Lip & Jolly, 2008; Ekwunife, Oreh & Ubaka, 2012; Tangkiatkumjai, Boardman, Praditpornsilpa & Walker, 2013; Açıkgöz et al., 2014). However, results of previous studies about the effect of HDS use on medication adherence are conflicting (Stys et al., 2004; Littlewood & Vanable, 2013; Tilburt, Dy, Weeks, Klag & Young, 2008). From the previous study in Malaysia, it is found that the number of supplements taken and the knowledge and attitude towards dietary supplement did not affect the medication adherence among chronic disease patients (Fadzil, Omar & Tohid, 2018).

Diabetes is currently the leading health issue in Malaysia; according to the National and Health Morbidity Survey done in 2019, it was estimated around 12.5% (3.9 million) have diabetes in Malaysia (National Health Morbidity Survey, 2019). Owing to the economic burden of diabetes, policy makers can no longer ignore the issues of

cost-effective management, and poor adherence is a well-known adversary of effective health care systems. Disbelief or dissatisfaction with conventional medicine in terms of effectiveness or safety may play a role in preference of HDS use over conventional ones and decrease in medication adherence (Açıkgöz et al., 2014). Although there were many studies on the use of CAM among Malaysians population with different types of chronic diseases was published, there is limited evidence from primary care settings in Malaysia, particularly in Kubang Pasu, Kedah, where cultural and socioeconomic factors may influence supplement use and health behaviors. Furthermore, the effects of HDS use on medication adherence of diabetic patients have not been evaluated so far except in one study on chronic diseases patients in Malaysia with discrepant results (Fadzil et al., 2018).

Apart from the effects of HDS use on medication adherence, there were concerns with the use of HDS, particularly the drug-HDS interaction & the adverse effects of HDS. HDS were shown to exert pharmacological effects & toxicological effects which potentially cause undesirable health outcomes, especially the HDS with impurities invited by adulterants and contaminants (Hassen et al., 2022). HDS-related hepatotoxicity is a growing concern particularly with the significant rise of case reports in the United States (Navarro et al., 2016). Besides, concurrent consumption of herbal supplements and conventional drugs results in drug-herb interaction which has important clinical significance in medical practice (Fasinu, Bouic & Rosenkranz, 2012). The drug-HDS interaction affects the bioavailability of drugs which results in either increased risk of toxicity or reduced efficacy of conventional medicines (Kinsella, Grossberg & Prakash, 2018).

A better understanding of HDS use among T2DM and its association with medication adherence is important for optimizing patient care, ensuring the effectiveness of prescribed medications, and preventing potential adverse interactions. This study therefore aims to determine the prevalence and the reasons of HDS use among T2DM patients, describe the socio-demographic characteristic HDS users, and examine the association between HDS use and medication adherence among T2DM patients.

METHODOLOGY

A cross-sectional study was conducted from March to June 2023 among 290 patients registered under primary health care clinics in Kubang Pasu by using an interviewed-structured questionnaire. The interviewed-administered questionnaire comprises 3 sections involving Section A: demographic information, Section B: diabetes mellitus and HDS intake, and Section C: Malaysia Medication Adherence Assessment Tool (MyMAAT). The questionnaire was adopted. Prior to the pilot study, a team of pharmacists conducted a detailed item-by-item review to ensure uniform understanding and standardisation in the administration of the questionnaire.

Subsequently, a pilot study was carried out with a convenient sample of 30 respondents at Klinik Kesihatan Kodiang to evaluate the clarity, comprehensibility, and preliminary validity of the instrument. Internal consistency reliability testing was conducted for the MyMAAT section, yielding a Cronbach's alpha of 0.89, indicating good internal reliability.

There are 3 main sections in the final version of the questionnaire: Section A: the demographic information includes gender, age, race, marital status, level of education, employment status and monthly income. Section B: Diabetes mellitus characteristics including duration of disease, comorbidities, current prescription medications, diabetes complication and HDS intake which include history of HDS use, pattern of usage, duration of usage, number of HDS use, reason for HDS use, source of HDS, disclosure of HDS use to their physician, awareness of interactions between HDS and drug and effects of the use of HDS. The last section, Section C: assessed the association of HDS intake with medication adherence by using MyMAAT. Respondents were categorised under good adherence with score $\geq$54 and moderate and poor adherence with score <54.

The study inclusion criteria were adult patients aged 18 years old and above who have been diagnosed with T2DM and currently taking medication for at least 6 months and able to read and communicate in Bahasa Melayu or English. The exclusion criteria involved patients with gestational diabetes, type 1 diabetes mellitus, psychiatric disorders, cognitive impairment, and those attending Klinik Kesihatan Ibu & Anak (KKIA) or Klinik Komuniti (KKOM) in Kubang Pasu. Each patient was given informed consent to ensure confidentiality of the study data.

Statistical analysis was performed using SPSS version 27. Descriptive analysis was conducted to assess prevalence and data related to HDS. Data were presented as mean standard deviation or median interquartile range depending on the normality of data for numerical data and percentages for categorical data. Chi-square, Kruskal Wallis was used to compare association between socio-demographic variables and medication adherence among HDS use (never, current and former use). A *p*-value of 0.05 or less determined statistical significance.

RESULTS

In our study's demographic data, the comparison of patient characteristics between non-HDS users, current HDS users, and former HDS users showed no significant differences in age, sex, race, marital status, employment, or duration of diabetes. However, education level (p = 0.004) and monthly income (p = 0.031) were significantly associated with HDS use, where current and former HDS users were more likely to have higher education and income compared to non-users. Regarding diabetes complications, neuropathy (p < 0.001) and absence of complications (p = 0.005) showed significant differences across groups, with former HDS users

reporting higher rates of neuropathy. No significant differences were observed in comorbidities, hospitalization, or treatment modality among the groups.

Table 1 presents the information on the prevalence of HDS usage among T2DM patients. Prevalence of HDS use in this study population was 35.8%; 79 patients (27.2%) were currently using HDS. Most of them used dietary supplements (60.8%). When asked further, the most common dosage form used was in the form of tablet/ capsule (63.1%). Other forms of HDS use were crude herbs (20.4%), solution (9.7%), sachet (4.9%) and powder (1.9%). Most of the patients take HDS on a daily basis (74.8%) and mainly for the purpose of general health (51.5%).

Table 1: Prevalence of Herbal and Dietary Supplements Usage among T2DM Patients

Variables	Categories	n (%)
HDS usage (N=290)	Non-HDS users	186 (64.1)
	Current HDS users	79 (27.2)
	Former HDS users	25 (8.6)
If current HDS users, Type of HDS used	Herbal supplement	24 (30.4)
	Dietary supplement	48 (60.8)
	Both	7 (8.9)
Indication (N= 103) [a]	For blood glucose	25 (24.3)
	For general health/ collagen/ antibody/blood circulation	53 (51.5)
	For cholesterol	9 (8.7)
	For pain/ musculoskeletal	6 (5.8)
	Others	10 (9.7)
Dosage form (N= 103) [a]	Tablet/ Capsule	65 (63.1)
	Powder	2 (1.9)
	Solution	10 (9.7)
	Sachet	5 (4.9)
	Crude herbs	21 (20.4)
How to use (n= 103) [a]	Manufactured	82 (79.6)
	Non-manufactured	21 (20.4)
How often (n= 103) [a]	Daily	77 (74.8)
	Weekly	7 (6.8)
	When necessary	18 (17.5)
	Rarely	1 (0.9)

[a] More than one HDS was applicable for each HDS user, so these total more than 79.

Table 2 shows a few reasons of HDS use among the current use patients and sources of HDS. In this study we found that 31.1% (n=41) consumed HDS due to general health and wellbeing and this is the most common reason. Meanwhile, trying HDS because of suggestions from relatives and friends was also another reason which contributed 18.9% (n=25) and 17.4% (n=23) respectively.

The use of herbal and dietary supplements (HDS) for managing chronic conditions such as glycaemic control, blood pressure regulation, insomnia, and sexual dysfunction was also identified as one of the reasons for consumption. According to the findings, 16.7% of respondents (n = 22) reported using HDS for these purposes. In term of sources of HDS, mostly obtained from direct sale, magazine, newspaper, TV and internet (28, 31.1%).

Table 2 : Reasons for HDS use and Sources of HDS

	n (%)
Reason (n = 132) [a]	
General health and well being	41 (31.1)
Disappointment from conventional medical therapy	1 (0.8)
Trying because of suggestion from health care provider	4 (3.0)
Trying because of suggestion from friends	23 (17.4)
Trying because of suggestion from relatives	25 (18.9)
Trying because of information from social network/ social media	14 (10.6)
They are safer than conventional medicines	0 (0)
They are cheaper than conventional medicines	0 (0)
Treat acute conditions: pain	2 (1.5)
Treat chronic conditions: glycaemic control, BP control, insomnia, sexual problems	22 (16.7)
Other	0 (0)
Source of HDS (n = 90) [a]	
Hospital	0 (0)
Buy from drugstore, folk remedy shop	20 (22.2)
Buy from direct sale, magazine, newspaper, TV, internet	28 (31.1)
Provided by family/ friends	27 (30)
Collecting from garden	12 (13.4)
Other	3 (3.3)

Abbreviations: HDS herbal and dietary supplements

[a] More than one answer was applicable, so these total more than 79.

Table 3 shows the association between socio-demographic background and diabetes-specific characteristics with conventional medication adherence among T2DM patients. The tables classified subjects into good adherence and moderate or poor adherence. A total of 3 patients with age <30 years old were classified under moderate and poor adherence. A total of 140 patients were aged 31-60 years old

with 69 (49.3%) having good adherence and 71 (50.7%) were found to be moderate and poor adherence. The largest group of patients were aged >60 years old with 73 (49.7%) patients having good adherence and 74 (50.3%) patients having moderate and poor adherence.

From the study, 170 respondents were female, of whom 82 (48.2%) demonstrated good adherence, while 88 (51.8%) had moderate to poor adherence. Among the 3 races, Malay comprised the largest proportion of respondents with 122 (47.5%) patients with good adherence and 135 (52.5%) with moderate or poor adherence.

However, there were no statistically significant differences found among the socio-demographic backgrounds and diabetes specific characteristics except monthly income which showed statistically significant with p=0.007. Most of the respondents (233, 80.3%) in this study have monthly income less than RM 2500 and 128 (55.0%) were of moderate and poor adherence.

Table 3: Association between Socio-demographic Backgrounds and Conventional Medication Adherence among T2DM Patients

Variables	n (%)		*p*-value
	Good adherence	Moderate & poor adherence	
Age (year)			0.366[a]
≤ 30	0 (0)	3 (2.0)	
31 - 60	69 (48.6)	71 (48.0)	
> 60	73 (51.4)	74 (50.0)	
Gender			0.767
Male	60 (42.3)	60 (40.5)	
Female	82 (57.7)	88 (59.5)	
Race			0.155
Malay	122 (85.9)	135 (91.2)	
Non-malay	20 (14.1)	13 (8.8)	
Marital status			0.084[a]
Single	3 (2.1)	11 (7.4)	
Married	135 (95.1)	134 (90.5)	
Divorced	4 (2.8)	3 (2.0)	
Level of education			0.552
No formal education	4 (2.8)	4 (2.7)	
Primary education	35 (24.6)	47 (31.8)	
Secondary education	83 (58.5)	81 (54.7)	
Tertiary education	20 (14.1)	16 (10.8)	
Employment status			0.194[a]
Employed	44 (31.0)	44 (29.7)	
Unemployed	62 (43.7)	78 (52.7)	

Retired	36 (25.4)	26 (17.6)	
Monthly income (RM)			0.007*
≤ RM 2500	105 (73.9)	128 (86.5)	
> RM 2500	37 (26.1)	20 (13.5)	
Duration of DM (year)			0.692
≤ 5	61 (43.0)	71 (48.0)	
Jun-15	65 (45.8)	62 (41.9)	
> 15	16 (11.3)	15 (10.1)	
Comorbidities			0.507
With comorbidities	135 (95.1)	143 (96.6)	
No known comorbidity	7 (4.9)	5 (3.4)	
Treatment			
Oral medications only	88 (62.0)	90 (60.8)	0.783
Insulin only	9 (6.3)	8 (5.4)	0.783
Both	45 (31.7)	50 (33.8)	0.704
Diabetic complication			0.770
With diabetic complications	59 (41.5)	59 (39.9)	
No known diabetic complication	83 (58.5)	89 (60.1)	

[a] Fisher Exact

* Significant level is set at p < 0.05 (95% CI)

The association between the use of HDS and conventional medication adherence were tabulated in table 4. There was a total of 186 patients who were non HDS users with 92 (49.5%) were of good adherence while 94 (50.5%) were moderate and poor adherence. Current HDS users involved 79 patients with 35 (44.3%) were compliant and 44 (55.7%) were non-compliance. Former HDS users with a total of 25 patients, 15 (60.0%) were adhering to medication while 10 (40.0%) were non-comply to medication. Finding shows that HDS users were more likely to have moderate to poor medication adherence. However, there was no statistically significant difference between HDS usage and medication adherence.

Table 4: Association between Herbal and Dietary Supplements Usage among T2DM Patients and Conventional Medication Adherence

Variables	**Categories**	**n (%)**		***p* value**
		Good adherence	**Moderate & poor adherence**	
HDS usage (N=290)	Non-HDS users (n = 186)	92 (49.5)	94 (50.5)	0.382

	Current HDS users (n = 79)	35 (44.3)	44 (55.7)
	Former HDS users (n = 25)	15 (60.0)	10 (40.0)

Table 5 below shows of the 79 current HDS users, 43 (54.4%) of them are not aware of the interactions between HDS and the conventional medicines. Only 15 (19%) of them have awareness of the interactions between HDS and conventional medicines. Moreover, the majority of the current HDS users (70.9%) did not inform their physician about HDS use while only 23 (29.1%) of them were reported to inform their physician regarding the HDS use. The common reason for their non-disclosure of the HDS use to their physician was the physician doesn't ask (92.9%). Additionally, 3 (5.4%) of them felt unnecessary to inform the physician about the HDS use. Regarding the effects after taking HDS reported by the current HDS users, 42 (41.2%) of them noticed the strengthening of their body, followed by 35 (34.3%) of them felt the relief of several symptoms. However, 15 (14.7%) of the current HDS users felt there were no changes after taking the HDS. Only 4 (3.9%) negative effects were reported after HDS use.

Table 5: Awareness of Interaction between Conventional Medicine and HDS, Disclosure of HDS Use to HCP, and Effects Reported by Patients

	Current users n (%)
Awareness of interaction (N = 79)	
No	43 (54.4)
Probably	21 (26.6)
Yes	15 (19.0)
Informed their physician about HDS use (n = 79)	
Yes	23 (29.1)
No	56 (70.9)
If no (n = 56),	
Reasons for undisclosed use of HDS	
Their physician doesn't ask	52 (92.9)
No need to inform their physician	3 (5.4)
Other reason	1 (1.8)
Effects reported by patients (n= 102) [a]	
No change	15 (14.7)
Strengthening of body	42 (41.2)
Physically worse	2 (1.9)

Being in good psychological condition	6 (5.9)
Being bad	1 (1.0)
Psychological condition	1 (1.0)
Feeling of relief of several symptoms	35 (34.3)

[a] More than one answer was applicable, so these total more than 79.

DISCUSSIONS

In this study, the prevalence of HDS use among T2DM patients was 35.8%, which is lower than two local studies in Selangor (45.8% and 62.5%) (Wahab et al., 2021; Ching et al., 2013). A global review reported wide variation in CAM use among diabetes patients, ranging from 8% to 89%, influenced by differences in definition, study design, recall period, and study population (Alzahrani et al., 2021; Joeliantina et al., 2019).

Education and monthly income were significantly associated with HDS use, but these factors cannot predict usage. Unlike studies in Saudi Arabia that linked HDS use with higher age, income, and education (Alowais & Selim, 2019), our findings showed no clear trend. Underreporting may partly explain the differences.

Most patients used dietary supplements (60.8%), followed by herbal products (30.4%) and both types (8.9%). This likely reflects the rapid expansion of the supplement market and growing public awareness of nutrition (Wierzejska, 2021). General health and well-being were the main reasons for use (31.1%), followed by recommendations from family (18.9%) and friends (17.4%) (Wahab et al., 2021). Patients with comorbidities also used HDS for chronic conditions like blood sugar or blood pressure control (16.7%), consistent with findings that herbal medicines support chronic disease management (Peltzer & Pengpid, 2019).

Most users reported positive effects such as improved strength (41.2%) and symptom relief (34.3%), while only 3.9% reported negative effects. Sources of information included social media (10.6%), direct sales and media (31.1%), and healthcare providers (3.0%). Family and friends also played a strong role in influencing use (30%). Patients mainly obtained HDS from drugstores or traditional shops (22.2%) compared to online sources, which carry a higher risk of misinformation (Welz et al., 2018).

The present study found that the awareness of the drug-HDS interaction among the HDS users was relatively low with more than half of the HDS users (54.4%) unaware of the drug-HDS interaction. This result was parallel with the recent study in Malaysia (Yan, Hong & Alshagga, 2021). From the previous study done in Malaysia (Islahudin, Shahdan & Mohamad-Samuri, 2017), the majority of the public had positive beliefs toward CAM use, especially in patients with chronic illness. The perception that

herbal products are a natural source, do not contain harmful chemicals and are free of side effects is a common misconception (Tengku Mohamad, Islahudin, Jasamai & Jamal, 2019). As such, the satisfaction achieved from combining HDS with conventional medication reflects the need to not limit the use of HDS (Arthur et al., 2012). Moreover, the lack of adequate knowledge of HDS contributed to the low awareness of the drug-HDS interaction (Jamshed, Khan, Ahmad & Elkalmi, 2016). Thus, healthcare providers should frequently update their knowledge about HDS in order to provide accurate information, as well as discussing HDS effects and acknowledge the adverse effects of the HDS to the patients.

Majority of the HDS users (70.9%) did not disclose their HDS use to their physician, consistent with the result from previous studies done in Malaysia and Thailand & Taiwan (Wahab et al., 2021; Sripa, 2005; Tangkiatkumjai et al., 2013; Putthapiban, Sukhumthammarat & Sriphrapradang, 2017; Chang et al., 2011). Such nondisclosure becomes an issue because the healthcare providers may not have the opportunity to assess the appropriateness of HDS use, detect HDS-related problems (e.g., toxicity, interactions, etc.) or provide professional advice without the proper information about the HDS use. The primary reason for the undisclosed HDS use was the physician doesn't ask (92.9%). Awareness of the widespread use of HDS by people with Type 2 diabetes is crucial for healthcare professionals (Chang et al., 2011). Inquiry regarding the HDS use should be a part of standard practice among physicians, particularly in T2DM patients with chronic kidney disease (Tangkiatkumjai et al., 2013). It is important for healthcare providers to routinely obtain the patient's history of HDS use as well as screening for potential adverse effects. Pharmacists play a pivotal role in the medication history assessment which is fundamental to include the details of HDS use. Pharmacists in every practice setting need to be vigilant in monitoring the possible drug-HDS interaction by asking the patients about the HDS and drugs they take concurrently and advising them regarding HDS to be avoided when taking certain medications (Bebeçi et al., 2015).

In this study, most respondents showed moderate to poor adherence to their prescribed medications, based on MyMAAT scores. We did not find a significant link between HDS use and medication adherence. This suggests that taking HDS did not clearly affect whether patients followed their conventional treatment.
Other studies, however, have reported that supplement or herbal medicine users may be less likely to follow their medications. This may happen because patients believe supplements are safer or more natural, or they may replace prescribed drugs with HDS. In some cases, the added pill burden may also reduce motivation to take medicines (Islamoglu et al., 2024; Liu et al., 2024; Rajahthurai et al., 2022). The lack of association in our study could be due to underreporting of HDS use or patients not admitting to poor adherence.

We also found that monthly income was significantly related to HDS use and conventional medication adherence. This reflects that greater financial capacity of

higher income patients to purchase HDS and they have fewer financial barriers to accessing medications, greater health literacy, more stable daily routines, and better social support, all of which can facilitate consistent medication-taking behaviour. However, in this study, there is no significant association was observed between HDS use and medication adherence, indicating that income influences HDS use but does not directly affect adherence to conventional therapy among T2DM patients in this setting.

CONCLUSION

The prevalence of HDS use among T2DM patients is low in Kubang Pasu district and this may be due to underreporting by patients as they were afraid to disclose regarding the use of HDS and most of them were unaware of the drug-HDS interaction. They are using HDS mainly because of their intention to improve general health and well-being or from relative and friends suggestions. Patients purchased HDS supplies from direct selling, magazines, newspapers and tv internet. Lastly, no association was found between the use of HDS and conventional medication adherence. As healthcare providers, we should provide evidence-based information on safety issues, efficacy, and potential interactions among commonly used HDS and should be more aware of HDS use in DM patients and always take a complete history of HDS use.

LIMITATION

There are certain limitations of our study. First, this research is by patient-reported information, therefore recall bias is possible. Secondly, we found that some patients are afraid to disclose the use of HDS and thus may lead to underreporting. Lastly, we do not have sufficient knowledge on HDS in order to assess the presence of HDS-drug interactions.

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DIGI-DENT: A PILOT STUDY OF TRANSFORMING ORAL HEALTH EDUCATION THROUGH DIGITALISATION

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ABSTRACT

Introduction: Digi-Dent is a digital oral health education initiative developed by the ToothTech Innovators team to enhance the delivery of oral health information through interactive and mobile-friendly content. In support of the National Oral Health and Digital Education Policies, Digi-Dent targets the general public, educators and dental personnel. This project aimed to assess both user experience and the impact on users' oral health knowledge.

Methodology: Digi-Dent was developed by incorporating various digital educational resources, such as videos, e-books, slides, and quizzes into a single mobile-accessible platform. Access was provided via QR codes and was spread to the public through posters and stickers at all dental clinics in Kulim district, social media campaigns, and oral health seminars. The usability of Digi-dent was evaluated using user feedback and quiz results.

Results: Among 32 respondents, Digi-Dent received positive user experience in which 78.1% found the content engaging, and 75% agreed that digital materials were more easily accessible than printed versions. About 81.3% of the respondents showed increased oral health knowledge after using the apps.

Discussion: Digi-Dent effectively met its objectives by delivering accurate and engaging dental content through an accessible, mobile-friendly platform. It supports modern oral health education and empowers users to learn independently. Although digital literacy remains a barrier for some, Digi-Dent offers a scalable and impactful approach to oral health promotion.

Keyword: oral health, digital innovation, health education, interactive education

INTRODUCTION

Oral health is an integral component of overall health and well-being, yet maintaining high levels of public awareness and knowledge remains a significant challenge for healthcare providers (Ministry of Education Malaysia, 2021). Conventional methods of health promotion which often rely on printed materials like pamphlets and posters, face limitations in engagement, accessibility, and the ability to convey information. In an era of rapid technological advancement, the digitalisation of healthcare services and information offers a transformative solution to these challenges (Department of Statistics Malaysia, 2023). The integration of digital tools in health education aligns with national strategic goals including the Malaysian National Oral Health and Digital Education Policies which advocate for innovative approaches to empower citizens with accessible health knowledge (Ministry of Health Malaysia, 2022).

In response to this call for innovation, the ToothTech Innovators team developed Digi-Dent, a digital oral health education initiative (Figure 1*)*. Digi-Dent is designed to centralise and enhance the delivery of oral health information by integrating various resources into a single, interactive, and mobile-friendly platform. The platform is developed for a diverse audience, including the general public, educators, and dental personnel, aiming to make learning about oral health more engaging and convenient.



Figure 1: Digi-Dent

This pilot study was designed to formally evaluate the initial implementation of the Digi-Dent platform. The primary objective was to assess user experience and measure the platform's perceived impact on oral health knowledge. Specifically, the study aimed to determine the platform's ease of access, clarity of content, and overall acceptance of digital materials among the target audience. The findings are intended to provide evidence-based insights to guide the future development and potential expansion of the Digi-Dent initiative as an effective tool for public health promotion.

METHODOLOGY

This study was a descriptive cross-sectional design to evaluate the usability and impact of the Digi-Dent platform among its initial user bases. The methodology was

structured to gather quantitative feedback on user perceptions and experiences following their interaction with the platform.

The Digi-Dent platform was developed as a comprehensive mobile-accessible hub. The development team incorporated a variety of digital educational formats, including instructional videos, engaging e-books, informational slides, and interactive quizzes and games, to cater to different learning preferences. The content was curated to be accurate, engaging, and easy to understand.

Distribution of the platform to the target population was carried out through a multi-channel strategy primarily within the Kulim district. Access was facilitated via Quick Response (QR) codes printed on posters and stickers, which were strategically placed in all government dental clinics throughout the district. This primary method was supplemented by digital outreach through social media campaigns and promotion during oral health seminars to broaden the reach to the general public and educators.

The study population comprised individuals who accessed and used the Digi-Dent platform during its initial pilot phase. A convenience sampling method was employed, with respondents recruited through various access points. Users who voluntarily scanned QR codes or followed links from social media were invited to provide feedback. Data were collected using a structured online questionnaire designed to evaluate user experience, platform usability, and the platform's impact on oral health knowledge.

Study Instrument and Variables

The survey questionnaire was divided into two main sections. The first section collected demographic information, including the user's category (e.g., Educator, General Public) and how they learned about Digi-Dent (Source of Information). The second section assessed user perceptions using a series of statements rated on a 5-point Likert scale. The scale was defined as follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. The key variables measured through this scale were 1) ease of access to the platform 2) improvement in oral health knowledge, 3) clarity of content, 4) acceptance of digital materials over conventional print and 5) overall evaluation of the platform.

Data Analysis

All collected data were compiled and analysed using descriptive statistics. Frequencies and percentages were calculated to summarise responses for each survey item. This quantitative approach enabled a clear presentation of user demographics as well as the distribution of satisfaction and agreement levels across different aspects of the Digi-Dent platform. The results were subsequently organised to facilitate interpretation.

RESULTS

The pilot study results are based on responses from 32 users of the Digi-Dent platform. As shown in Table 1, the majority of respondents were members of the general public (59.4%), followed by educators (37.5%). The most effective channel for user engagement was QR codes displayed in dental clinics, through which 25 respondents (78.1%) accessed the platform.

Table 1: Source of Information (N =32)

Sources of Information	n (%)
QR Code at Dental Clinics	25 (78.1%)
Social media	4 (12.5%)
Others	3 (9.4%)

Table 2: Respondent Categories (N =32)

Categories	n (%)
Educators	12(37.5)
General Public	19(59.4)
Others	1(3.1)

User Experience and Platform Evaluation

Respondents evaluated their experience with Digi-Dent using a 5-point Likert scale, with the detailed breakdown of responses presented in Table 2. Overall, the feedback was positive across all metrics, indicating high levels of satisfaction and acceptance.

The majority of users found Digi-Dent easy to access, with 24 respondents (75.0%) strongly agreeing and 6 respondents (18.8%) agreeing. Importantly, the platform was widely perceived as a valuable educational tool, with 26 respondents (81.3%) strongly agreeing that it improved their oral health knowledge.

The platform's content was very well received, with 96.9% of users agreeing (n = 6, 18.8%) or strongly agreeing (n = 25, 78.1%) that it was easy to understand. In addition, there was strong acceptance of the digital format, with 11 users (73.3%) strongly agreeing that digital materials were preferable.

The overall evaluation of Digi-Dent was highly positive, with 25 respondents (78.1%) giving the highest satisfaction rating (Strongly Agree) and 6 respondents (18.8%) rating it as satisfactory (Agree). Notably, no respondents reported a "Disagree" or "Strongly Disagree" rating for the overall experience.

Table 2: User Perception and Satisfaction with Digi-Dent (N =32)

Survey Question	Strongly Disagree (1) n (%)	Disagree (2) n (%)	Neutral (3) n (%)	Agree (4) n (%)	Strongly Agree (5) n (%)
Digi-Dent is Easy to Access	0(0%)	1(3.1%)	1(3.1%)	6(18.8%)	24(75%)
Digi-Dent Improves Knowledge	0(0%)	1(3.1%)	0(0%)	5(15.6%)	26(81.3%)
Content is Easy to Understand	1(3.1%)	0(0%)	0(0%)	6(18.8%)	25(78.1%)
Acceptance of Digital Materials	0(0%)	0(0%)	2(6.3%)	6(18.8%)	24(75%)
Overall Evaluation	(0%)	(0%)	1(3.1%)	6(18.8%)	25(78.1%)

Footnote: The labels for the 5-point scale correspond to Strongly Disagree/Strongly Unsatisfactory, Disagree/Unsatisfactory, Neutral/Moderate, Agree/Satisfactory, and Strongly Agree/Strongly Satisfactory respectively.

DISCUSSION

This pilot study aimed to evaluate the effectiveness and user reception of Digi-Dent, a novel digital platform for oral health education. The findings indicate that the initiative was highly successful in meeting its preliminary objectives of delivering accessible, understandable, and impactful dental content to its target audience.

Interpretation of Principal Findings

The study's results are encouraging. The high rate of access via QR codes 25 users (78.1%) confirms that placing access points within dental clinics is an effective strategy for reaching an engaged audience. This approach aligns with research demonstrating that QR codes can serve as effective, low-cost for spreading targeted health information and resources directly to patients in clinical settings (Kamel Boulos et al., 2016). The overwhelmingly positive feedback on ease of access and content clarity demonstrates a high level of platform usability. This is a critical factor, as studies consistently identify poor usability and complex interfaces as significant barriers to the adoption and sustained use of mHealth technologies (Septiani et al.,2024).

The most significant finding is the platform's perceived impact on user knowledge, with 26 users (81.3%) strongly agreeing that Digi-Dent improved their oral health knowledge. This finding aligns with a growing body of evidence suggesting that

interactive mHealth applications are effective tools for enhancing health literacy and promoting positive behavioural change (Tay et al., 2023). By providing resources like videos, quizzes, games and e-books, Digi-Dent empowers users to learn independently. This use of interactive elements is supported by studies on gamification which show that features like quizzes can significantly boost engagement and knowledge retention in health education contexts (Septiani et al., 2024). The platform's high overall evaluation score further validates Digi-Dent as a valuable public health tool that facilitates patient empowerment and self-management, a key goal in modern digital healthcare (Tay et al., 2023).

Limitations of the Study

While the results are positive, the study has several limitations that must be acknowledged. Firstly, the small sample size of 32 respondents limits the generalisability of the findings to a wider population. Secondly, the use of a convenience sampling method may have introduced selection bias.

Furthermore, the reliance on self-reported data for knowledge improvement without an objective pre- and post-intervention assessment, is a key limitation. Perceived knowledge gain can be subject to recall and social desirability biases and may not always correlate with actual improvements in understanding (Taylor et al., 2011). Finally, as noted, digital literacy remains a potential barrier. This is a well-documented challenge in the deployment of digital health interventions, one that risks exacerbating health limitation by excluding certain demographics, such as older adults or those with lower educational level (Stauch et al., 2025; van Deursen & van Dijk, 2011).

Implications and Future Directions

Despite these limitations, the study provides a strong proof-of-concept for Digi-Dent. For future research, it is recommended that a larger-scale study be conducted incorporating objective knowledge assessments (pre/post-quizzes) to quantify the learning impact more precisely.

In terms of practice, Digi-Dent offers a scalable and cost-effective model for health promotion. Further development should focus on enhancing accessibility by co-designing features with users of varying digital literacy levels to ensure the platform is equitable and reaches the widest possible audience.

CONCLUSION

This pilot study successfully demonstrated that the Digi-Dent platform is a practicable, effective, and highly rated tool for digital oral health education. The initiative succeeded in delivering accessible and engaging content that users found beneficial to their knowledge of oral health. The positive reception underscores the potential for well-designed digital tools to revolutionise health promotion by making it

more interactive and user centred. While acknowledging the limitations of a pilot study, the results provide a clear mandate for the continued development and wider implementation of the Digi-Dent platform, positioning it as a promising model for make use of technology to empower individuals and promote better health outcomes

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LEVEL OF EMOTIONAL INTELLIGENCE (EI) AMONG NURSES IN PUBLIC HOSPITAL

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ABSTRACT

Background: Emotional intelligence (EI) refers to the ability to understand, manage, and use one's emotions effectively to handle stress, communicate well, empathize, resolve conflicts, and overcome challenges. In the nursing profession, EI is critical as it impacts decision-making, clinical judgment, stress management, and ultimately patient care quality. Nurses with high EI are better equipped to handle the emotional demands of their job and improve patient outcomes. This study aimed to determine the level of EI among nurses at a public hospital and its association with demographic variables.

Methods: A cross-sectional study was conducted with 310 nurses from seven departments at Hospital Sultanah Bahiyah. Data was collected using a self-administered questionnaire consisting of two sections: demographic information and 51-item Emotional Quotient Inventory (EQ-i) back-translated by Najib et.al, (2006). The questionnaire covered five EI dimensions: intrapersonal, interpersonal, general mood, adjustment, and stress management.

Results: A significant level of 0.05 was used. The study revealed that 72.6% of nurses at HSB exhibited moderate emotional intelligence. Age , with the result $\chi^2(2, N = 310) = 10.59$, ($p = 0.005$), academic qualification with the result $\chi^2(2, N = 310) = 11.728$ ($p = 0.010$) and job position with the result $\chi^2(2, N = 310) = 11.728$ ($p = 0.010$) significantly influenced EI levels, while gender, ethnicity, years of service, and marital status did not.

Conclusion: The findings suggest that targeted EI training could improve emotional competencies among nurses, ultimately enhancing patient care and nurse well-being.

Keywords: Emotional Intelligence, nurses, healthcare profession, patient care.

INTRODUCTION

Emotional Intelligence, also known as EI, refers to the ability to understand, utilize, and manage one's own emotions in positive ways (Mat Saad & Ahmad Marzuki, 2013). This includes stress relief, effective communication, empathy, overcoming challenges, and resolving conflicts. EI is commonly defined by five attributes: self-management, adaptability, general mood, interpersonal skills, and intrapersonal skills (Mat Saad & Ahmad Marzuki, 2013).

The global healthcare system is currently facing multiple challenges, including workforce shortages, rising patient care demands, and burnout among healthcare professionals. The World Health Organization (2023) estimates that the global nursing shortage could reach 13 million by 2030, creating immense strain on healthcare systems. Furthermore, a meta-analysis in JAMA Network reported that emotional exhaustion and burnout significantly reduce job satisfaction and retention among nurses (Shanafelt et al., 2024).

Within the nursing profession, EI plays a critical role in managing stress, improving decision-making, and enhancing patient care. Nurses with high EI are better equipped to regulate emotions, demonstrate empathy, and communicate effectively, leading to improved patient outcomes and satisfaction (Mayer, Salovey, & Caruso, 2004; Dolev & Leshem, 2020). High EI in leadership also supports efficient resource allocation and strengthens hospital operations (Goleman, 1998). Conversely, low or moderate EI among nurses can hinder stress management, conflict resolution, communication, and sound decision-making (Lown et al., 2018).

Nurses in public hospitals are particularly vulnerable, as they often face high workloads, limited resources, staff shortages, and emotionally taxing situations. These pressures frequently lead to burnout and emotional exhaustion (Salem & Ebrahem, 2018; Al-Hamdan et al., 2017). Research has shown that nurses with higher EI are more adept at conflict management and delivering compassionate care (Codier et al., 2009; Landa et al., 2008), while low EI correlates with job dissatisfaction, poor coping, and reduced patient safety (Momm et al., 2015; Por et al., 2011).

The research gap related to this issue lies in the need to evaluate the EI of nursing staff and further explore its relationship with demographics. By examining age, gender, ethnicity, academic qualification, position, years of service, and marital status, we can gain valuable insights into the factors that may influence EI levels among nurses.

GENERAL OBJECTIVE

To determine the level of Emotional Intelligence (EI) among nurses in a public hospital and examine differences based on demographic factors.

SPECIFIC OBJECTIVE

To identify EI levels among nurses and analyze their association with demographic factors (age, gender, education, job position, years of service, marital status).

EMOTIONAL INTELLIGENCE FRAMEWORK

Bar-On (1997) emphasized that a person must have the capability in both cognitive and emotional to meet the obstacles in daily life. To highlight the differences between the two categories of intelligence, intellectual and emotional, coined the acronym "EI." For this study, Bar-On (2000) definition will be referred to: EI is a non- cognitive ability and emotion management abilities which influence one's capability to deal with daily routines. Interpersonal skills, including empathy, social responsibility, and interpersonal relationships, play a crucial role in individual and collective well-being (Bar-On, 2006).

On the other hand, intrapersonal skills such as self-regard, emotional self-awareness, assertiveness, self-actualization, and independence are vital for individual psychological well-being and resilience (Salovey & Mayer, 1990

Adaptability encompasses skills such as problem-solving, flexibility, and reality testing, which are indispensable in navigating complex and dynamic environments (Luthans, 2002). Problem-solving skills enable individuals to analyze challenges and generate effective solutions, fostering resilience and innovation (D'Zurilla & Nezu, 2010). Stress management skills, including stress tolerance and impulse control, are pivotal for maintaining psychological well-being and coping with adversity (Connor & Davidson, 2003).

MATERIALS AND METHODS

Sample Collection

The study was conducted at 7 departments, there are Obstetrics and Gynaecology, Medical, Surgical, Pediatric, NICU, Orthopedic and Multidiscipline ward. The target population included all available nurses who were employed in Hospital Sultanah Bahiyah. This study utilized a cross-sectional design. Total number of nurses 1668, the study involved 310 nurses as samples of the study based on the determination of the sample size technique by Krecjie and Morgan (1970). The sampling method used for this study was convenience sampling with cross-sectional study design. The data collection was taken from October 2023-February 2024. The data analysis was done by using SPSS 27 version.

Table for Determining Sample Size from a Given Population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368

Figure 1: Sample size technique by Krecjie and Morgan (1970)

Research instrument

Data was collected using the questionnaire which was developed based on the instruments by previous researchers. The questionnaire consists of two sections: Section A gathers demographic information of the respondents, while Section B comprises a 51-item Emotional Quotient Inventory (EQ-i), which was back-translated by Najib et al. (2006). Items were scored according to Likert Scale point from 1 = not true of me, to 5 = true of me. It included five dimensions as suggested by Bar-On (1997) which are intrapersonal, interpersonal, general mood, adjustment and stress management.

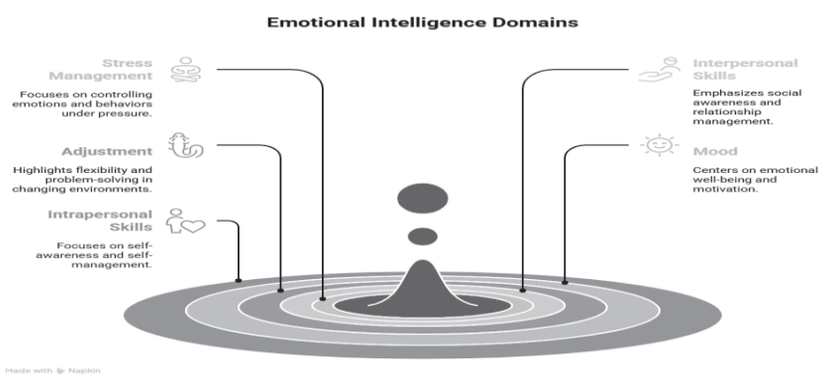


Figure 2: Emotional Intelligence Domains

The time required to complete the questionnaire ranged from 15 to 20 minutes. Upon completion, the questionnaire was collected by the researcher for analysis. The responses were evaluated using the Emotional Quotient Inventory (EQ-i) scoring system. According to Bar-On, the scoring categories are as follows: markedly low (below 119), average or moderate (120–187), and markedly high (188–255). Each item was rated on a 5-point Likert scale, ranging from 1 = 'Not true of me' to 5 = 'True of me'.

Validation and pilot study

The questionnaire consisted of 51 questions related to the level of EI with the five Likert Scale. Thus, a minimum sample size of 153 samples to produce a good Cronbach's alpha and correct factor solution with 1:3 as the rule of thumb to calculate the sample size (M.A. Bujang et.al, 2012). With an additional 20% dropout rate, the sample size was 192 samples. The intrapersonal level subscale consisted of 10 items (α =.82). the Interpersonal subscale consisted of 10 items (α =.79), the stress management level subscale consisted of 8 items (α =.87), the adjustment level subscale consisted of 7 items (α =.71) and the mood level subscale consisted of 10 items (α =.81).

Data collection procedure

Ethical approval for this study was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia. Following approval, printed copies of the questionnaire were distributed to nurses who met the inclusion criteria. A brief description of the study, along with a statement of agreement, was attached to the questionnaire. Participants were required to provide informed consent before beginning the questionnaire. The investigator met with staff nurses individually or in groups within their work units to explain the study's purpose and procedures, and to obtain written consent.

Informed consent was obtained from all participants, who were assured that their participation was entirely voluntary, their responses would remain confidential, and the data collected would be used solely for research purposes. Participants were given one to two weeks to complete the questionnaire at their convenience.

RESULTS

Demographic characteristics of respondents

Table 1 shows the demographic characteristics of the respondents include factors such as age, gender, ethnicity, academic qualification, job position, years of service, and marital status.

Table 1: Demographic characteristics of respondents (N=310)

Variable	n (%)	Mean (SD)
Age		36.4 (5.64)
< 34y/o	123 (39.7)	
≥ 35y/o	187 (60.3)	
Gender		
Male	10 (3.2)	
Female	300 (96.8)	
Ethnicity		
Malay	290 (93.5)	
Non-Malay	20 (6.5)	
Academic Qualification		
Sijil Pelajaran Malaysia (SPM)	37 (11.9)	
Diploma	261 (84.2)	
Degree	12 (3.9)	
Position		
Community Nurse	37 (11.9)	
Registered Nurse	249 (80.3)	
Sister	22 (7.1)	
Matron (Professional Management)	2 (0.6)	
Years Of Services		13.2 (5.08)
< 12 years	173 (55.8)	
≥ 13 years	137 (44.2)	
Marital Status		
Single	21 (6.8)	
Others	289 (93.2)	

The study on the level of Emotional Intelligence (EI) among nurses at Hospital Sultanah Bahiyah (HSB), Alor Setar, Kedah, involved a diverse sample, as reflected in the demographic data. The mean age of participants was 36.4 years (SD = 5.64), with the majority (60.3%) aged 35 years and above. This suggests that most participants were mature and likely possessed substantial professional experience. The gender distribution was predominantly female, accounting for 96.8% of respondents, which is consistent with the traditionally female-dominated composition of the nursing profession.

In terms of ethnicity, the majority of nurses were Malay (93.5%), with a minority (6.5%) identifying as non-Malay, reflecting the general ethnic composition of the region. Regarding academic qualifications, most participants held a Diploma (84.2%), while a smaller proportion had completed Sijil Pelajaran Malaysia (SPM) (11.9%) or held a degree (3.9%). This indicates that diploma-level education remains the predominant entry route into the nursing profession at HSB.

In terms of job positions, the majority of participants were Registered Nurses (80.3%), followed by Community Nurses (11.9%). Higher-ranking positions, such as Sisters and Matrons, were less represented, comprising 7.1% and 0.6% of the sample, respectively. The mean duration of service among participants was 13.2 years (SD = 5.08). There was a relatively even distribution of experience, with 55.8% having less than 12 years of service and 44.2% having 13 years or more, suggesting an overall experienced nursing workforce at HSB.

Lastly, marital status data indicates that the vast majority of participants are either married or categorized under 'Others' (93.2%), with only 6.8% identified as single. Collectively, the demographic profile presents a predominantly female, ethnically homogenous, and well-experienced nursing workforce with diverse educational backgrounds. This foundational understanding of the participants provides essential context for interpreting the subsequent analysis of emotional intelligence (EI). These demographic characteristics may play a significant role in shaping EI levels, which in turn can influence nurses' professional performance, interpersonal interactions, and quality of patient care.

Table 2 presents the distribution of Emotional Intelligence (EI) levels across the various dimensions measured by the Emotional Quotient Inventory (EQ-i). The findings indicate that nurses at HSB exhibit a broad spectrum of EI competencies, with the majority falling within the moderate level across all dimensions.

Table 2: Emotional Intelligence Level

Outcomes	High n (%)	Moderate n (%)	Low n (%)
Stress Management	155 (50.0)	154 (49.7)	1 (0.3)
Interpersonal	134 (43.2)	174 (56.1)	2 (0.6)
Adjustment	131 (42.3)	174 (56.1)	5 (1.6)
Mood	124 (40.0)	186 (60.0)	0 (0.0)
Intrapersonal	92 (29.7)	212 (68.4)	6 (1.9)
Overall	85 (27.4)	225 (72.6)	0 (0.0)

The analysis of Emotional Intelligence (EI) levels among nurses at Hospital Sultanah Bahiyah (HSB), Alor Setar, Kedah, reveals a nuanced distribution of competencies across various EI dimensions. The data indicates that nurses exhibit varying levels of EI, with most participants falling within the moderate range for each dimension, underscoring a balanced yet adaptable workforce. In terms of stress management, exactly half of the participants (50.0%) demonstrated a high ability to handle stress. The interpersonal skills dimension shows that a majority (56.1%) have moderate levels, with 43.2% possessing high interpersonal competencies. The mood dimension reveals that most nurses (60.0%) display moderate levels of emotional balance. Intrapersonal skills, which involve self-awareness and emotional independence, were predominantly moderate (68.4%). When considering overall

emotional intelligence, the majority of nurses (72.6%) fall within the moderate category. These findings highlight the nurses' strengths in stress management, interpersonal relationships, and adaptability while identifying areas such as mood regulation and self-awareness that could benefit from targeted interventions or training programs. This balance of EI is vital for delivering effective and compassionate care in a challenging healthcare setting.

Table 3: Association between Demographic Factors and Emotional Intelligence Level

Variables	Moderate	High	*p*-value	x^2
	n (%)	n (%)		
Age			0.001 [b]	
< 34y/o	102 (82.9)	21 (17.1)		10.967
≥ 35y/o	123 (65.8)	64 (34.2)		
Gender			0.852 [b]	
Male	7 (70.0)	3 (30.0)		
Female	218 (72.7)	82 (27.3)		
Ethnicity			0.192 [b]	
Malay	213 (73.4)	77 (26.6)		
Non-Malay	12 (60.0)	8 (40.0)		
Academic Qualification			0.005 [b]	
Sijil Pelajaran Malaysia (SPM)	25 (67.6)	12 (32.4)		10.585
Diploma	196 (75.1)	65 (24.9)		
Degree	4 (33.3)	8 (66.7)		
Position			0.010 [a]	
Community Nurse	27 (73.0)	10 (27.0)		
Registered Nurse	187 (75.1)	62 (24.9)		11.728
Sister	11 (50.0)	11 (50.0)		
Matron (Professional Management)	0 (0.0)	2 (100.0)		
Years Of Services			0.375 [b]	
< 12 years	129 (74.6)	44 (25.4)		
≥ 13 years	96 (70.1)	41 (29.9)		
Marital Status			0.701 [b]	
Single	16 (76.2)	5 (23.8)		
Others	209 (72.3)	80 (27.7)		

Note [a] Fisher's Exact test.
[b] Pearson's Chi-Square test

Table 3 shows the relationship between various demographic factors and emotional intelligence (EI) levels. The Chi-square test result (χ^2 (1) = 10.967, p = 0.001) shows a statistically significant association between age category and overall level in the data indicating that participants aged ≥ 35 years were more likely to have high emotional intelligence compared to those aged <34 years. Most participants under 34 years old had moderate emotional intelligence (82.9%). Both genders showed similar distributions of moderate (70.0% for males, 72.7% for females) and high emotional intelligence (30.0% for males, 27.3% for females). Ethnicity did not show a significant impact on emotional intelligence (p = 0.192). A higher proportion of Malay participants exhibited moderate emotional intelligence (73.4%). A Chi-Square test of independence showed a statistically significant association between academic qualification and overall level, $\chi^2(2, N = 310) = 10.59$, p = 0.005. Participants with a degree qualification were more likely to exhibit high emotional intelligence. Participants with a Degree had the highest proportion of high emotional intelligence (66.7%). A significant association was found between job position and emotional intelligence $\chi^2(2, N = 310) = 11.728$ (p = 0.010). Participants in the Matron (Professional Management) position had the highest proportion of high emotional intelligence (100%). No significant relationship was found between years of service and emotional intelligence (p = 0.375). Participants with less than 12 years of service had a slightly higher proportion of moderate emotional intelligence (74.6%). Marital status did not have a significant effect on emotional intelligence (p = 0.701). Both single and other marital status groups had similar distributions of moderate and high emotional intelligence, with 76.2% of singles having moderate emotional intelligence. No significant relationship was found between years of service and emotional intelligence (p = 0.375). Marital status did not have a significant effect on emotional intelligence (p = 0.701).

DISCUSSION

The findings provide valuable insights into the relationship between demographic characteristics and emotional intelligence (EI) levels among nurses. These results contribute to understanding how factors such as age, gender, ethnicity, academic qualifications, and years of service relate to the development and application of EI in the healthcare environment.

The sample of nurses in this study predominantly consisted of individuals aged 35 years or older (60.3%), with a mean age of 36.4 years (SD = 5.64). This demographic trend aligns with previous research suggesting that age correlates with higher emotional intelligence, particularly in areas such as stress management and interpersonal skills. Older individuals often exhibit better self-regulation, empathy, and emotional resilience due to accumulated life and professional experiences (Bar-On, 2006; Goleman, 1995). This finding is further supported by studies indicating that

older nurses are more likely to engage in effective emotional coping strategies, thus enhancing their EI (Schutte et al., 1998; Côté et al., 2011).

Moreover, the significant association between age and stress management (p = 0.001) found in Table 3 reinforces the notion that older nurses may possess greater emotional regulation skills, which are critical in managing the high stress demands of nursing practice (Saarni, 1999; Mayer & Salovey, 1997).

The sample showed a marked gender imbalance, with 96.8% of respondents being female, which is consistent with global nursing workforce trends (International Council of Nurses, 2020). Despite this imbalance, Table 3 indicates that there were no significant differences in EI levels between male and female nurses (p = 0.852). This aligns with earlier studies suggesting that although females may express EI differently—often with stronger interpersonal and empathetic qualities — there are no major gender differences in overall EI levels (Goleman, 1995; Salovey & Mayer, 1990; Brackett et al., 2006).

While gender itself may not affect overall EI, some studies have pointed to gender-specific strengths in certain EI dimensions, such as emotional awareness and empathy in females (Goleman, 1995). Future research could explore whether gender influences the application of EI in nursing practice, especially in patient care and leadership roles (McQueen, 2004; Dewaele & Hu, 2019).

The sample was predominantly Malay (93.5%), with a small proportion of non-Malay nurses (6.5%). Table 3 showed no significant association between ethnicity and EI (p = 0.192), suggesting that ethnic background did not have a direct impact on EI levels in this sample. However, previous studies have emphasized that cultural context plays an important role in shaping emotional intelligence (Mayer & Salovey, 1997; Ang et al., 2007). For instance, cultural norms around emotional expression and social interaction may influence how nurses develop and utilize EI in their daily practice (Elfenbein, 2007; Goleman, 1995). Understanding cultural variations in EI could provide insights into how healthcare institutions can better support a diverse workforce and improve communication across cultural boundaries (Mayer et al., 2004).

Most nurses in this study held a diploma (84.2%), while 11.9% had completed SPM and 3.9% had obtained a degree. The distribution of academic qualifications suggests a need to further explore how education level correlates with EI. Studies have shown that higher levels of education, especially university degrees, are linked to greater emotional intelligence (Schutte et al., 1998; Salovey & Mayer, 1990). Higher education is often associated with improved cognitive abilities, which, in turn, can enhance self-awareness, interpersonal skills, and emotional regulation (Goleman, 1995). Additionally, the relationship between academic qualifications and EI suggests that nursing education programs may play a role in enhancing EI through curricula

designed to foster emotional awareness and social competencies (Mayer et al., 2004; Goleman, 2006). This can be said that we need to encourage nurse and give the chances into higher nursing education such as in Degree, Master and PhD for their level of emotional intelligence and critical thinking at the same time bringing them to good career opportunities.

The significant association between job position and overall EI levels suggests that as a person's position in the organization changes, their emotional intelligence also tends to vary. Higher job positions, such as managerial or leadership roles, require more emotional regulation and interpersonal skills. Leaders are often required to manage stress, conflict, and team dynamics, which can enhance or necessitate a higher level of emotional intelligence (Goleman, 1998). It is also possible that individuals in higher positions have had more exposure to professional development or have had to refine their emotional intelligence over time to handle the demands of their role effectively. As one climbs the organizational ladder, they may also accumulate more experience in managing emotional situations (Boyatzis et al., 2000). It's possible that people with higher emotional intelligence are more likely to be promoted improve their emotional skills even more. This shows that organizations should help employees develop emotional intelligence early on, especially those aiming for leadership roles. This can lead to better leaders and a healthier workplace overall.

With a mean year of service of 13.2 years (SD = 5.08), the respondents were relatively experienced, with 55.8% of respondents having less than 12 years of service, and 44.2% having 13 or more years. Table 3 indicated no significant association between years of service and overall, EI levels (p = 0.375), suggesting that experience in nursing does not necessarily correlate with higher EI. However, some studies suggest that emotional intelligence can be developed over time, particularly with exposure to challenging work environments and patient interactions (Côté & Miners, 2006; McQueen, 2004). Nurses with more years of service may develop greater emotional resilience, but this does not always translate to higher EI across all dimensions. Investigating the specific EI competencies that develop with experience, such as stress management or interpersonal skills, could be a useful direction for future research.

The majority of the respondents were married or in a similar marital status (93.2%), while only 6.8% were single. While marital status did not show a significant relationship with EI in this study, research has suggested that emotional intelligence may be influenced by personal relationships and social support systems (Goleman, 1995). Married individuals often have access to stronger social networks, which may enhance emotional support and improve their capacity for empathy and emotional regulation (Brackett et al., 2006). Future studies could examine how marital status, family dynamics, and social support systems impact emotional intelligence in healthcare workers, especially in the context of managing work-related stress.

RECOMMENDATIONS

- Implement structured EI training programs focusing on self-awareness, self-management, empathy, and relationship skills.
- Provide workshops, coaching, and continuous professional development to strengthen EI competencies.
- Integrate EI development into nursing education curricula and ongoing in-service training.
- Encourage and support nurses to pursue higher academic qualifications (e.g., bachelor's, master's).
- Develop leadership programs that emphasize EI skills for nurses in junior positions.
- Include EI assessment tools in recruitment and promotion processes.
- Foster a positive and supportive workplace culture that enhances emotional well-being.
- Conduct further research to explore additional factors influencing EI in healthcare settings.

CONCLUSION

The findings of this study reveal that emotional intelligence (EI) plays a critical role in the nursing profession, with significant implications for various stakeholders. Nurses with higher EI levels are better equipped to handle the emotional demands of their job, which directly influences patient care quality and outcomes. For clients, the development of EI among nurses is crucial in ensuring that patients receive compassionate, attentive, and empathetic care. For the community, nurses with high EI contribute to overall public health by promoting emotional well-being and reducing stress within the healthcare environment. At the organizational level, investing in EI development through training and professional development programs can lead to a more productive and effective nursing workforce. On a national scale, enhancing EI among healthcare professionals can have far-reaching impacts on the healthcare system.

In conclusion, this study sheds light on the level of EI among nurses in Hospital Sultanah Bahiyah, Alor Setar, Kedah. The findings provide valuable insights for healthcare practitioners and administrators to develop strategies and interventions that can enhance EI among nurses, ultimately improving patient care and overall well-being in the healthcare setting. Further research in this area is recommended to gain

a deeper understanding and develop more targeted approaches to enhance EI among nurses in this specific context.

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PREVALENCE, USAGE PATTERNS, AND PERCEPTIONS OF ORALLY ADMINISTERED TRADITIONAL AND COMPLEMENTARY MEDICINES AMONG HOSPITALIZED PATIENTS AT HOSPITAL SULTANAH BAHIYAH

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ABSTRACT

Introduction: The growing acceptance and utilization of traditional and complementary medicine (TCM) in both advanced and emerging nations, such as Malaysia, have brought about notable public health policy concerns.

Objective: To investigate the prevalence of TCM use among hospitalized patients in Hospital Sultanah Bahiyah. The study also looked into the types of TCM taken, purpose, perception and any adverse effect experienced by respondents.

Method: A convenient sampling was conducted among hospitalized patients in the general medical ward of Hospital Sultanah Bahiyah for the period of May 2019 till May 2022. A questionnaire was distributed to every second newly admitted patient in the wards.

Results: About 25.5% out of 306 respondents took the TCM. The most preferred type of TCM was vitamins and supplements (68.4%). Most respondents took TCM for the purpose of general wellness (67.9%) rather than adjunct treatments to current illnesses. About 23.1% of respondents had the perception that TCM is very helpful in their daily activities and 47.4% respondents felt that TCM is somewhat helpful for their general well-being in conjunction with conventional medications. Only 2 participants (2.6%) reported experiencing undesirable side effects, such as diarrhoea, after taking TCM.

Conclusion: Vitamins and supplements were identified as the most commonly used type of TCM. However, overall usage of TCM was not widespread among patients admitted to the medical wards. A small number of patients continue taking TCM even without being sure of its benefit, while some patients continue taking TCM despite experiencing side effects.

Keywords: prevalence, traditional medicines, vitamins, complementary medicine, supplements, TCM

INTRODUCTION

In recent years, there has been a notable resurgence of interest in traditional and complementary medicines (TCM) worldwide, fueled by a growing awareness of holistic health approaches and a desire for culturally sensitive healthcare options. TCM encompasses a diverse range of practices, including herbal medicine, acupuncture, Ayurveda, traditional Chinese medicine, and various indigenous healing modalities. These practices have deep historical roots and have been utilized for centuries in diverse cultures around the globe (Siti et al., 2009).

The increasing popularity and use of traditional and complementary medicine in both developed and developing countries, including Malaysia, have raised significant public health policy issues.

In Malaysia, traditional and complementary medicines play a significant role in the country's healthcare landscape, reflecting its rich multicultural heritage and diverse healthcare traditions. Traditional Malay medicine, Chinese traditional medicine, Indian Ayurvedic practices, as well as indigenous healing modalities, collectively contribute to Malaysia's vibrant TCM sector.

The Malaysian government recognizes the importance of traditional and complementary medicines and has taken steps to integrate them into the national healthcare system. Traditional medicine clinics are available in public hospitals and healthcare centers, providing access to traditional healing services alongside modern medical treatments. Additionally, the Ministry of Health Malaysia regulates and promotes the safe and effective use of traditional and complementary medicines through registration requirements and quality control measures.

Nowadays, a rising number of patients are presenting to hospitals for various general medical procedures. Traditional and complementary medicines especially herbal medicines are widely used by most people, including hospitalized patients. These medicines may pose numerous challenges during the care of patients in the ward. These complications could be due to their direct action, pharmacodynamic or pharmacokinetic effect. The healthcare practitioners should be aware of the potential adverse effects of those drugs. Thus, steps should be taken to prevent, recognize, and treat the complications that may arise due to their use or discontinuation.

TCM may interrupt the functioning of conventional medications via their pharmacokinetic or pharmacodynamic mechanism. Due to their complex structure, herbal medicines are more prone to interactions. Some of the commonly purchased TCMs have been proven to have interactions with conventional medication, for example, evening primrose oil, ginkgo, glucosamine or red yeast rice (Moses et al., 2010). According to Elmer et al. (2007), the most common adverse interaction reported is a risk of bleeding due to concurrent use of ginkgo, garlic, or ginseng

together with aspirin, warfarin, ticlopidine, or pentoxifylline which are commonly given in general medical wards or upon discharge from the hospital.

This study helps to determine the prevalence of TCM use, the most common TCM taken by general medical ward patients and identifies those that have the potential for adverse interaction, either with diseases or conventional medications. No prior publications of TCM use were carried out in HSB a tertiary hospital in Kedah.
This study also will help health practitioners in general medical wards to take precautionary steps to prevent, recognize, and treat the complications that may arise due to the usage of TCM since the most common TCM used by general medical ward patients will be identified and any potential interactions can be studied earlier.

General Objective

To investigate the prevalence of TCM use and the perception of traditional and/or complementary medicines (TCM) among hospitalized patients in general medical wards of Hospital Sultanah Bahiyah.

Specific Objective

●To investigate the types of TCM taken by hospitalized patients in general medical wards.

●To investigate the most common orally taken TCM by patients.

●To investigate the indications of patients taking those herbs/traditional and/or complementary medications.

●To explore the perception of patients towards TCM.

●To record any undesirable effects experienced by patients who took TCM.

METHODOLOGY

Study Type and Design

A cross-sectional study was conducted among hospitalized patients in general medical wards of Hospital Sultanah Bahiyah. A questionnaire was distributed to selected patients to be completed. Systematic Random Sampling was utilized whereby every second newly admitted patients to the general medical wards of Hospital Sultanah Bahiyah were selected for this study.

Inclusion Criteria

Hospitalized patients in general medical wards who were conscious or with patient assistant personnel (PAP) around, able to communicate verbally or non-verbally.

Exclusion Criteria

Critically ill patients (intubated or isolated patients), unconscious or altered behavior patients (patients with delirium, dementia, or psychiatric conditions), prisoners, cognitively impaired patients without PAP around.

Sample Size

The population size was 1500 admission and based on a confidence interval of 95% and the margin error of 5%, the minimum recommended size of the survey was 306.

Statistical Analysis Plan

The data from the questionnaire survey was entered into an Excel sheet. Any adverse effects with TCM were noted included in the result. Data cleaning and data analysis were conducted with SPSS.

RESULTS

Demographics of Respondents

The study comprised 306 participants, exhibiting a gender distribution where 222 males (72.5%) outnumbered 84 females (27.5%). The majority of respondents were Malay (85%), followed by Chinese (11.1%), Indian (2.3%), and others (1.6%).

Among the 306 participants, 78 individuals (25.5%) reported using Traditional and Complementary Medicine (TCM). Within this subgroup, 52 were male (66.7%), and 26 were female (33.3%). Notably, Malay participants exhibited the highest prevalence, comprising 62 individuals (79.5%), followed by 15 Chinese participants (19.2%), 1 from others (1.3%), and none Indian participants.

Types of TCM

The preferred types of traditional and complementary medicines were diverse, with the majority favoring vitamin/ supplements (68.4%). Following closely were Malay TCM at 21.8%, and Chinese TCM at 11.5%. Among the vitamin/ supplements, multivitamins, and fish oil were the most favored. For comparison, a study conducted in 2009 involving 6947 Malaysians has shown herbal products to be the most prevalent TCM, with vitamins and supplements being the third most prevalent TCM at the time of that study. Our study results may reflect the change in trend in consumer choice.

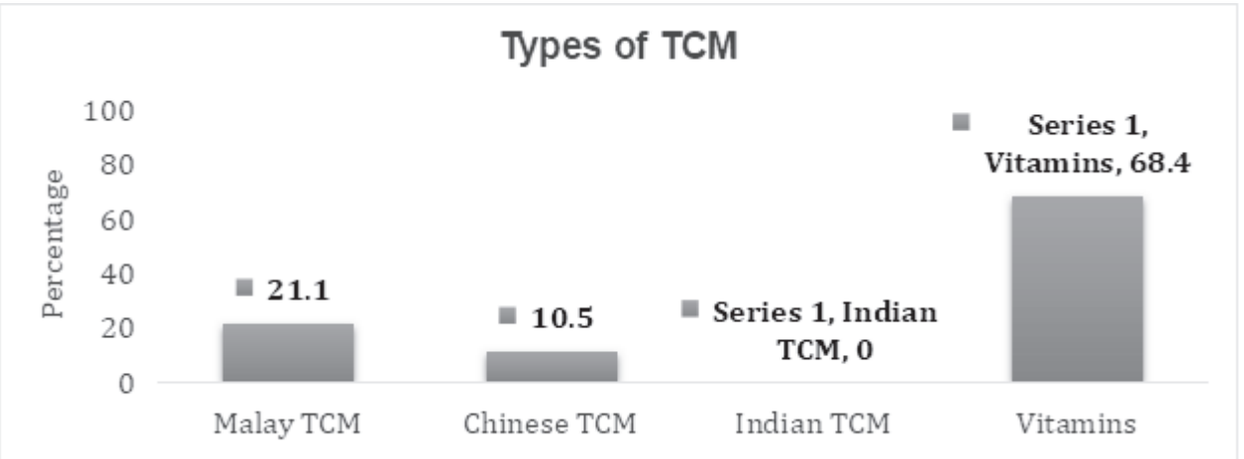


Figure 1: Types of TCM

Indications of TCM taken

The survey findings indicate that most participants utilize TCM primarily for general wellness rather than as an adjunct therapy for their underlying illnesses, whether the conditions are acute or chronic.

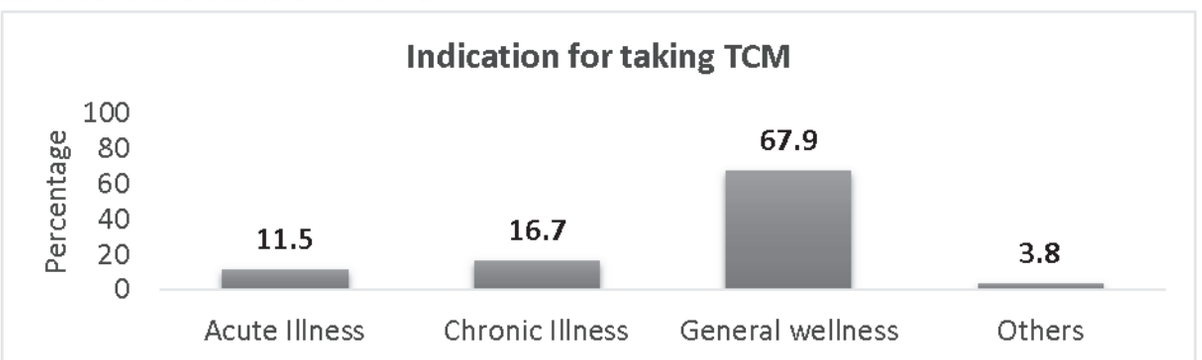


Figure 2: Indication for taking TCM

Perceptions of TCM

In evaluating patients' perceptions of consuming traditional or complementary medicines, 47.4% feel that these therapies are somewhat helpful for general well-being in conjunction with their conventional medications. However, 9% of participants believe that the TCM they have been taking is not helpful, and 20.5% are unable to provide a comment on their perception.

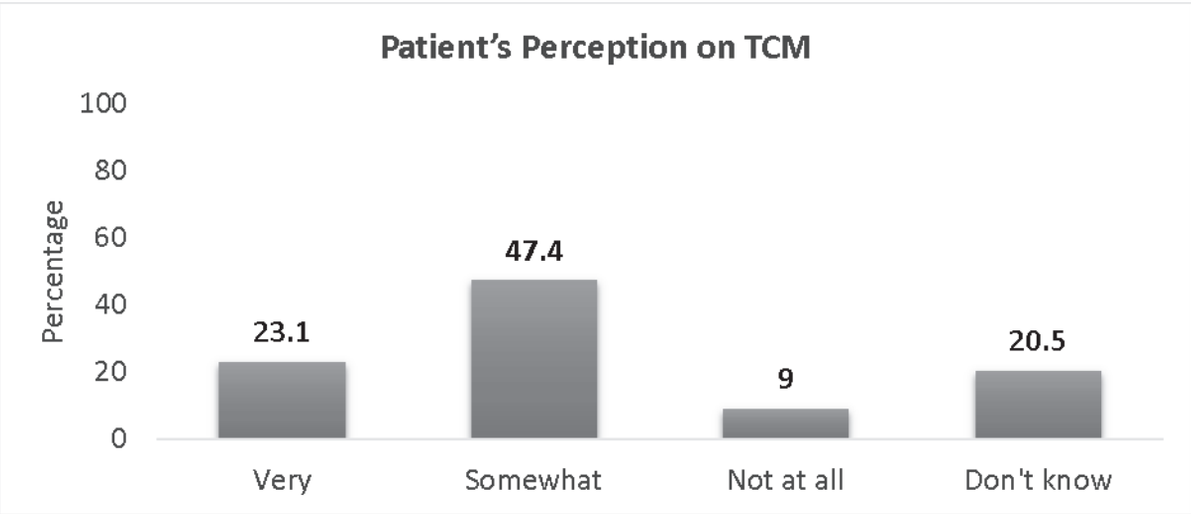


Figure 3: Patient's perception on taking TCM

Experience of side effects

Only 2 participants (2.6%) reported experiencing undesirable side effects, such as diarrhea, after taking TCM.

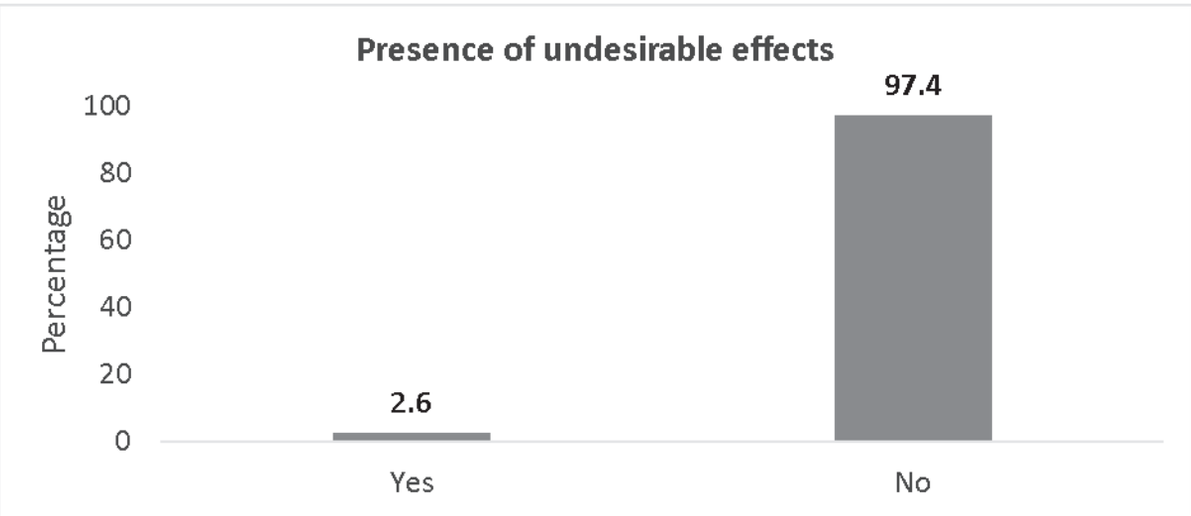


Figure 4: Presence of undesirable effects

Factors/variables influencing the use of TCM

Age

The data concerning age and the use of TCM indicate that the mean age of individuals taking TCM was 55.0 years, with a percentage of 18.18. In contrast, the mean age of those not taking TCM was slightly lower at 53.5 years, with a percentage of 18.48. The associated *p*-value for this comparison was 0.516, suggesting that there is no statistically significant difference in the mean ages

between the two groups. This implies that age, as measured in this study, does not appear to be a decisive factor influencing the decision to use TCM. Individuals of varying ages seem equally likely to choose TCM as an alternative approach, and the observed difference in mean ages could be attributed to random variation rather than a meaningful pattern.

Gender

The analysis revealed that among participants who reported using TCM, 52 (66.7%) were male and 26 (33.3%) were female. In contrast, among those who did not use TCM, 170 (74.6%) were male and 58 (25.4%) were female. There was no statistically significant difference in TCM usage between males and females in the study population (p=0.177).

Race

Moreover, the data reveals a significant relationship between race and the usage of TCM. Among TCM users, the majority were Malays (79.5%), followed by Chinese (19.2%) and individuals of other races (1.3%). None of the Indian participants reported using TCM. Among non-TCM users, the majority were also Malays (86.8%), followed by Chinese (8.3%), Indians (3.1%), and individuals of other races (1.8%). There was a statistically significant association between Chinese participants and the use of TCM (p=0.029).

Presence of medical conditions

Additionally, the data underscores the relationship between medical conditions and the utilization of TCM. Among participants who reported using TCM, 83.3% had underlying medical conditions, while 16.7% did not. In comparison, 81.1% of non-TCM users had medical conditions, and 18.9% did not. There was no statistically significant association between the presence of medical conditions and the decision to use TCM (p=0.665).

Types of medical conditions

Lastly, the utilization of TCM among patients with various types of medical conditions was analyzed. The provided data highlights a significant association between patients with and without neurology conditions and their respective usage of TCM. Among patients with neurological conditions, only a small percentage (1.5%) used TCM, while a higher proportion (12.3%) did not. Conversely, among patients without neurological conditions, the majority (98.5%) used TCM, with a smaller percentage (87.7%) not using it. There was a statistically significant relationship between the presence of neurological conditions and the use of TCM (p=0.011).

DISCUSSION

Prevalence of TCM usage

The prevalence of TCM usage among our respondents (25.5%) was lower than the national prevalence reported in Malaysia, which stood at 55.6% based on a nationwide study by Siti et al. (2009). Similarly, studies conducted in Japan (Yamashita, 2002) and Singapore also recorded a much higher prevalence of TCM usage, with rates reaching 76% in their respective populations.

Types of TCM used

A nationwide baseline study on TCM conducted in 2009 by Siti et al., reported that herbs and herbs-based products were the most used type of TCM. A later study by Kew et al. (2015) conducted among respondents with cardiovascular risk factors also revealed the same result. The same finding was not reflected in our study, with vitamins and supplements being the most commonly consumed. This might reflect the changing trend of consumers' preference from herbs products to vitamins/supplements due to aggressive marketing from manufacturers in more recent years,

Indications of patients taking TCM

Our study found that most respondents used TCM primarily for general well-being rather than as an adjunct treatment for acute or chronic conditions. This finding aligns with the study by Kew et al. (2015), conducted in the state of Pahang. Interestingly, a contrasting result was reported by Othman et al. (2012) in Sabah, where 66.5% of respondents used TCM specifically for disease treatment. This difference may reflect underlying cultural variations in TCM usage between the two states.

There is a concern that patients with underlying medical conditions might take TCM as a substitute for conventional medications. This is especially significant with chronic conditions that require compliance with medications. Kew et al. (2015) found that almost 30% of their respondents took TCM as a substitute for conventional medications for their underlying medical conditions (hypertension, diabetes mellitus, or dyslipidemia). The authors express their worries that those who take TCM as substitutes might have sub-optimized treatment for their diseases and pose a significant public health issue.

Perceptions on TCM

Nearly half of the respondents (47.2%) perceived TCM to be somewhat helpful for general well-being in conjunction with their conventional medications.

Side effects of TCM

The perception of TCM being safe, “natural” and posing no risk of side effects might affect the safety and efficacy of patients’ current treatment of their medical conditions. A study conducted in Switzerland by Marian et al. (2008), found that the majority of their respondents (n=3065) believe homeopathy is safe and only 1.9% of their respondents who consume homeopathy reported side effects.

Patients with underlying conditions who are taking both conventional medications and TCM should be encouraged to disclose the information to their healthcare provider. This is because of the concern of drug-drug interactions, as this might affect the safety and efficacy of their existing treatment. For instance, some very common TCM such as garlic and ginkgo biloba are known to have significant interactions with the anticoagulant drug, warfarin, causing increased bleeding risk (Elmar et al., 2007). Healthcare providers should be educated to recognize and monitor such important interactions. Fortunately, only 2 (2.6%) of our respondents reported side effects (mild diarrhea) which was self-limiting.

Influence of variables

Our study showed differences in age, gender, and the presence of medical conditions do not influence TCM usage among our respondents. This is in line with the study from Kew et al. (2015) which did not find any defining characteristics of which subgroups of their respondents are more likely to consume TCM. For comparison, a study conducted in Indonesia found that older age, socioeconomic status, religion, urban residence, and poor physical and mental health status were significantly associated with the use of traditional and complementary medicine. Understanding which population groups are more likely to use TCM is both interesting and important, as it helps identify target audiences for education and awareness efforts related to TCM consumption.

Limitations of the study

This study is subject to several limitations that may affect the interpretation of the findings. Firstly, the study period coincided with the COVID-19 outbreak, posing challenges to conducting comprehensive interviews with patients regarding their use of traditional medications. Due to restrictions and safety concerns related to the pandemic, researchers encountered difficulties in obtaining detailed information from participants regarding their traditional medication use, potentially limiting the depth of insights into TCM practices. Additionally, the study is limited by the availability of data and information on drug-supplement interactions. Given the complexity of interactions between traditional supplements and conventional medications, a thorough understanding of potential interactions is crucial for assessing the safety and efficacy of TCM use. Moreover, the reliance on self-reported responses introduces the possibility of recall bias or under reporting, which may further limit the

accuracy of the findings. The study has also lacked sufficient data or resources to comprehensively evaluate drug-supplement interactions, thereby limiting the ability to draw definitive conclusions about the risks and benefits associated with TCM use in conjunction with conventional medications. These limitations underscore the need for future research efforts to address these challenges and enhance our understanding of TCM practices in diverse healthcare settings.

CONCLUSION

Vitamins and supplements emerge as the predominant type of TCM utilized by our respondents, reflecting a widespread inclination towards natural remedies for health maintenance. Notably, most participants reported using TCM primarily to enhance their overall well-being, rather than specifically for managing existing medical conditions. This trend underscores a growing interest in preventive healthcare practices and holistic approaches to wellness among the surveyed population.

Furthermore, our findings reveal that approximately half of the respondents perceive TCM supplementation as beneficial for their general well-being when used alongside conventional medications. This suggests a positive perception of TCM's potential synergistic effects with mainstream healthcare interventions, highlighting the importance of integrating traditional and complementary therapies into comprehensive treatment plans.

Despite the generally favorable views on TCM usage, it is noteworthy that only a minority of respondents reported experiencing side effects associated with TCM consumption. While this suggests a relatively low incidence of adverse reactions, it is crucial to acknowledge the potential risks of TCM, particularly concerning interactions with conventional medications. Given the complex nature of drug-herb interactions, patients are encouraged to engage in open dialogue with their healthcare providers regarding their TCM usage habits. This proactive communication enables healthcare practitioners to offer informed guidance, monitor for potential adverse effects, and ensure the safe and effective integration of TCM into patients' overall healthcare regimens.

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EDUSMILE PROJECT: EMPOWERING *TABIKA PERPADUAN* EDUCATORS IN ORAL HEALTH EDUCATION IN KULIM DISTRICT

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ABSTRACT

Background: *EduSmile* is a community-based oral health initiative grounded in Participatory Action Research (PAR) principles, aiming to strengthen oral health education through the empowerment of preschool educators. Focusing on *Tabika Perpaduan* kindergartens in Kulim District, the project addressed the lack of structured oral health knowledge and practices among teachers, intending to promote lifelong healthy oral hygiene habits among young children.

Methodology: This project adopted a participatory action research design involving cycles of planning, action, evaluation, and replanning. An Oral Health Education Kit was developed which included visual and digital tools. An Oral health seminar was conducted to enhance educators' knowledge and skills. Teachers then implemented oral health activities in their respective classrooms, including toothbrushing, self-mouth inspection, and the creation of Dental Health Corners. Teaching aids were created to make interactive oral health education. Monitoring and feedback mechanisms were established through online reporting and site visits, promoting continuous improvement.

Results: A total of 43 educators across 23 preschools participated, impacting 529 students. Post-intervention findings showed improvements in teachers' oral health knowledge (from 63% to 78.9%) and awareness of students' oral health status (from 93.3% to 100%). Daily toothbrushing routines increased significantly (from 21.7% to 60.9%), while positive student attitudes toward oral health reached 88%, as reported by educators.

Conclusion: The participatory and collaborative approach of *EduSmile* proved effective in integrating oral health education within preschool settings. This model demonstrates the sustainability and scalability of teacher-led health promotion initiatives in early childhood education.

Keywords: Participatory Action Research, teacher empowerment, *Tabika Perpaduan*, oral health promotion, preschool education.

INTRODUCTION

The *EduSmile* project is an initiative introduced in 2024 to enhance oral health education and promotion among preschool children, specifically in *Tabika Perpaduan* throughout the Kulim District. The name “EduSmile” is inspired by the term “Educator Smile,” symbolizing the encouraging and empowering role of educators in promoting lifelong healthy habits among young children.

Oral health plays a vital role in overall health, influencing not only physical well-being but also psychological, social, and academic development. Dental caries among preschool children were prevalent worldwide and had a significant impact on children and their families (Chen et al., 2024). It can lead to pain, discomfort, difficulties in eating and speaking, and significantly reduce a child’s quality of life. The World Health Organization (WHO) has established age five as the global average to determine children's oral health status. In Southeast Asia, a 2016 study reported the prevalence of dental caries in children aged five to six as 49.0% in Singapore, 59.0% in Brunei, 79.0% in Thailand, and 89.0% in the Philippines (Duangthip et al., 2017). In Malaysia, the National Oral Health Survey of Preschool Children (NOHPS) 2015 reported that 71.3% of five-year-old children had dental caries. Such alarming statistics demonstrate the need for more effective preventive strategies beginning in early childhood.

Preschool educators are influential in shaping children's behaviours and habits. However, several studies have indicated that many teachers in Malaysia have only a moderate understanding of oral health. A study conducted by Shahida et al. (2014) in Kuala Muda, Kedah, revealed that while preschool teachers acknowledged the importance of oral health, many lacked accesses to proper training or structured modules. These gaps highlight the need for a comprehensive, educator-friendly approach that supports teachers in becoming effective health promoters.

The *EduSmile* project was conducted in response to this need. The project aligns with national and international strategies, including the National Oral Health Strategic Plan (NOHSP) 2022–2023 and the National Oral Health Plan (NOHP) 2030. The NOHP aims to ensure that at least 50% of six-year-old children are caries-free by 2030. Achieving this target requires structured oral health promotion programs in early childhood education, especially in preschools.

The conceptual foundation of the *EduSmile* project is based on the Ottawa Charter for Health Promotion (1986), which outlines five key action areas: building healthy public policy, creating supportive environments, strengthening community action, developing personal skills, and reorienting health services. The *EduSmile* project supports healthy public policy by translating strategic goals into practical classroom activities. It creates a supportive environment by encouraging schools to adopt daily oral hygiene routines and visual reminders that reinforce healthy habits. The program

promotes community participation by involving a collaboration of Kulim/Bandar Baharu District Dental Health Office and Kulim District National Unity and Integration Office. It also highlights the development of personal skills by offering teachers with knowledge of oral health and brushing techniques that they can showcase and convey to their students. Furthermore, the *EduSmile* project reorients health services from a purely treatment-based approach to one that prioritizes health education, empowerment, and preventive care.

METHODOLOGY

The *EduSmile* project adopted a *Participatory Action Research* (PAR) design study, which is a collaborative, community-based approach that engages participants as active partners in both the design and implementation of the intervention (Figure 1). PAR is particularly suitable for initiatives like *EduSmile* that focus on capacity building, practical application and behavioural change within real-world settings. This approach enabled preschool educators, dental health professionals, and local agencies to work together in identifying oral health issues, co-developing solutions, and integrating them sustainably within the preschool environment. In contrast to conventional interventions, PAR encourages a sense of personal responsibility among those involved, empowering them to influence the program's direction and sustainability. The continuous cycle of planning, action, evaluation and replanning was crucial to the *EduSmile* operations, facilitating continuous improvement informed by realistic input and specific conditions.

The study was conducted among 43 teachers from Tabika Perpaduan in the Kulim District. The main objective was to assess the teachers' knowledge and awareness toward oral health and to determine whether there was any improvement in their understanding and practices, as well as among their students, after an oral health intervention. During the pre-intervention phase, a baseline questionnaire was distributed to the teachers during an oral health seminar to evaluate their existing knowledge and awareness. Following a month period during which oral health activities were carried out in the kindergartens, a post-intervention survey was conducted to gather response and to assess any observable changes in oral health awareness and knowledges among both teachers and students.

One of the components of the *EduSmile* project was the development and distribution of an Oral Health Education Kit (Appendix 1), designed specifically for the preschool context. This kit was the result of a multidisciplinary collaboration involving specialists, dental officers, dental therapists, and community oral health promoters known as *Ikon Gigi Kulim*. The kit featured various engaging and age-appropriate teaching tools, including educational buntings that illustrated proper brushing techniques, A4 posters with motivational hygiene messages, an oral self-inspection schedule, and a digital educational tool named *Digi-Dent*. These tools were designed to enhance both educator capability and student interest by bridging the gap between

theoretical knowledge and practical implementation. The materials were intended to be used and to reinforce key oral health messages in a fun and repetitive way.

The *EduSmile* team organized an established oral health seminar for the educators in Kulim District to strengthen their capacity. The seminar aimed to enhance teacher knowledge, confidence, and communication skills regarding oral health. Facilitated by dental health professionals, the sessions covered essential topics such as causes and prevention of dental health diseases, proper tooth brushing techniques, and effective ways to engage young children in health education. Feedback collected during the seminar helped refine the materials and teaching strategies that were later integrated into classroom practices. The seminar also promoted networking and peer support among educators from different kindergartens, strengthening the sense of community and shared purpose.

Following the seminar, educators were guided through the process of establishing dedicated oral health corners within their classrooms. These corners served as important points for toothbrushing routines and included customized storage units for toothbrushes and toothpaste. Teachers displayed the educational buntings and posters prominently in these areas to reinforce daily messages about brushing habits and self-care. Mirrors were installed to support oral self-inspections, which were supervised and guided by the teachers. An oral self-inspections schedule was included in the Oral Health Kit, enabling teachers to record the dates when the activity was conducted with students. These routines were designed to be both fun and educational, helping children internalize healthy habits through repetition and observation.

Monitoring and supervision were essential components of the *EduSmile* project, ensuring that the activities were not only implemented but also sustained effectively over time. The School Dental Service conducted regular visits while the *EduSmile* project committee carried out monitoring and documentation through an online platform. Teachers were required to upload documentation such as photographs of activities, brief reports and feedback forms. The use of an online platform enabled the efficient management of multiple schools while minimizing the need for physical site visits. The system served as a record for best practices, encouraging teachers training from other educators and promoting the implementation of successful practices implemented in other kindergartens.

To sustain motivation and celebrate the efforts, the *EduSmile* project capped the publication of *Bintang Gigi* (Appendix 2). This publication showcased photographs and creative projects from the participating kindergarten. It served both as a motivational tool and a form of recognition for the dedication and creativity demonstrated by the educators. The magazine was distributed widely among kindergarten and stakeholders, reinforcing the visibility of the initiative and its impact on the ground. It also encouraged healthy competition and inspired continuous

improvement among kindergartens. The recognition helped reinforce the value of the teachers' roles as oral health models within their communities. Furthermore, the publication acted as a record of achievement and a reference point for future program expansion in other districts or states. Through this approach, the *EduSmile* project created a culture of appreciation and shared learning which is vital for long-term sustainability.

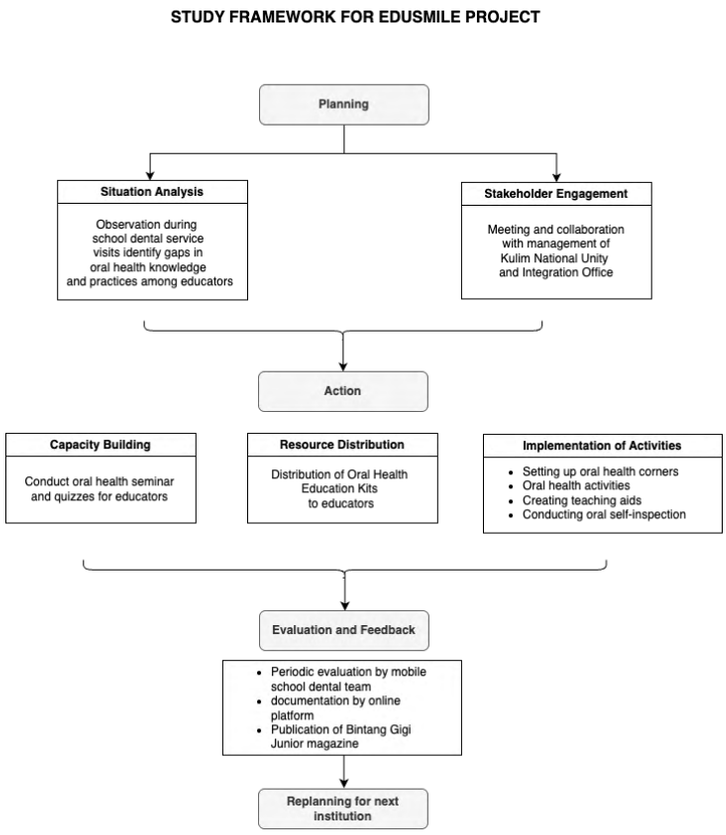


Figure 1: EduSmile Project's Framework

RESULTS

As stated in Table 1, the EduSmile project led to notable improvements across several key oral health indicators among kindergarten teachers and students. Teacher attendance at oral health workshops increased from 72.1% to 100% and their attendance at dental clinics rose from 62.7% to 74.4%, indicating improved health-seeking behavior. Educators' knowledge about oral health showed an increase from 63% to 78%, while awareness of students' dental health status rose to 100% from the initial 93.3%. Moreover, all kindergartens (100%) conducted oral health activities post-intervention and 88.3% of students were reported to have a positive attitude toward oral health, a new and encouraging indicator.

As mentioned in Table 2, there was a marked change in the frequency of toothbrushing routines practiced in kindergartens after the EduSmile intervention. The percentage of kindergartens conducting daily toothbrushing increased markedly from 21.7% to 60.9%, reflecting a positive behavioral shift. Those that brushed only once a week reduced from 47.8% to 39.1%, and those that rarely conducted brushing activities dropped from 30.5% to 0%. Notably, none of the kindergartens reported a complete absence of toothbrushing practices during either period, indicating a baseline commitment to oral hygiene.

Table 1: Comparison of Pre- and Post-Intervention Data (N =43)

Indicator	Pre-Intervention *n* (%)	Post-Intervention *n* (%)
Attendance to Oral Health Workshop	31(72.1)	43(100)
Attendance to Dental Clinic (Teachers)	27(62.7)	32(74.4)
Knowledge about Oral Health (Quiz Accuracy)	63%	78%
Awareness about Students' Dental Health Status	40(93.3)	43(100)
Oral Health Activities Conducted in Kindergarten	41(95.6)	43(100)
Positive Student Attitude toward Oral Health	-	38(88.3%)

Table 2: Frequency of Toothbrushing Routine at Kindergarten (N =23)

Frequency	Pre n (%)	Post n (%)
Every Day	5(21.7)	14(60.9)
Once a Week	11(47.8)	9(39.1)
Rarely	7(30.5)	0(0.0)

DISCUSSION

The *EduSmile* project demonstrated a notable improvement in several key indicators related to oral health knowledge, practices and attitudes among preschool educators and students in Kulim District. As seen in Table 1, attendance of educators at oral health workshops and dental clinic visits increased after the intervention. The 100% attendance rate at the oral health workshop post-intervention reflects the strong engagement and commitment of educators toward improving their capacity in oral health promotion. Likewise, the increase in attendance at dental clinic indicates a shift toward better self-care and professional engagement, which is essential as teachers serve as role models for young children.

In terms of knowledge and awareness, only 63% of educators demonstrated adequate oral health knowledge, which rose to 78% post-intervention. This improvement can be attributed to the oral health seminar. The increase in awareness of students' oral health status from 93.3% to 100% is significant because it reflects a heightened level of attention paid by educators to their students' oral conditions. When teachers are more aware, they are more likely to detect issues early and seek appropriate care, thus supporting early intervention and preventive practices. These outcomes align well with the principles of health promotion outlined in the Ottawa Charter, particularly on the development of personal skills and creation of supportive environments.

The implementation of oral health activities in kindergartens also saw a complete uptake. This means that all participating schools actively incorporated oral health into their routines, signifying a culture shift towards preventive dental care in early education settings. One of the most notable post-intervention outcomes was: positive student attitude toward oral health, measured at 88%, which is crucial for long-term habit formation. The positive attitudes observed among children not only demonstrate the effectiveness of the teaching approach but also indicate that the incorporation of interactive, age-appropriate materials enhanced the enjoyment and retention of oral health education.

Table 2 further supports these findings by showing a marked change in the frequency of toothbrushing routines at kindergartens. This is a clear indication that the *EduSmile* project successfully embedded daily oral hygiene practices into the school day, reinforcing healthy behaviour at a formative age. This project's success is demonstrated by brushing frequencies in normalizing daily brushing routines across all participating schools. This elimination of "rarely" brushing habits reflects a major behavioural transformation and suggests that oral hygiene has become a consistent and visible part of the school culture.

Overall, the results highlight the effectiveness of a structured, school-based oral health program that empowers educators with the tools and confidence to promote dental hygiene among children. The positive outcomes observed in both knowledge and behaviour among teachers and students suggest that the *EduSmile* approach could serve as a model for replication in other districts. The integration of oral health education into daily classroom routines, supported by ongoing monitoring and creative teaching aids, was key to the project's success. Future initiatives may benefit from including parental engagement to reinforce these practices at home. Continuous follow-up, refresher training, and feedback mechanisms will also be important in ensuring the sustainability of these positive changes. The success of the *EduSmile* reinforces the critical role of early childhood settings in shaping lifelong health habits and contributes to broader public health goals outlined in national oral health plans.

CONCLUSION

The *EduSmile* project demonstrated a structured and sustainable approach to enhancing oral health awareness among preschool children by empowering educators as key health promoters. By offering standardised instructional materials, practical instruction and the establishment of interactive oral health corners, the project strengthened the delivery of accurate oral health messages within the early education setting. Children's oral hygiene habits and awareness are expected to improve over time because of consistent, school-based activities. This initiative also emphasizes that dental personnel cannot *work in silos* to achieve meaningful public health outcomes. Strong collaboration with educators, community leaders, and other stakeholders is essential to ensure the continuity and effectiveness of oral health promotion. To create long-lasting effects and promote a preventative culture from a young age, a multi-sectoral strategy is essential.

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APPENDICES



Appendix 1: EduSmile Project's Oral Education Toolkit



Appendix 2: EduSmile Project's Magazine (Bintang Gigi Junior)

PREVALENCE OF *Salmonella* spp. IN POULTRY ALONG THE SUPPLY CHAIN

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ABSTRACT

Introduction: *Salmonella* is the most common pathogenic microorganism that leads to foodborne diseases in the poultry industry. Contamination can occur at various stages along the poultry supply chain, starting from the farm, processing establishment, and retailer. This study aimed to determine the prevalence of *Salmonella* spp. in poultry along the supply chain using polymerase chain reaction.

Methods: The prevalence of *Salmonella* spp. in the poultry supply chain was determined by analyzing 156 samples that were collected at different stages in the farm, processing establishment, and retailer. *Salmonella* spp. was isolated by the conventional culture-based method. Polymerase chain reactions were carried out to confirm *Salmonella* spp. from the presumptive black colony, and consequently, the samples were amplified using a PCR reaction mixture.

Results: The PCR results showed that 13 samples from the farm, 7 samples from the transport crate, 5 samples from the processing establishment, and 14 samples from the retailer confirmed for *Salmonella* spp. strain.

Discussion: The study confirmed that the prevalence of *Salmonella* spp. in poultry along the supply chain was 25% (39/156). Previous prevalence data from Malaysia reported 100% prevalence of *Salmonella* spp. from samples collected at small-scale processing establishments and retailers.

Conclusion: The data obtained in this study may be useful for tracing possible foodborne outbreaks of *Salmonella* in Malaysia and may aid in the development of surveillance programs and additional standards for poultry farms, poultry processing establishments, and poultry retailers.

***Keywords*:** Prevalence, poultry supply chain, *Salmonella* spp., polymerase chain reaction.

INTRODUCTION

Salmonellosis is a foodborne illness caused by the ingestion of *Salmonella* spp. *Salmonella* spp. is one of the leading salmonellosis communicable disease worldwide (Antunes, Mourão, Campos, & Peixe, 2016a; Ha et al., 2018; Zwe et al., 2018). Communicable Disease Center (CDC) reported that every year in the United States, there are about 1.35 million salmonellosis infections with 26,500 people hospitalized and 420 deaths. *Salmonella* spp. is a major foodborne pathogen that causes millions of cases of salmonellosis, billions of cases of gastroenteritis, and thousands of cases of death (Goni, Effarizah, & Rusul, 2018; Ni et al., 2017). European Food Safety Authority (EFSA) reported that in 2016, there were 96,039 *Salmonella* spp. cases from 28 state members with a notification rate of 20.4 per 100,000 population (Koutsoumanis et al., 2019). *Salmonella* spp. is a pathogenic bacteria that can cause infection at low doses (Tan et al., 2018). The incidence of salmonellosis in Malaysia has increased in the past ten years. *Salmonella* spp. occurrence in food comes from many sources; however, human salmonellosis incidence is mostly related to the consumption of contaminated poultry and poultry products.

Ministry of Health reported that the eastern state of Malaysia was an endemic area for thypoid disease, from 2000-2016, and the thypoid fever in Malaysia has reduced to 1 per 100,000 population. A study in Kelantan state showed a risk of thypoid fever infection occurred among people who bought food from food stalls, ate packaged food without reheating, and ate uncooked meals (Nair et al., 2017). *Salmonella* spp. can be transmitted along the poultry supply chain from the farm, processing plant and retailer (Shang et al., 2019). There are many routes through which *Salmonella* spp. can be spread in the poultry farm. Poor cleaning and disinfection of poultry houses, contaminated litter, water, dust, equipment, feed, and the presence of carriers can lead to *Salmonella* spp. infection (Fagbamila et al., 2018). Non-typhoidal *Salmonella* can live for several months inside the poultry gastrointestinal tract. Furthermore, this non-typhoidal Salmonella can survive for more than two years in litter and feed. Therefore, poultry litter is a major reservoir for non-typhoidal *Salmonell*a (Voss-Rech et al., 2019). In later stages of processing, *Salmonella* can be introduced into the poultry processing line throughout the production stages. High moisture environment in the poultry processing establishment is ideal for the growth and colonization of pathogenic microorganisms, therefore favorable for *Salmonella* growth (Nidaullah et al., 2017). As in Malaysia, there is no study has been carried out on the prevalence of *Salmonella* spp. in poultry along the supply chain.

METHODOLOGY

Sample collection

Samples collection involved three stages of the poultry supply chain: (i) farm, (ii) processing establishment, and (iii) retailer. Samples were collected from the supply chain of one factory located in Negeri Sembilan. A total of 159 samples were taken in the field.

Salmonella spp. *detection using Polymerase Chain Reaction (PCR)*

Samples were streaked on the Xylose Lysine Decarboxylase agar plate. The growth of presumptive colonies of black colonies was extracted for the DNA and analyzed by using polymerase chain reaction with a specific primer pair. The presence of the interest band was compared to the DNA molecular marker ladder (100bp). The sample was confirmed as positive when the band appeared at 140 base pairs for set A primers and at 780 base pairs for Set B primers (Food Safety and Quality Division, Ministry of Health Malaysia, 2013).

Result interpretation

Descriptive data analysis was conducted, and results interpreted based on the positive *Salmonella* spp. strain detected in samples (Food Safety and Quality Division, Ministry of Health Malaysia, 2013).

RESULT AND DISCUSSION

Polymerase chain reaction was carried out to confirm *Salmonella* spp. in the 86 samples amplified using the PCR reaction mixture. The results showed that 13 samples from the farm, 12 samples from the processing establishment, and 14 samples from the retailer confirmed for *Salmonella* spp. The confirmed farm's samples consist of five from workers' boots, one drinker, one feeder, and six poultry's litter. Distribution of confirmed *Salmonella* spp. samples from the processing establishment were six transport crates, one slaughtering and bleeding, one de-feathering, and four whole chickens. **Table 1** shows the distribution of *Salmonella* detected from poultry farms, processing establishments, and retailers.

Table 1: The results for samples detected with *Salmonella* spp., samples collected at the farm, processing establishment, and retailer.

Sample description	Farm		Processing establishment		Retailer		Total +ve *Salmonella* spp.	Prevalence percentage
	Number of samples	Number of samples detected with *Salmonella* spp.	Number of samples	Number of samples detected with *Salmonella* spp.	Number of samples	Number of samples detected with *Salmonella* spp.		
Litter	80	6					6	14.1%
Drinker	3	1					1	
Feeder	3	1					1	
Worker's boots	6	5					5	
Transport crate			12	6			6	35.3%
Electrical stunning			1					
Slaughtering and bleeding			3	1			1	
Scalding			1					
De-feathering			3	1			1	
Evisceration			3					
First washing			1					
Second washing			1					
Deboning			3					
Whole chicken			6	4			4	
Chill whole chicken					30	14	14	46.7%
Total number of samples	92	13	34	12	30	14	39	**25%**

The study confirmed that the prevalence of *Salmonella* spp. in poultry along the supply chain was 25% (39/156). The distribution prevalence of *Salmonella* in the poultry supply chain category was 14.13% of poultry farms, 35.29% of processing establishments, and 46.7% of retailers. In this study, the retailer has the highest prevalence at, 46.7% followed by processing establishment 35.29%, and poultry farm with 14.13%.

EFSA (2019) conducted an assessment on *Salmonella* control in poultry at the farm level. The assessment discusses the contributing factors of *Salmonella* occurrence in poultry flocks. The study reported that the highest *Salmonella* prevalence with 3/6 samples from boots swabs in one farm. Prevalence of *Salmonella* in laying hens from 2014 until 2016 was 0.8%, 0.9% and 1.3%, respectively. It was stated that swab

samples of the caecum in broiler flocks at the farm level in Spain reported 29/802 samples positive for *Salmonella.* Another prevalence study on the occurrence of *Salmonella* Enteritidis in laying hen cages and non-cage systems was reported in six countries (Koutsoumanis et al., 2019). A previous study prevalence and characterization of *Salmonella* in two integrated broiler operations in Korea, reported that 15.3% of samples from the poultry farm tested positive with *Salmonella* (Ha et al., 2018). The study suggested that the route of *Salmonella* contamination started with infected eggs at the hatchery; these eggs get contaminated from the unhygienic environment and infected litter (Ha et al., 2018). *Salmonella* can survive outside the gut of broilers for several years in dry and humid environments; these biological characteristics make it common for *Salmonella* to grow aerobically or anaerobically outside the host and contaminate the feed mills and hatcheries (Koutsoumanis et al., 2019).

Although the present study found the prevalence of *Salmonella* spp. in the farm is low at 14.2%, one-day-old broilers are vulnerable and prone to getting infected with *Salmonella* from the contaminated litter and human factors, i.e., workers' boots. This is because 6/80 litter samples and 5/6 workers' boots were confirmed for Salmonella spp. Persistent *Salmonella* will be carried over along the supply chain. Poor management, a lack of cleaning and sanitation program, contaminated feed and water, and a lack of biosecurity control measures might be contributing factors for *Salmonella* transmission in the poultry farm (Bucini et al., 2019).

The prevalence of *Salmonella* spp. in the processing establishment was 35.29%. Shang et al. (2019) reported a lower prevalence of *Salmonella* in processing establishments in South Korea at 12.2%. However, previous prevalence data from Malaysia reported 100% prevalence of *Salmonella* spp. from samples collected at small-scale processing establishments and retailers (wet market). Samples include poultry parts, transport crate, cage, cutting board, blade, washing water, floor, and working table (Nidaullah et al., 2017). Improperly cleaned surfaces will promote biological soil formation. In the presence of water, there will be the formation of biofilm, which might contain pathogenic microorganisms. Therefore, *Salmonella* can easily attach and form biofilms on surfaces found in processing establishments, including plastic, cement, and stainless steel. Similar findings were reported in a study on the formation of persistent *Salmonella* biofilm in processing equipment that can adapt and has a long survival age (Chuah et al., 2018a).

The transport crate that was used to carry the broilers was detected with *Salmonella* spp. (6/12). A previous study in a small-scale processing establishment in northern Malaysia reported 4/4 (100%) transport crate samples detected with *Salmonella* spp. (Nidaullah et al., 2017). Transport crates that carry broilers might transmit pathogenic microorganisms. The broiler will rub against the transport crate and each other. In addition, carcasses shared the same transport crate (Shang et al., 2019). Our present study found that the knife that was used for slaughtering detected with

Salmonella spp. (1/3). Nidaullah et al. (2017) reported 100% (14/14) prevalence of *Salmonella* spp. on the samples collected from the knife.

Scalding samples in this study were not detected with *Salmonella*. The scalding process step involves heat treatment at 60-65^{o}C. Similar findings were also reported by Nidaullah et al. (2017), where no *Salmonella* contamination was found at this process step. This is probably due to treatment with high temperatures. Scalding process significantly reduces aerobic plate count bacteria, coliform, *Salmonella,* and Campylobacter populations on poultry carcasses (Blevins et al., 2017). *Salmonella* cannot survive at temperatures above 50^{o}C (Eng et al., 2015). In the present study, 1/3 samples from the de-feathering process step reported positive for S*almonella* spp. However, Nidaullah et al. (2017) reported that 11/12 samples collected from the de-feathering machine were positive for *Salmonella* spp. Insufficient cleaning and disinfection activities might promote the formation of persistent *Salmonella* biofilm on the rubber finger of the machine (Chuah, Shamila Syuhada, Mohamad Suhaimi, Farah Hanim, & Rusul, 2018b; Ha et al., 2018; Nidaullah et al., 2017).

Washing water samples in this study did not detect *Salmonella*. This could probably be due to the water used for washing in this processing establishment was treated with chlorine. Jeong et al. (2018) studied the relationship between different treatments of chlorine on poultry in a processing establishment. The study showed that even with a high concentration of chlorine treated during the chilling process in the processing establishment, it only gives a small probability reduction to get infected with microorganisms (Jeong et al., 2018). The present study did not detect *Salmonella* during the deboning process. This is probably due to the process being automated by a machine and less manual work handling; therefore, less susceptible to cross-contamination.

In the present study, the prevalence of *Salmonella* spp. in poultry at retailers is 46.7%. The finding is higher than Basri et al. (2016), who reported the prevalence at 20.8% but lower than Nidaullah et al. (2017) at 84.8%. The difference in prevalence between the reported data and previous studies is probably due to samples of poultry meat were from different retailers. Poultry meat samples in Nidaullah et al. (2017) were from a wet market, while in the present study, samples were collected at a hypermarket. Wet market retail concepts were outdoors which packed with peoples. Poultry were slaughtered in wet market therefore the environment, knife, chopping boards, drums, water, utensil, floors and the poultry meat were highly contaminated with *Salmonella* (Nidaullah et al., 2017; Shafini et al., 2017; Wang et al., 2015). Chuah et al. (2018a) identified *Salmonella* from poultry sold in the retail market and the environment in northern Malaysia. Environmental samples included contact surfaces to the poultry, which were workers' aprons, chopping board, knife, container, washing basin, bench, drain water, floor, and drain, while poultry samples include whole poultry and cut poultry. The study suggested that the occurrence of *Salmonella* was due to cross-contamination between poultry and the environment.

According to Food Regulations 1985 and Food Hygiene Regulations 2009, poultry meat intended for sale and display at retailers must be kept at all times in a temperature range between -1ºC to 10ºC for chilled poultry meat (Food Hygiene Regulations 2009, 2015). In this study, the poultry meats are sold as chilled meat. However high number of *Salmonella* prevalence at the retailer stage was observed, and this could be due to temperature abuse. It was observed that the retailer displayed the poultry meat in bulk on a countertop with flake ice beneath it; no ice flakes topped the poultry meat. Poultry meat that is displayed for sale for a long time will be subjected to temperature abuse; *Salmonella* can grow and multiply rapidly. An increase in *Salmonella* load will deteriorate the poultry meat and is highly dangerous for consumption if not cooked properly. Therefore, the retailer must comply with the temperature requirement for the sale of poultry meat to prevent greater contamination and spoilage of the poultry meat. The transport truck that delivered the chilled poultry meat to the retailer also has to maintain the temperature of the storage at all times between -1ºC to 10ºC (Food Hygiene Regulations 2009, 2015).

Several studies reported the association of farm samples and processing establishments' samples contaminated with *Salmonella*. Cross-contamination *of Salmonella* spp. occurred in the poultry processing establishment starting from the receiving of live broiler, scalding, feather removal, evisceration, washing, and chilling (Sahan et al., 2016). Broilers from the farm carry feces and can contaminate the processing chain. It is important to study the routes of *Salmonella* spp. contamination at various stages of the poultry processing to ensure the safety and quality of the poultry. As mentioned, transport crates that carry broilers might transmit pathogenic microorganisms. The broiler will rub against the transport crate and each other. In addition, carcasses shared the same transport crate (Shang et al., 2019). In later stages of processing, *Salmonella* can be introduced into the poultry processing line throughout the production stages. High moisture environment in the poultry processing establishment is ideal for the growth and colonization of pathogenic microorganisms, therefore favorable for *Salmonella* growth (Nidaullah et al., 2017). However, there was a lack of studies to associate the contamination from different stakeholders along the poultry supply chain.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study confirmed that the prevalence of *Salmonella* spp. in poultry along the supply chain was 25%. The study found contamination of *Salmonella* in litter, drinker, feeder, worker's boot, transport crate, slaughtering and bleeding, de-feathering, whole chicken and chilled whole chicken from retailer; showed that *Salmonella* contamination can occur along the supply chain. This indicates a need to develop establish surveillance programs with additional standard for poultry farm, poultry processing establishment and poultry retailer to assure the produce is safe along the

supply chain and prevent occurrence of Salmonellosis outbreak among Malaysia population. It is the first preliminary report on the prevalence of *Salmonella* spp. along the supply chain in Malaysia.

Recommendation

Multi-refine approach to reduce the occurrence of *Salmonella* spp. in the poultry supply chain is needed, as in Malaysia, there is no available open data on food poisoning cases, the details on the etiological agent, the suspected food involved, and the root cause of the outbreaks. Understanding risk factors and routes of *Salmonella* contamination along the poultry supply chain would provide knowledge on how to control the contamination from occurring. Epidemiological surveillance activities along the poultry supply chain can identify the vehicles and contributing factors of *Salmonella* contamination and *Salmonella* infection in humans. An epidemiological approach will provide more data to evaluate the current preventive measures being practiced at different supply chain stages. The Hazard Analysis Critical Control Point (HACCP) approach can be applied in the poultry processing establishment. HACCP is applicable throughout the food chain. Further study to isolate the *Salmonella* spp. Salmonella serotyping type should be carried out to identify serovar species, as different serovar species will result in different pathological effects on humans. There is still a lack of information on the relationship between routes of *Salmonella* contamination from the farm, the processing establishment, and the retailer. This information would be significant to control possible contamination from occurring along the supply chain activities. The data obtained in this study may be useful for tracing possible foodborne outbreaks of *Salmonella* in Malaysia and may aid in the development of surveillance programs and additional standards for poultry farms, poultry processing establishments, and poultry retailers.

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STATUS OF FORMALDEHYDE MIGRATION LEVEL IN MELAMINE WARE SOLD IN KEDAH STATE MARKETS

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ABSTRACT

Background: Melamine-formaldehyde resins are widely used in the production of durable kitchenware and tableware due to their hardness, thermal stability and cost-effectiveness. However, concerns have arisen regarding the migration of residual monomers particularly formaldehyde, from this product into food, potentially posing health risks to consumers. The International Agency for Research on Cancer (IARC) classifies formaldehyde as a Group 1 carcinogen. This study aims to determine the level of formaldehyde migration from melamine ware available in Kedah state markets and evaluate whether these products comply with established safety limits.

Methodology: 30 samples of melamine ware were collected in November 2024 from the Kota Setar, Kubang Pasu, Kuala Muda and Kulim districts in Kedah. The samples varied in size, shape and type of shops with different brands sampled separately. Standard sampling procedures were followed and the samples were sent to the Selangor Food Safety and Quality Laboratory (FSQL) for analysis. High-Performance Liquid Chromatography (HPLC) was used for testing. Descriptive analysis was performed to interpret the results.

Results: Out of the 30 samples, 30% exceeded the Specific Migration Limit (SML) established by the Commision Regulation (EU) No 10/2011 which is 15 mg/kg or equal to 2.5 mg/dm², while 70% had results below the SML. Among the samples that exceeded the limit, six (6) samples were obtained from convenience stores, while three (3) samples came from kitchenware shops. Additionally, 38.1% of the non-compliant samples were below 500ml in size, whereas 11.1% were above 500ml. These results indicate a potential risk of formaldehyde exposure for consumers using melamine ware from certain retailers, particularly for small-sized items.

Conclusion: This study confirms the presence of melamine ware exceeding the SML in Kedah state markets. Consumers should take precautions, particularly by avoiding exposure to high temperatures and acidic foods when using melamine ware.

Keyword: Melamine ware, formaldehyde, Specific Migration Level (SML)

INTRODUCTION

Melamine ware, made from melamine-formaldehyde resins, has become one of the most widely used materials in the production of durable and cost-effective kitchenware and tableware. The appeal of melamine products lies in their excellent hardness, thermal stability, resistance to scratching, and affordability compared to alternatives such as ceramic or glass. Because of these qualities, melamine is commonly used for producing a wide variety of everyday kitchen and dining items, such as plates, bowls, trays, and cups, as well as for institutional use in schools, hospitals, and restaurants.

Despite its widespread use, melamine-based products have raised health concerns over time. Specifically, one of the major risks associated with melamine ware is the potential migration of formaldehyde, a residual monomer from the melamine-formaldehyde resin, into food. Formaldehyde is a volatile organic compound, and even low levels of exposure over time can be harmful to human health. The International Agency for Research on Cancer (IARC) has classified formaldehyde as a Group 1 carcinogen, meaning it is a known cause of cancer in humans (IARC, 2012). Prolonged exposure to formaldehyde may lead to serious health issues, including respiratory problems, skin irritation, and an increased risk of cancer, particularly nasopharyngeal cancer (IARC, 2012).

For this reason, regulations have been put in place to limit the amount of formaldehyde that can migrate from melamine products into food. The European Union's Commission Regulation (EU) No 10/2011, which sets specific migration limits (SML), allows a maximum formaldehyde migration of 15 mg per kilogram (mg/kg) or 2.5 mg per square decimeter (mg/dm²) (European Commission, 2011). This standard is intended to ensure that melamine products sold for food contact do not pose significant health risks to consumers. In addition to European regulations, other countries have similar safety standards to protect consumers from harmful levels of chemical migration in food contact materials. However, despite these regulations, there have been concerns over the enforcement and compliance of safety standards, especially in markets where product quality may vary.

Given the potential health risks, this study was designed to evaluate the migration levels of formaldehyde from melamine ware sold in markets within Kedah state, Malaysia. The research aimed to assess whether these products comply with the established safety limits and to identify any potential health risks for consumers. The importance of this study is amplified by the fact that melamine products are often used for serving food at both home and commercial levels, where they may be subjected to varying temperatures, including heat from microwaves, ovens, and exposure to acidic foods, which can increase the likelihood of formaldehyde migration (Gonzalez et al., 2015). Through a systematic analysis of samples from local markets, this study provides valuable insights into the safety of melamine

products and highlights any areas where improvements in manufacturing or regulatory enforcement may be needed to protect public health.

OBJECTIVES

General Objective

To evaluate the level of formaldehyde migration from melamine ware products sold in markets across Kedah state of Malaysia.

Specific Objectives

1) Determine the formaldehyde migration levels in melamine ware samples collected from various retail outlets in Kedah, including convenience stores and specialized kitchenware shops.
2) Assess compliance with the established safety limits for formaldehyde migration, as specified by international regulations, such as the Commission Regulation (EU) No 10/2011, which sets a Specific Migration Limit (SML) of 15 mg/kg or 2.5 mg/dm².
3) Evaluate variations in migration levels based on product size and retail type, to better understand which categories of melamine ware might pose a higher risk to consumer health.

METHODOLOGY

Study Design

This study was a cross-sectional study.

Sample Size

A total of 30 melamine ware samples were collected from a variety of retail environments including convenience shops and kitchenware stores from 4 major districts in Kedah which is Kota Setar, Kubang Pasu, Kuala Muda and Kulim.

Target Population

Melamine ware sold in convenience shops and kitchenware stores in 4 districts in Kedah

Sampling Design

The samples were randomly purchased in 4 districts in Kedah Markets.

Study Setting

Kota Setar, Kubang Pasu, Kuala Muda and Kulim District.

Study Period
The study was carried out from November 2024 until April 2025.

Field Operation

The sampling was carried out between 10th November 2024 and 18th November 2024. The sampling process was carried out by trained and qualified staff. Sampling officers must ensure all samples taken were only melamine ware products. Sampling was done according to standard procedure for formaldehyde determination in melamine ware. Total pieces of each sample should be at least 4 pieces to meet the requirement set up by the laboratory. An appointment with the laboratory was done before the samples were submitted to the lab. Samples were sent to the Selangor Food Safety and Quality Laboratory (FSQL), Klang, Selangor for analysis.

Study Instruments & Variable Definition

The laboratory using High-Performance Liquid Chromatography (HPLC) as the analytical method for detecting and quantifying formaldehyde migration from melamine ware. This laboratory and method of analysis already have been accredited with International Standard (ISO/IEC) 17025:2017.

The analytical results were compared against the Specific Migration Limit (SML) for formaldehyde which is 15 mg/kg of sample weight or 2.5 mg/dm² of contact surface as stipulated in Commission Regulation (EU) No 10/2011.

Data Management & Data Analysis

Data entry was done using Microsoft Excel. The data was checked and cleaned accordingly to eligibility criteria. Descriptive statistical analysis was performed to describe the analysis that meet the objectives for various parameters.

RESULT

Among the 30 samples, 26.7% was collected in Kota Setar and Kulim district market respectively. Following by Kuala Muda and Kubang Pasu district with 23.3% respectively.

Table 1: Sample distribution of melamine ware samples by 4 districts in Kedah

No	District	Number of samples	Percentage (%)
1	KOTA SETAR	8	26.7
2	KUALA MUDA	7	23.3
3	KUBANG PASU	7	23.3
4	KULIM	8	26.7

60% of the melamine ware samples were bought at kitchenware shops compare to convenience stores with only 40%. Melamine ware products at kitchenware shops have a wider selection that convenience shops.

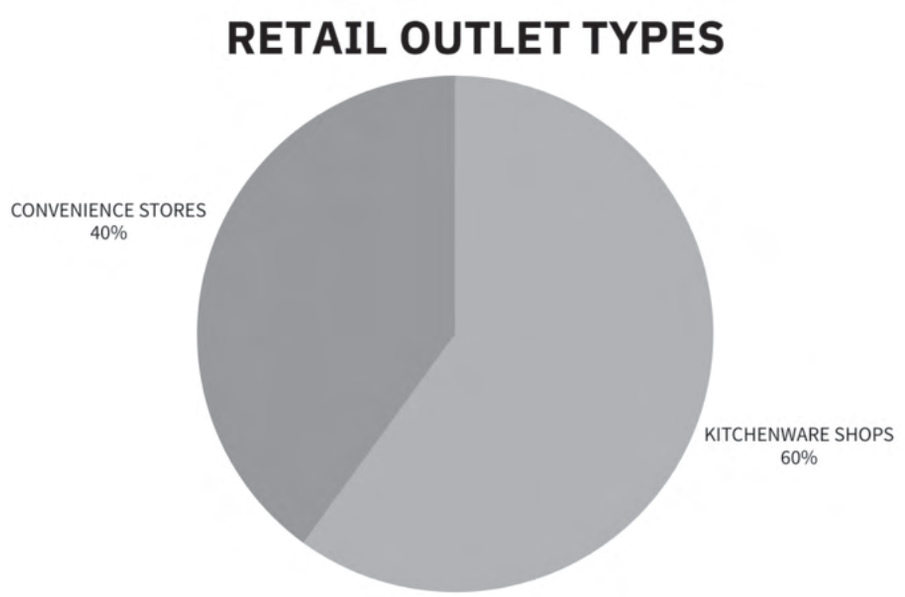


Figure 1: Type of retail outlets for sampling across 4 districts in Kedah.

Out of 30 melamine ware samples analyzed, 9 samples (30%) has exceeded the SML while 21 samples (70%) were within acceptable limits.

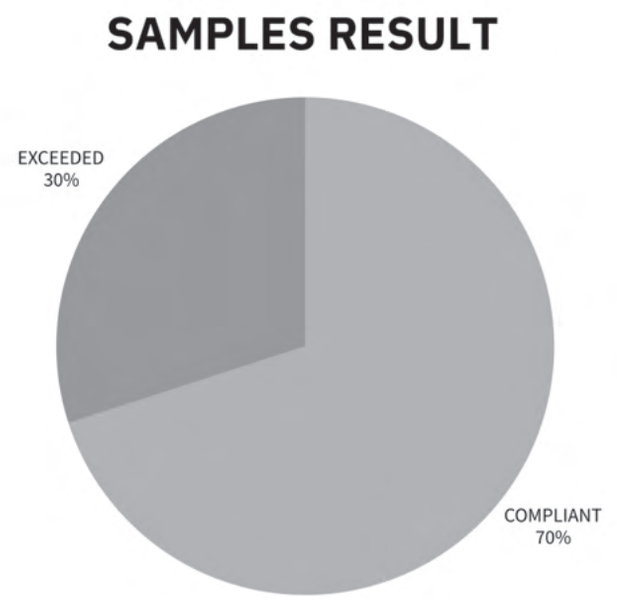


Figure 2: Result of the analysis for all samples

Among all the non-compliant samples, six were collected from convenience stores, accounting for a non-compliance rate of 50.0% (6 out of 12 samples). In comparison, three non-compliant samples were identified from kitchenware shops, corresponding to a non-compliance rate of 16.7% (3 out of 18 samples).

Table 2: Distribution of non-compliant samples by type of retail shops

Type of Retail Shops	Total samples	Non-compliant Samples	Non-compliant Percentage
Conveniece stores	12	6	50.0
Kitchenware shops	18	3	16.7

For the melamine ware samples, two size categories were established: those below 500 ml and those above 500 ml. Samples with a capacity below 500 ml were analyzed based on contact surface area, while samples above 500 ml were analyzed based on sample weight. Out of all the samples, 21 were tested using the contact

surface method, and 9 were tested using the weight method. Among the non-compliant samples, the non-compliance rate was 38% for those analyzed by contact surface and 11% for those analyzed by sample weight.

Table 3: Distribution of non-compliant samples by sample size categories

Sample Size Categories	Total Samples	Non-compliant Samples	Non-compliant Percentage
Below 500 ml (contact surface)	21	8	38.1
Above 500ml (sample weight)	9	1	11.1

DISCUSSIONS

This study evaluated the level of formaldehyde migration from melamine ware sold across four districts in Kedah which is Kota Setar, Kuala Muda, Kubang Pasu and Kulim. The sampling strategy ensured balanced representation across districts, with 30 samples collected from various retail sources, including both kitchenware shops and convenience stores. It was found that the majority (60%) of samples came from kitchenware shops, which typically offer a broader range of melamine products. However, the analysis revealed that 30% of the samples exceeded the Specific Migration Limit (SML) for formaldehyde, as stipulated by the Commission Regulation (EU) No. 10/2011 which is 15 mg/kg or 2.5 mg/dm².

In comparison to Malaysia's Food Regulations 1985 under the Food Act 1983, melamine and formaldehyde-based materials are not regulated but under Regulation 27 has mention no person shall import, manufacture, advertise for sale, sell, use or cause or permit to be used in the preparation, packaging, storage, delivery or exposure of food for sale, any package, utensil, container, or vessel that releases or may release into its contents any substance that is toxic, harmful or detrimental or that contributes to the deterioration of the food. This study's finding of a 30% non-compliance rate indicates that several products currently available in local markets do not meet this national safety standard.

The study also found that convenience store samples showed a significantly higher non-compliance rate (50%) compared to those from kitchenware shops (16.7%). This diffrences may be due to less stringent sourcing practices or lower product quality controls in convenience stores. It raises concerns about the supply chain integrity and emphasizes the need for regulatory monitoring of imported and low-cost melamine wares that may not comply with national or international safety standards.

In addition, the evaluation of product size showed that smaller sized melamine ware (below 500 ml) which is typically used for serving condiments or children's meals has exhibited a higher formaldehyde migration rate (38%) compared to larger sized melamine ware (11%). Smaller wares have a greater surface-area-to-volume ratio, increasing the potential contact between food and the resin surface, which may accelerate the migration of residual monomers, especially when exposed to heat or acidic conditions.

The findings of this study are consistent with previous international studies that have highlighted the potential health risks of formaldehyde migration from melamine-based kitchenware, particularly under high-temperature conditions such as serving hot soups, curry or acidic beverages like lemon juice. Long-term exposure to formaldehyde which is a Group 1 carcinogen classified by the International Agency for Research on Cancer (IARC) has been linked to respiratory issues, skin irritation, and potential carcinogenic effects with prolonged exposure.

Recommended Actions

1. Strengthen Regulatory Surveillance: Authorities such as the Ministry of Health Malaysia (MOH) should enhance market surveillance to detect non-compliant melamine products, particularly those sold in convenience stores.

2. Mandatory Certification and Import Control: Melamine ware should be required to have certification of compliance with migration limits before being imported or distributed in the market. Non-compliant brands or suppliers should be subject to recalls, fines or import bans.

3. Labeling Requirements: Melamine products should carry clear use instructions, including temperature limitations and warnings against use with acidic or oily foods. Consumers also should be educated to avoid using melamine in microwaves or with hot and acidic foods.

4. Public Awareness Campaigns: Ministry of Health (MOH) or others public health agencies should educate consumers about the safe use of melamine ware through infographics, digital media, and retail signage. Emphasis should be placed on alternatives for food contact materials, particularly for children's products and hot food applications.

5. Further Research: Additional studies should be conducted on the effects of long-term usage, repeated washing and degradation of melamine ware over time to better understand how migration levels change.

CONCLUSION

This study revealed that a significant proportion of melamine ware products sold in Kedah markets exceed the permissible formaldehyde migration limits, posing a potential health risk to consumers. Products sourced from convenience stores and smaller sized wares were particularly prone to non-compliance. Although Malaysia's food safety regulations clearly state about the use of hazardous packaging is prohibited but the presence of non-compliant items suggests gaps in enforcement and market control.

To ensure the safety of food contact materials, proactive steps including enhanced market surveillance which include food regulations review, stricter import controls including banning or recall, better product labeling and public education should be implemented. Consumers are advised to use melamine ware responsibly which is particularly avoiding high temperatures or acidic foods and to consider safer alternatives food contact materials when possible.

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MALOCCLUSIONS AND DENTAL ANOMALIES IN CLEFT LIP AND/OR CLEFT PALATE PATIENTS RECEIVING ORTHODONTIC TREATMENT: A MULTICENTER STUDY

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ABSTRACT

Background: Cleft lip and/or palate (CLP) are congenital anomalies that pose significant challenges to oral health, resulting in malocclusions and dental anomalies. Orthodontic treatment for CLP patients involves early intervention and multidisciplinary care. This multi-center study aimed to investigate the prevalence and associations of malocclusions and dental anomalies among CLP patients receiving orthodontic treatment in Kedah, Malaysia.

Methodology: This retrospective cross-sectional study involved data collection from dental records of patients in five government orthodontic clinics. Demographics data, cleft types, malocclusions and dental anomalies including hypodontia, impacted teeth and hyperdontia were recorded.

Results: A total of 258 dental records were included in this study. The median age of the subjects was 11.0 years old. Most of the subjects were female (54.3%) and Malay ethnicity (84.1%). Unilateral cleft lip and palate (UCLP) was the most prevalent cleft type (65.1%) followed by bilateral cleft lip and palate (BCLP) (26.4%). Class III malocclusion predominated (78.3%). Hypodontia was the most common dental anomaly (66.3%). Gender (p=0.003) and ethnicity (p=0.048) were significantly associated with cleft types, with males more likely to have BCLP and females more likely to have cleft palate (CP). Hypodontia (p=0.010) and hyperdontia (p=0.030) showed significant associations with cleft types.

Conclusion: The high prevalence of Class III malocclusion and hypodontia highlights the need for early orthodontic interventions in CLP patients. Gender and ethnic disparities in cleft types suggest potential etiological differences. These findings underscore the importance of early detection and multidisciplinary care to optimize outcomes for CLP patients.

Keyword: malocclusions, dental anomalies, cleft lip, cleft palate, unilateral, bilateral, multicenter

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INTRODUCTION

CLP are some of the most commonly occurring dentofacial congenital defects. The frequency of CLP is higher in the Asian population, compared to the other population and region (Sharma, 2020). A 2-year study at the Maternity Hospital, Kuala Lumpur, reported that out of 52,379 babies delivered, 64 were born with CLP. The rate of occurrence of cleft was 1.24 per 1000 livebirths or 1.20 per 1000 deliveries. Chinese ethnicity had the highest incidence (1.9 per 1000 deliveries) while the Malays had the lowest (0.98 per 1000 deliveries) (Boo & Arshad, 1990).

The most common type of cleft was the unilateral cleft of the primary and secondary palates. In contrast, a study by Shah, Mirani and Sahito (2018) found that the Malay ethnic group was the most commonly affected racial group followed by Chinese and Indian origin. CLP is a relatively common craniofacial anomaly that affects the physical, psychological and social aspects of the cleft child and his/her parents. It requires a multidisciplinary team of specialists to address the various challenges associated with the deformity. The team may include surgeons, dentists, orthodontists, speech therapists, psychologists, geneticists and social workers (Watted, Watted, Abu Hussein & Muhamad, 2020).

Malocclusion is defined as an irregularity from normal occlusion concerning teeth alignment and/or their occlusal relationship during dental occlusion (Jacobson, 1987). Not all malocclusions need to be treated but treatment typically will be provided after consideration of significant benefit in aesthetic or function. Gupta *et al*. (2016) revealed maximum subjects with Angle's Class II (10.7%) and Class III (4.9%) malocclusion were seen in unilateral CL deformities in the Jammu population. None of the UCLP patients had Class III malocclusion. In contrast, Class III malocclusion was most prevalent in Korean cleft patients (72.7%), followed by Class I (18.5%) and Class II (8.8%) malocclusion (Baek, Moon & Yang, 2002). Individuals with non-syndromic CLP commonly exhibit various dental anomalies involving tooth shape, size, and position (Kim & Baek, 2006; Ranta, 1983). Al-Kharboush, Al-Balkhi, and Al-Moammar (2015) reported that hypodontia (66.8%) was the most common dental anomaly observed in Saudi CLP patients, followed by microdontia (45.6%), intra-oral ectopic eruption (12.5%), supernumerary teeth (12.5%), intranasal ectopic eruption (3.2%), and macrodontia (3.2%). Similar findings were obtained by Paranaiba *et al*. (2013) where hypodontia was the most prevalent dental anomaly in Brazilian CLP population, followed by impacted teeth, supernumerary teeth and microdontia.

Orthodontic treatment remains a major treatment in cleft patients (Nakajo, Tokugawa, Kita & Kochi, 2012). Okayasu *et al.* (2018) reported that aesthetic and masticatory improvements were accomplished with orthodontic treatment. In addition, orthodontic treatment also positively affected speech. Orthodontists play a crucial role in patient care, offering treatment from birth through adulthood. Their services encompass pre-surgical orthopedics, orthodontic preparation for alveolar bone grafts, early orthodontic treatment post-grafting, and comprehensive orthodontic treatment, which may or may not include orthognathic surgery (Shetye, 2016). Knowledge in the prevalence of malocclusions in CLP patients can aid in early detection and provide efficient treatment planning leading to a good prognosis (Deeksheetha & Kareem, 2020). Studies regarding the presence of dental anomalies in individuals with CLP will aid orthodontists to anticipate the malocclusion and other challenges when dealing with such cases in the clinic (Al-Kharboush *et. al.*, 2015).

This study will provide prevalence of malocclusion in CLP patients and hence, hope to emphasize the importance of knowledge among health professionals to motivate and highlight the need of cleft patients to complete their complex treatment involving multidisciplinary teams especially in orthodontic treatment (Figure 1). At present, there are very few published data or studies found regarding prevalence of malocclusion and dental anomalies, and their association with CLP patients in Malaysia. The management of these patients is a multidisciplinary effort. As a result, this study will raise awareness among medical and dental practitioners about the importance of referring the CLP patients with malocclusions to orthodontists so that these patients can be treated at the appropriate age and thus improve the quality of life of life in terms of speech, mastication, and aesthetics, improving their self-esteem in their entire life. This study aimed to investigate the contributing factors such as demographics, types of malocclusions, and dental anomalies associated with the types of clefts among patients receiving orthodontic treatment in Kedah.



Figure 1: Intraoral photos of a UCLP patient undergoing orthodontic treatment

METHODOLODY

Ethical approval for this cross-sectional retrospective study was granted by the Medical Research Ethical Committee (MREC). The study analyzed secondary data from dental records and radiographs of cleft cases treated between 2014 and 2023. The study population comprised patients referred for orthodontic treatment to all Ministry of Health (MOH) Orthodontic Specialist Clinics (OSC) in Kedah, specifically those in Kota Setar, Changlun, Sungai Petani, Kulim, and Kuah. Sample size estimation was calculated using the population proportion formulae (Lemeshow, Hosmer, Klar & Lwanga, 1990).

Prior data indicate that the prevalence of cleft lip and palate was 0.636 (Baek *et al*., 2002). Samples calculated with type I error probability (0.05) and precision (0.07) resulted in 182 samples. With an additional 20% dropout rate, the final sample size was 228. In this study, the quota sampling method was utilized. To ensure fair distribution of samples, the number of respondents were calculated using the probability proportional to size (PPS) sampling method based on the population size in each of the 5 orthodontic specialist clinics in Kedah (Table 1). This study included syndromic and non-syndromic CLP patients who were undergoing treatment at any orthodontics clinics in Kedah. They must at least have an orthopantomogram (OPG) taken as part of radiological investigation and patients under 7 years old were excluded. CLP patients under 7 years old were excluded as the upper central incisors are erupting and it affects the classification of malocclusion. Following the identification of suitable cases, information was collected on cleft types, prevalence of cleft patients by age, ethnicity, and gender, type of malocclusion according to the British Standards Institution (BSI, 1983) incisor classification, as well as the prevalence of hypodontia, hyperdontia, and impacted teeth. These data were obtained from orthodontic records, including dental treatment cards (LP8-1 Pin 7/97 and LP8-2 Pin 7/97), orthodontic treatment cards (LP7), and radiographs.

Data analysis was performed using Jamovi software version 2.6. Categorical data were presented as frequencies and percentages, while non-normally distributed numerical data were expressed as medians and interquartile ranges. Pearson's chi-square test for independence was used to assess the association between demographic variables, types of malocclusions, dental anomalies, and different cleft types. Fisher's exact test was utilized when Pearson's chi-square assumptions were not met. Significance level was set at $p < 0.05$.

Table 1: Selection of respondents by probability proportional to size (PPS) sampling in each OSC

No.	OSC	Populations		Sample Size
		N	(%)	*n*
1	Kota Setar	150	(58.8)	134
2	Changlun	13	(5.1)	11
3	Sungai Petani	70	(27.5)	63
4	Kulim	12	(4.7)	11
5	Kuah	10	(3.9)	9
TOTAL		255	(100.0)	228

RESULTS

This study included 258 respondents with a median age of 11.0 years (IQR = 3.00). The predominant age group was 7-12 years, accounting for 69.0% of the participants. Females represented the majority of the respondents at 54.3%, and most participants were Malay (84.1%). The demographic characteristics of the respondents are detailed in Table 2.

UCLP was the most common type of cleft, observed in 65.1% (168) of respondents. This was followed by BCLP (26.4%, 68 respondents), CP (7.0%, 18 respondents), and CL (1.6%, 4 respondents). A high percentage of respondents (78.3%) presented with class III malocclusion. Hypodontia was the most frequent dental anomaly in this study (57.8%), with impacted teeth (24.0%) and hyperdontia (18.2%) also noted. Table 2 provides a detailed breakdown of cleft types, malocclusion types, and dental anomalies.

Table 2: Demographic characteristics of respondents (N=258)

Variables		*n*	(%)
Age group (in years)			
	7-12	178	(69.0)
	13-17	58	(22.5)
	18-29	20	(7.8)
	>30	2	(0.8)
Gender	Male	118	(45.7)
	Female	140	(54.3)
Ethnicity	Malay	217	(84.1)
	Chinese	30	(11.6)
	Indian	8	(3.1)
	Others	3	(1.2)
Types of clefts	CL	4	(1.6)
	CP	18	(7.0)
	Unilateral CLP	168	(65.1)
	Bilateral CLP	68	(26.4)

Types of malocclusions	Class I	38	(14.7)
	Class II/1	12	(4.7)
	Class II/2	6	(2.3)
	Class III	202	(78.3)
Dental anomalies	Hypodontia: Present	171	(57.8)
	Impacted tooth: Present	71	(24.0)
	Hyperdontia: Present	54	(18.2)

Note:CL = Cleft Lip;CP = Cleft Palate;CLP = Cleft Lip and Palate

The distribution of cleft types was found to be associated with gender and ethnicity, but not age. Specifically, gender (p=0.003) and ethnicity (p=0.048) showed significant associations with cleft types, while age (p=0.109) did not (Table 3). Males exhibited a higher prevalence of Cleft Lip (CL) at 75.0% and Bilateral Cleft Lip and Palate (BCLP) at 60.3%. Conversely, females were more frequently affected by Cleft Palate (CP) at 83.3% and Unilateral Cleft Lip and Palate (UCLP) at 57.7%. Malays constituted the largest group across all cleft types, particularly for UCLP (85.7%). Chinese respondents, however, showed a higher prevalence in CP (16.7%) compared to other cleft types.

Table 3: Association between demographic variables and types of clefts (N=258)

Types of clefts	**CL** **n (%)**	**CP** **n (%)**	**Unilateral CLP** **n (%)**	**Bilateral CLP** **n (%)**	***p*-value**
Age group (in years)					0.109[a]
7-12	3 (75.0)	7 (38.9)	123 (73.2)	45 (66.2)	
13-17	1(25.0)	8 (44.4)	31 (18.5)	18 (26.5)	
18-29	0 (0.0)	3 (16.7)	13 (7.7)	4 (5.9)	
>30	0 (0.0)	0 (0.0)	1 (0.6)	1 (1.5)	
Gender					0.003[b]
Male	3 (75.0)	3 (16.7)	71 (42.3)	41 (60.3)	
Female	1 (25.0)	15 (83.3)	97 (57.7)	27 (39.7)	
Ethnicity					0.048[a]
Malay	3 (75.0)	15 (83.3)	144 (85.7)	55 (80.9)	
Chinese	0 (0.0)	3 (16.7)	21 (12.5)	6 (8.8)	
Indian	1 (25.0)	0 (0.0)	3 (1.8)	4 (5.9)	
Others	0 (0.0)	0 (0.0)	0 (0.0)	3 (4.4)	

Note: [a]Fisher's exact test;[b]Pearson's chi-square test.CL = Cleft Lip;CP = Cleft Palate;CLP = Cleft Lip and Palate.

Types of malocclusions were associated with the types of clefts. However, Table 4 showed that no significant association was observed between types of malocclusions and cleft types (p=0.129).

Table 4: Association between types of malocclusions and types of clefts (N=258)

Types of clefts	CL	CP	Unilateral CLP	Bilateral CLP	*p*-value[a]
	n (%)	n (%)	n (%)	n (%)	
Types of malocclusions					0.129
Class I	1 (25.0)	2 (11.1)	29 (17.3)	6 (8.8)	
Class II/1	1 (25.0)	1 (5.6)	6 (3.6)	4 (5.9)	
Class II/2	0 (0.0)	0 (0.0)	2 (1.2)	4 (5.9)	
Class III	2 (50.0)	15 (83.3)	131 (78.0)	54 (79.4)	

Note: [a]Fisher's exact test;CL = Cleft Lip;CP = Cleft Palate;CLP = Cleft Lip and Palate

Dental anomalies such as hypodontia, impacted tooth, and hyperdontia were associated with the types of clefts. Results in Table 5 showed that hypodontia (*p*= 0.010) and hyperdontia (*p*=0.030) except impacted tooth (p-value = 0.190) were associated with the types of clefts. Specifically, hypodontia was identified as the most prevalent dental anomaly in BCLP (73.5%). Hyperdontia exhibited a higher prevalence in CL (50.0%).

Table 5: Association between dental anomalies and types of clefts (N=258)

Types of clefts	CL	CP	Unilateral CLP	Bilateral CLP	*p*-value[a]
	n (%)	*n* (%)	*n* (%)	*n* (%)	
Dental anomalies					
Hypodontia: Present	2 (50.0)	6 (33.3)	113 (67.3)	50 (73.5)	0.010
Impacted tooth: Present	2 (50.0)	6 (33.3)	50 (29.8)	13 (19.1)	0.190
Hyperdontia: Present	2 (50.0)	0 (0.0)	39 (23.2)	13 (19.4)	0.030

Note: [a]Fisher's exact test;CL = Cleft Lip;CP = Cleft Palate;CLP = Cleft Lip and Palate

DISCUSSION

This study aimed to determine the prevalence and assess the demographic characteristics, types of malocclusions, and dental anomalies between respondents with CL, CP, UCLP, and BCLP. The results showed that the prevalence of UCLP, BCLP, CP, and CL were 69.0%, 22.5%, 7.8%, and 0.8%, respectively. These findings aligned with previous studies indicating that UCLP is the most prevalent form of orofacial clefts.

Analysis showed that gender was significantly associated with the types of clefts. This finding indicates males were more likely to have CL and BCLP whereas females were more likely to have CP and UCLP. These gender distributions are consistent with regional data whereby a study in Malaysia found that the incidence of cleft lip and/or palate was higher in females compared to males (Shahid, Syed, Rahman & Sahito, 2015). This study found an association between ethnicity and the types of

clefts. Malay respondents were more likely to have experienced UCLP compared to non-Malay respondents. This result has also been shown in the previous study that the Malay ethnic group was found to be the most commonly affected racial group followed by Chinese and Indian origin (Shah *et al,* 2018).

Class III malocclusion showed to be the most common malocclusion across all cleft types, particularly in UCLP. The high prevalence of Class III malocclusion among CLP patients is well-documented. A study evaluating malocclusions in CLP patients found a significant occurrence of Class III malocclusion, attributed to maxillary growth deficiencies commonly associated with cleft conditions (Baek et al, 2002; Vettore & Campos, 2010).

This study revealed two additional fascinating findings, indicating that dental anomalies like hypodontia and hyperdontia were significantly linked to the types of clefts. Hypodontia is significantly the most common dental anomaly in BCLP. There was significant association between hyperdontia in UCLP. A meta-analysis concluded that individuals with orofacial clefts are more likely to exhibit dental anomalies, such as tooth agenesis and supernumerary teeth, compared to those without clefts (Marzouk et al, 2021).

This study has some limitations. Although it involved several centers, all were located in Kedah, which may not reflect the wider Malaysian population or the diversity of ethnic groups in the country. In addition, the use of secondary data from dental records has limited control over confounding factors and introduced the possibility of bias due to incomplete or inconsistent information. Lastly, the study does not track treatment outcomes over time, which would provide a more dynamic understanding of orthodontic interventions' effectiveness. Future research using a prospective or longitudinal design would offer insights on the long-term effects of orthodontic treatment.

CONCLUSION

This study provides valuable insights into the prevalence, demographic characteristics, types of malocclusions, and dental anomalies among individuals with various types of orofacial clefts, namely CL, CP, UCLP, and BCLP. The findings confirm that UCLP is the most common cleft type, aligning with trends reported in previous literature. Significant associations were observed between cleft types and demographic factors such as gender and ethnicity, with males more likely to present with CL and BCLP, and Malays more frequently affected by UCLP.

Class III malocclusion was the most prevalent type across all cleft categories, particularly among UCLP patients, likely due to maxillary growth deficiencies associated with cleft conditions. Additionally, this study highlights a significant relationship between specific cleft types and dental anomalies. Hypodontia was most

common in BCLP, while hyperdontia was significantly associated with UCLP. These findings underscore the importance of early diagnosis and comprehensive treatment planning, particularly in orthodontic care, to address the complex clinical challenges presented by cleft-related malocclusion and dental anomalies.

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THE PSYCHOMETRIC ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF MEDICATION ERROR REPORTING AMONG HEALTHCARE PRACTITIONERS IN PRIMARY CARE SETTINGS

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ABSTRACT:

Introduction: Medication errors are preventable incidents that may result in inappropriate medication use or patient harm. Assessing the knowledge, attitude, and practise (KAP) related to medication error reporting is essential for enhancing patient safety and the overall quality of healthcare services. Despite its importance, validated instruments to measure KAP in this area remain limited. Therefore, this study aims to conduct a psychometric assessment of a structured questionnaire to address this gap and support improvements in clinical practice.

Methodology: This cross-sectional study was conducted among 30 healthcare workers in health clinics in Padang Terap. The questionnaire, adapted from existing literature, comprised four sections: socio-demographics, knowledge, attitude, and practice. Content validity was evaluated by five experts, and face validity was tested with 10 participants to ensure clarity and feasibility. Internal consistency was measured using Cronbach's alpha, while corrected item-total correlations were performed to assess the relevance and reliability of each item within respective domains.

Results: The mean I-CVI values for knowledge, attitude, and practice were 0.94, 1.0, and 1.0, respectively. Domains with an I-CVI <1.0 were revised based on expert feedback. Cronbach's alpha for knowledge domain was 0.6688 (moderate reliability), improving to 0.6850 after removing a low-correlation item (item B6). The attitude domain showed good internal consistency with a Cronbach's alpha of 0.8908, indicating high reliability. The practice domain was not tested for reliability as all items reflected on actual reporting actions.

Conclusion: This pilot study demonstrated the revising B6 in the knowledge domain enhanced internal consistency. The findings support that the developed questionnaire is a reliable tool for assessing healthcare practitioners' knowledge, attitudes, and practices regarding medication error reporting.

Keywords: medication error, medication error reporting, knowledge, attitude, practice, primary care settings

INTRODUCTION

Medication error (ME) is one of the leading causes of avoidable harm and injury in the healthcare system on a global level. According to the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), a medication error is defined as any preventable event that may lead to inappropriate medication use or patient harm while the medication is under the control of a healthcare professional, patient, or consumer (National Coordinating Council for Medication Error Reporting and Prevention [NCC MERP], 2025). These events may be associated with various aspects of healthcare delivery, including but not limited to professional practice, healthcare products, procedures, and systems. Specific areas of concern include prescribing, order communication, product labelling, packaging, and nomenclature, as well as compounding, dispensing, distribution, administration, education, monitoring, and medication usage. According to Global Patient Safety Action Plan 2021-2030, medication error happens when weak medication systems and/or human factors such as fatigue, poor environmental conditions or staff shortages compromise the process of prescribing, transcribing, dispensing, administration and monitoring. These errors may lead to harm, disability and even death (World Health Organization, 2021).

Medication safety is a fundamental aspect of patient care and overall healthcare quality. The World Health Organization (WHO) emphasizes that primary care services play a pivotal role within healthcare systems, significantly influencing patient outcomes and the efficient use of health resources. Enhancing safety within these services is essential for advancing universal health coverage and achieving the United Nations Sustainable Development Goals. Conversely, unsafe or suboptimal primary care practices can contribute to increased morbidity and preventable mortality. Therefore, a collaborative effort among all healthcare professionals is critical to strengthening patient safety. This includes the systematic collection and analysis of data related to medication error reporting, which serves as a key mechanism for identifying risks and implementing preventive measures (Rupert et al, 2016).

A study conducted in 12 government primary care clinics from 4 states in Malaysia concluded that medication errors (ME) were the second most common clinical management errors (41.3% of all management errors). The errors that occurred were found to be preventable with 40% of the errors potentially causing harm to the patient (Khoo et al, 2012). Drug errors eventually lead to increase cost in modern medical practice considering both human suffering and additional healthcare cost (Glavin, 2010). Therefore, one of the strategies to reduce medication errors is to encourage ME reporting through the analysis of the report, review of contributory factors that may lead to drug error as well as solutions that can be implemented. The changes can be made at the primary level and eventually impact the changes that can be executed at the national level (Teoh et al, 2015).

The Ministry of Health Malaysia as the national health policy maker has launched various initiatives and programs to further promote medication safety. Now, the Medication Error Reporting System (MERS) has been introduced in 2009 by Pharmaceutical Services Programme, Ministry of Health Malaysia as the national reporting system. MERS enables healthcare professionals to report any medication error encountered on the job (Teoh et al, 2015). The MERS system serves as a platform for all healthcare professionals to report medication error, analyse and monitor medication error (ME), establish error preventive strategies, dissemination of information, quality improvement program and adopt just culture (Teoh et al, 2015).

Medication errors are the common medical errors occurring in our healthcare organizations and should be reporte. However, these errors are mostly under reported (Samsiah et al, 2020). A study conducted in Malaysia found that most participants had a good understanding of the definition of medication errors, were knowledgeable about medication error reporting, and were aware of the existence of the Medication Error Reporting (MER) system (Samsiah et al. 2016; Eman et al, 2018). However, they believed that near miss errors are not important to report since the errors do not reach patients and will not lead to patient's harm. The under reported near miss errors lead to low reporting of medication errors in their respective clinics (Samsiah et al, 2016). Findings from another study also revealed that half of the participants chose not to report the errors because they did not consider them serious enough to warrant reporting (Mamat et al, 2020). The under reporting of medication errors remains prevalent and associated with several factors that discourage healthcare practitioners from reporting the error. In a survey conducted in Malaysia, among those who had encountered medication errors, only 56% submitted a medication error report, while 70% had never reported any medication error throughout their entire working experience (Samsiah et al, 2020). Findings from other studies also indicated that the practice of reporting medication errors (MEs) through the Medication Error Reporting System (MERS), whether manually or online, was notably poor. Only a small number of participants had reported an ME by any method within the past 6 to 12 months (Samsiah et al, 2016). The primary barriers to reporting MEs included heavy workloads, time constraints, staff shortages, lack of understanding of the reporting process, and lack of awareness that an error had occurred (Samsiah et al, 2020; Samsiah et al, 2016; Eman et al, 2018; Salmasi et al, 2015).

Under reporting of medication error among primary care settings in Padang Terap Health District remains a prevalent issue. To date, there is lack of research investigating knowledge, attitude and practices (KAP) related to medication error reporting within this population. Assessing the knowledge, attitude and practices (KAP) related to medication error reporting is essential for enhancing patient safety and the overall quality of healthcare service. Despite the recognized importance of this issue, validated instruments regarding reporting of medication error can be further explored. Therefore, this study aims to conduct psychometric assessment of

a structured questionnaire on knowledge, attitude and practice of medication error reporting among healthcare practitioners to address this gap and support improvements in clinical practice.

METHODOLOGY

Development of the Questionnaire

The questionnaire assessing knowledge, attitude, and practice related to medication error reporting was systematically developed based on review of previously published literature (Mamat et al, 2020; Elshoura & Rasha, 2022) and further refined through a focus group discussion with a senior pharmacist responsible for medication safety with more than 10 years working experience.

The first draft of the questionnaire on KAP consisted of 25 items. It was divided into four sections comprising Section A: Socio-demographic characteristics (gender, age, job category and working duration), Section B: knowledge, Section C: attitude and Section D: practice. Based on a comprehensive literature review and insights gained from focus group discussions, we developed a set of 10 True/False questions to assess knowledge of medication errors and reporting. The attitude domain was evaluated using eight items measured on a 5-point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree.' For the practice domain, three questions were designed to capture actual reporting behaviours.

Content Validity

Content validation of the questionnaire was conducted by non-face-to-face approach in which the online validation form was sent to the experts and clear instructions were given to assist the validation process. Content validity of the questionnaire was conducted by 5 experts to verify its importance and relevance. The experts were tasked with grading each item on the scale of 1 to 4 (1: not relevant, 2: somewhat relevance, 3: quite relevant, 4: highly relevant). To ensure content validity, the Item Content Validity Index (I-CVI) was calculated. I-CVI is defined as the proportion of content experts who rate an item as either 3 or 4 on a 4-point relevance scale (Yusoff, 2019). Data obtained from the expert evaluations were entered into Microsoft Excel for the computation of I-CVI values. Several items were revised based on the expert’s feedback.

Face Validity

As to ensure clarity and feasibility, face validation was conducted by 10 respondents comprising of pharmacists, pharmacist’s assistants, medical officers, assistant medical officers and nurses. They were tasked to evaluate the questionnaire based on the criteria given. Final draft of the questionnaire was constructed after some minor changes were made in response to the feedback and to be used for reliability study.

Pilot Testing of the Questionnaire

A pilot study was conducted involving 30 respondents (n=30), including medical officers, assistant medical officers, pharmacists, pharmacist assistants, and nurses from five (5) health clinics in Padang Terap district to evaluate the reliability of the newly developed questionnaire. Participants completed the questionnaire via an online Google Form, in which the purpose and methodology of the study together with informed consent were attached. Cronbach's alpha was used to analyse the internal consistency, while corrected item-total correlation (CITC) was performed to assess the relevance and reliability of each item within respective domains. All statistical analyses were performed with STATA version 14 (StataCorp LP, College Station, TX, USA).

Ethics Considerations

This study was approved by the Malaysia Research Ethics Committees (MREC), Ministry of Health, Malaysia [NMRR ID: 24-03133-2ZA].

RESULTS

A total of 25 items from the first draft of the questionnaire were reviewed by a panel of five experts. The content validity was assessed using the Item-Level Content Validity Index (I-CVI) for each item and the Scale-Level Content Validity Index, Average Calculation Method (S-CVI/Ave) for each domain. I-CVI obtained from this study was good. The mean I-CVI values for knowledge, attitude, and practice were 0.94, 1.0, and 1.0, respectively (Table 1,2 and 3). Domain on knowledge showed eight items where all five experts agreed (Table 1). Items with I-CVI value less than 1.0 were revised based on expert's feedback and modified accordingly. Based on the feedback, five items in knowledge domain have been rephrased and the sequence of the items have been rearranged. The face validity assessment conducted with 10 respondents led to minor revisions in vocabulary and grammar. The respondents rated most of the items in the questionnaire were relevant, clear and understandable. The consensus among respondents indicated that the questionnaire demonstrated strong face and content validity.

Table 1: Rating on 10-item Scale for Knowledge on Medication Error and Medication Error Reporting by Five Experts: Item Rated 3 or 4 on 4-Point Relevant Scales

Item	**Expert 1**	**Expert 2**	**Expert 3**	**Expert 4**	**Expert 5**	Experts in Agreement	**I-CVI**
1	✓	✓	✓	✓	✓	5	1.0
2	✓	✓	✓	✓	✓	5	1.0
3	✓	✓	✓	✓	✓	5	1.0

4	✓	✓	✓	✓	✓	5	1.0
5	✓	✓	✓	✓	✓	5	1.0
6	✓	-	✓	-	✓	3	0.6
7	✓	✓	✓	✓	✓	5	1.0
8	✓	✓	✓	✓	✓	5	1.0
9	✓	✓	✓	✓	✓	5	1.0
10	✓	-	✓	✓	✓	4	0.8
						S-CVI/Ave	**0.94**
Proportion Relevant	1.0	0.8	1.0	0.9	1.0		

Note: I-CVI= Item Content Validity Index, S-CVI/Ave = Scale- Level Content Validity Index based on average method.

Table 2: Rating on an 8-Item Scale for Attitude Towards Medication Error Reporting by Five Expert: Items Rated 3 or 4 on 4-Point Relevant Scales

Item	**Expert 1**	**Expert 2**	**Expert 3**	**Expert 4**	**Expert 5**	Experts in Agreement	**I-CVI**
1	✓	✓	✓	✓	✓	5	1.0
2	✓	✓	✓	✓	✓	5	1.0
3	✓	✓	✓	✓	✓	5	1.0
4	✓	✓	✓	✓	✓	5	1.0
5	✓	✓	✓	✓	✓	5	1.0
6	✓	✓	✓	✓	✓	5	1.0
7	✓	✓	✓	✓	✓	5	1.0
8	✓	✓	✓	✓	✓	5	1.0
						(S-CVI/Ave)	**1.0**
Proportion Relevant	1.0	1.0	1.0	1.0	1.0		

Note: I-CVI= Item Content Validity Index, S-CVI/Ave = Scale- Level Content Validity Index based on average method.

Table 3: Rating on a 3-Item Scale for Practice on Medication Error Reporting by Five Expert: Items Rated 3 or 4 on 4-Point Relevant Scales

Item	**Expert 1**	**Expert 2**	**Expert 3**	**Expert 4**	**Expert 5**	Experts in Agreement	**I-CVI**
1	✓	✓	✓	✓	✓	5	1.0
2	✓	✓	✓	✓	✓	5	1.0
3	✓	✓	✓	✓	✓	5	1.0
						(S-CVI/Ave)	**1.0**
Proportion Relevant	1.0	1.0	1.0	1.0	1.0		

Note: I-CVI= Item Content Validity Index, S-CVI/Ave = Scale- Level Content Validity Index based on average method

Following the completion of content and face validity assessments, the reliability of the questionnaire was evaluated using responses from 30 respondents (n=30). The socio-demographic characteristics of the respondents was summarized in Table 4. Internal consistency was determined through the calculation of Cronbach's alpha coefficient. The reliability analysis for the knowledge domain produced a Cronbach's alpha of 0.6688, indicating moderate internal consistency. Item B6 demonstrated a low item-rest correlation (0.0681), and its removal resulted in a slight increase in the overall alpha to 0.6850 (Table 5). This suggests that Item B6 may not align well with the underlying construct being measured. Consequently, the exclusion of Item B6 from the final scale is justified to enhance the internal consistency and overall measurement accuracy of the instrument. Items B2 and B8 showed poor reliability with CITC values below 0.2, but their removal did not improve much of Cronbach's alpha, hence both were retained. Items B1 and B9 were constant, as all respondents gave similar answers, thus not contributing to alpha. The reliability analysis for the attitude domain yielded a high Cronbach's alpha of 0.8908, indicating excellent internal consistency among the items. Each item exhibited high value of Corrected Item Total Correlation (CITC), all exceeding 0.5, demonstrating their meaningful contribution to the overall construct (Table 5). Therefore, all items within the attitude domain are considered reliable and are recommended for retention. The practice domain was not tested for reliability as all items reflected on actual reporting actions.

Table 4: Socio-demographic characteristics of the respondents (N=30)

Variable	Characteristics	Frequency (n)	Percentage (%)
Gender	Male	6	20
	Female	24	80
Age	25-35 years old	15	50
	36-45 years old	6	20
	46-55 years old	9	30
Job category	Medical Officer	6	20
	Assistant Medical Officer	4	13.3
	Pharmacist	3	10
	Pharmacist Assistant	2	6.67
	Nurse	15	50
Working duration	0-10 years	9	30
	11-20 years	12	40
	21-30 years	9	30

Table 5: Cronbach's Alpha and Corrected Item Total Correlation (CITC) for Knowledge and Attitude Domain

Knowledge on medication error and medication error reporting					
Item	**Statement**	**Corrected Item-Total Correlation (with B6)**	**Cronbach's Alpha if item deleted (with B6)**	**Corrected Item-Total Correlation (without B6)**	**Cronbach's Alpha if item deleted (without B6)**
B1*	Medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm	-	-	-	-
B2	It is required to report the medication error even if the error did not reach the patient	0.1989	0.6694	0.1978	0.6911
B3	Reporting the error is not required if the error reached the patient but did not cause harm	0.5900	0.5865	0.6127	0.5996
B4	Medication error can only be reported by the person who made the error.	0.5259	0.5917	0.5520	0.6032
B5	Illegible handwriting will not result in a medication error	0.7334	0.5192	0.6795	0.5559
B6	Incomplete prescription is a part of medication error	0.0681	0.6850	-	-
B7	Any medications accidentally omitted from the prescription should be reported as a medication error	0.2966	0.6678	0.2837	0.6958
B8	Incorrect procedure or technique in drug administration is considered medication error	0.1989	0.6694	0.2068	0.6899
B9*	Medication Error Reporting System (MERS) is a method used in Malaysia to report medication error	-	-	-	-
B10	The Medication Error Reporting System (MERS) is accessible to doctors and pharmacists only	0.2966	0.6678	0.3225	0.6827
	Overall alpha		**0.6688**		**0.6850**

Attitude towards medication error reporting			
Item	**Statement**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if item deleted**
C1	I fail to report the medication error because I'm afraid of the reaction from superior	0.5922	0.8867
C2	I fail to report the medication error because most of my colleagues ignore the reporting	0.8024	0.8663
C3	I fail to report the medication error because I think the error is not serious to warrant reporting	0.6783	0.8761
C4	I fail to report the medication error because I'm afraid that I might lose the job	0.7086	0.8790
C5	I fail to report the medication error because the error does not reach or harm the patient.	0.7220	0.8716
C6	I fail to report the medication error because I have a lot of works to do.	0.6284	0.8807
C7	I fail to report the medication error because I do not know how to report.	0.5374	0.8888
C8	I fail to report medication error because I do not have enough time to report.	0.7753	0.8660
	Overall alpha		**0.8908**

*Note: B1 and B9 were constant in the analysis sample, dropped from analysis.

DISCUSSIONS

Psychometric validation of a newly developed questionnaire is a critical process in any study that employs questionnaires as a primary tool for data collection. Numerous observational studies on medication error (ME) reporting have been conducted to date; however, the findings from these studies have shown considerable variability, even when their objectives are comparable. Therefore, this study aims to prepare a validated questionnaire as a reliable tool in assessing KAP on ME reporting among healthcare practitioners.

During the questionnaire development phase, each item was formulated based on a thorough review of existing literature and input from a focus group discussion with senior pharmacists responsible for medication safety. The focus group discussion played a critical role in identifying and exploring key issues relevant to the study objectives. Insights gained from both the literature, and the focus group were instrumental in informing the design and content of the newly developed questionnaire (Mamat et al, 2020).

Content validity of the KAP questionnaire was obtained by measuring the I-CVI value of each item and S-CVI/Ave for each domain. Content validity refers to the extent to which the items of an assessment instrument are relevant to and accurately represent the intended construct for a specific assessment purpose (Yusoff, 2019).

The acceptable I-CVI value for content validation involving three to five experts is 1.0 (Yusoff, 2019). Since this study involving five experts for content validation, the acceptable I-CVI value should be 1.0. The I-CVI value for each item in attitude and practice domain showed 1.0 respectively. These results showed that items in both domains are acceptable and should be retained. However, there were two items in knowledge domain have I-CVI value less than 1.0. These two items were then revised and modified accordingly based on the feedback from experts.

The internal consistency for knowledge and attitude domain based on Cronbach's alpha coefficient were 0.6688 and 0.8908 respectively. The Cronbach's alpha of 0.7 or more is considered significant (Lohit et al, 2016). The results from the knowledge domain indicated suboptimal performance, suggesting a need to revise or remove certain items to enhance consistency and clarity. In this case, item with low CITC, which is item B6 was removed to improve the overall Cronbach's alpha to 0.6850. The removal of this item from the final scale strengthens the internal consistency of the questionnaire. Item B1 and B9 were dropped from the reliability analysis because they were constant, meaning that all respondents provided the same response. As a result, these items could not contribute to the calculation of internal consistency (Cronbach's alpha). Nevertheless, they were retained in the final instrument as they are considered conceptually important for representing the construct, even though they do not improve statistical reliability.

Following the psychometric validation process, the finalized questionnaire designed to assess knowledge, attitude, and practice (KAP) regarding medication error reporting comprised a total of 24 items. This included the removal of one item from the knowledge domain, based on its performance and contribution to the overall reliability and validity of the instrument.

This study has several limitations. One notable limitation of this study is the use of purposive sampling for participant recruitment in the reliability testing. While this method was appropriate for selecting healthcare professionals with direct experience in medication management and error reporting, it inherently limits the generalizability of the findings. The non-random selection process may introduce selection bias and reflect only the perspectives of those chosen, potentially overlooking views from a broader or more diverse population. Additionally, the subjectivity involved in participant selection could affect the reproducibility of the study in different settings or institutions. In contrast, a study by Mamat et al (2020) employed convenience sampling among pharmacists working in hospitals and primary care clinics. Although this method also posed a risk of sampling bias, it was regarded as acceptable within the context of psychometric validation. Another limitation of this study is that the questionnaire was developed and administered exclusively in a single language, which is English only. This may have restricted the accessibility and comprehension of the survey for participants whose primary language differs, potentially affecting the accuracy and reliability of their responses. Language barriers can lead to

misinterpretation of questions or nuances, resulting in response bias. Moreover, the use of a single language limits the applicability of the questionnaire across multilingual or culturally diverse populations, thereby reducing the generalizability of the findings. Future studies should consider translating and validating the instrument in multiple languages to ensure broader inclusivity and improved validity.

CONCLUSION

The questionnaire developed in this study demonstrated high reliability and can be used as valid instrument to assess knowledge, attitude and practice of medication error reporting among healthcare practitioners in future studies.

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DISCLOSURE

This study received no fundings. The authors declare that they have no conflict of interest.

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ROLES OF DEDICATED PROMOTION TEAM (DPT) IN IMPROVING ORAL HEALTH AMONG PRESCHOOLERS: A PILOT INITIATIVE

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ABSTRACT

Background: Developing effective oral hygiene practices from early childhood is crucial for ensuring lifelong oral health. Therefore, a Dedicated Promotion Team (DPT) focusing on preschoolers was established with the aims to increase the number of individuals who are caries-free and can retain their natural and functioning teeth. This pilot study was conducted to assess the implementation process and challenges faced.

Methodology: Preschoolers aged 4–6 from four Kota Setar preschools were selected via convenience sampling. Data was recorded in Google Sheets. Two calibrated dental therapists assessed plaque scores at pre-intervention and post-intervention using the same brand of disclosing agent. Various intervention activities were conducted including toothbrushing drills, role-playing and storytelling.

Results: A total of 92 preschool children were recruited; however, 13 were excluded due to absence or lack of parental consent during the second visit. Overall, plaque scores improved following the intervention. At pre-intervention, 28 children (35.4%) achieved Grade A, increasing to 42 children (62.0%) post-intervention.

Conclusion: This pilot initiative suggests that the Dedicated Promotion Team (DPT) plays a valuable role in improving oral hygiene among preschoolers through structured, school-based activities. While the overall improvement in plaque scores is encouraging, there are limitations such as small sample size, short duration, and logistical challenges. Further studies with more rigorous design are needed to evaluate long-term effectiveness and scalability.

Keyword: Oral health, Health promotion, Preschool Children

INTRODUCTION

Oral diseases are among the most common non-communicable diseases, affecting 3.5 billion people worldwide and the oral diseases burden is increasing, particularly in low- and middle-income countries (World Health Organization, 2024). In Malaysia, oral diseases, including dental caries, remain highly prevalent among children. According to the National Oral Health Survey Preschool Children (2015), 7 in 10 children had tooth decay (Ministry of Health Malaysia, 2020). Therefore, National Oral Health Strategic Plan 2022–2030 was developed to ensure that more than 50% of 5-year-olds have caries-free dentition and to help more Malaysians retain their natural teeth as they age.

Good oral hygiene habits are important to be cultivated in the early age, as behaviours developed in childhood tend to continue into later life. Thus, strengthening oral health promotion and awareness efforts are crucial in order to empower communities. Recognising this need, the Dedicated Promotion Team (DPT) was established under the Oral Health Programme of the Ministry of Health Malaysia. The aim of DPT establishment is to promote oral health messages among key target groups, namely toddlers, preschoolers, schoolchildren, and individuals with disabilities, including children with special needs (Ministry of Health Malaysia, 2024). The interactive teaching was found to be an effective approach for promoting oral health among children, including improved oral health knowledge, enhanced oral hygiene scores, and reductions in plaque scores (Patil *et* al., 2024).

In Kota Setar district, the Dedicated Promotion Team (DPT) was formed and divided into three teams namely team A, B, and C. Each of the teams has specific roles such as Team A primarily targets high-risk groups of primary and secondary school students whereby Team B focuses on most preschools, and conducts visits twice a year. Team C is also responsible for promoting oral health among preschool children, however, the team used *Brush 'N Go* concept and the program was conducted in collaboration with *Pusat Promosi Kesihatan Pergigian Komuniti* team. This pilot initiative explores the implementation of the DPT preschool programme in the Kota Setar district. Through a series of activities, the programme sought to instil good oral health practices among young children, with the intention of preventing dental caries and promoting healthy gums. Building on these efforts, the present study aims to evaluate the effectiveness of this school-based approach in improving oral hygiene among preschool children. Specifically, the study aims to: (1) measure changes in plaque scores before and after the intervention, and (2) assess whether this model can be adapted and expanded on a larger scale in the future.

METHODOLOGY

This was a school-based, uncontrolled pre- and post-interventional study conducted among preschool children in Kota Setar district, Kedah. The study was carried out in

2023 involving 79 preschool children aged 4 to 6 years, who were selected through convenience sampling. Four preschools were selected namely Tabika Kemas Penjara, Tabika Kemas Jalan Fajar, Tadika Perpaduan Telok Wanjah and Tadika Perpaduan IPK Kota Setar. The selection criteria were based on school availability, willingness to participate, accessibility to the Dedicated Promotion Team (DPT) Team C and logistical considerations.

The oral hygiene status of the preschool students was measured using a plaque score index developed by the Ministry of Health Malaysia. The index was modified from the Plaque Index System by Loe & Sillnes (1967) and the plaque scores were categorised into three grades namely grade A, C and E. For score 0–4, it will be classified as Grade A (Low risk); score 5–9 will be classified as Grade C (Moderate risk) and score 10–18 will be classified as Grade E (High risk). A plaque disclosing agent, using GC Tri Plaque ID Gel, was applied directly onto the student's teeth. The students were not allowed to rinse their mouth to retain the agent and highlight plaque deposits for more accurate scoring. Then, oral examinations were conducted by two calibrated dental therapists and the plaque was scored accordingly.

Then, the intervention program was designed using the Brush *'N Go* concept. During the intervention, a 30-minute *Latihan Memberus Gigi* (LMG) session was conducted, which is akin to a toothbrushing drill (Ministry of Health Malaysia, 2022), along with other intervention activities such as role-playing, storytelling, interactive books, multimedia shows and interactive games. After a 6 months interval, the plaque scores were reassessed among the preschool children.

The primary outcome variable assessed in this study was the change in the plaque score grade at the post-intervention. The independent variables included age, gender, and the preschool attended. Plaque scores were recorded manually in the dental record card namely LP8 card and later transferred into Google Sheets.

RESULTS

A total of 92 preschool children were initially recruited; however, 13 were later excluded due to absenteeism or lack of parental/guardian consent during the follow-up visit. Pre- and post-intervention assessments were completed for 79 preschool children, with a dropout rate of 14.13%.

The majority of participants were Malay (91.1%), with the remaining being Chinese and Indian. Due to the small sample size among non-Malay participants, racial subgroup analysis was not performed. In terms of age distribution, most participants were 6 years old (58.2%), followed by 5-year-olds (36.7%), with only a small proportion aged 4 years (5.1%).

At pre-intervention, 28 preschool children (35.4%) recorded low plaque scores (Grade A), 14 preschool children (17.7%) had high plaque scores (Grade E), and 37 students (46.9%) fell into the moderate score category (Grade C). Following the six-

month intervention, there was a notable shift in plaque score distribution. The number of students in Grade A increased to 49 (62.0%), indicating an improvement in oral hygiene. The number of students in Grade C decreased to 26 (32.9%), while those in Grade E reduced to 4 (5.1%) (Table 1).

Table 1: Comparison between Pre-Post Intervention Plaque Score (N=79)

Kindergarten	Plaque Score	Pre-Intervention	Post-Intervention
Tabika Kemas Penjara	A	3	16
	C	8	2
	E	9	2
Tabika Kemas Jalan Fajar	A	6	14
	C	9	4
	E	4	1
Tadika Perpaduan Telok Wanjah	A	8	8
	C	11	12
	E	1	0
Tadika Perpaduan IPK Kota Setar	A	11	11
	C	9	8
	E	0	1

The difference in plaque scores between the pre- and post-intervention periods based from **Table 2** is summarized as follows: Grade A (Low risk): increased from 28 to 49 students, Grade C (Moderate risk): decreased from 37 to 26 students and Grade E (High risk): decreased from 14 to 4 students.

Table 2: Total comparison between Pre-Post Intervention Plaque Score

Plaque Score	Pre-Intervention	Post-Intervention
A	28	49
C	37	26
E	14	4

DISCUSSION

The findings suggest that the combination of *Latihan Memberus Gigi* (LMG) sessions and complementary activities such as storytelling, role-play, and interactive demonstrations was effective in promoting behavioural change and improving daily oral hygiene among preschoolers. The increase in Grade A plaque scores, alongside a consistent reduction in moderate- and high-risk categories, reflects both improved

plaque control and better compliance with oral health messages delivered during the intervention period.

This outcome may also be attributed to the cultural and linguistic appropriateness of the intervention. With 91.1% of participants being Malay, activities were primarily conducted in Malay and English. This ensured better engagement and comprehension among the children, supporting the locally adapted *"Brush & Go"* concept. Although no comparative statistical analysis between ethnic groups was performed due to the uneven distribution, the overall improvements suggest general effectiveness across the population.

The positive trend was observed consistently across all participating preschools, indicating the programme's effectiveness regardless of school setting. Structured activities like supervised toothbrushing, game-based learning, and role-playing proved to be both engaging and educational for this age group. Previous studies support the use of such methods—game-based interventions combined with repeated reinforcement have been shown to improve various oral hygiene indices, including debris, plaque, and calculus scores (Patil *et al.*, 2024).

These findings align with the life-course approach promoted by the FDI World Dental Federation and Malaysia's NOHSP, both of which advocate for early, preventive action to improve long-term health outcomes. This study adds to the existing evidence by demonstrating short-term effectiveness in a Malaysian preschool setting, an area often overlooked in favour of interventions targeting older children, as noted in the review by Akera *et al* (2022).

Despite these promising results, the study had several limitations. Logistical challenges such as limited space for toothbrushing drills, transportation constraints for DPT members, and inconsistent adherence to standard protocols highlighted issues of sustainability. The absence of a control group and the relatively small sample size also limit the generalisability of findings.

For future interventions, the use of Artificial Intelligence (AI) should be explored. AI-powered chatbots, such as the "30-Day FunDee" mobile app by Prince of Songkla University, have shown potential in replicating human-like communication and delivering accessible oral health education (Pupong, K *et al.,* 2025). Given the high prevalence of dental caries in children, scalable and engaging tools like these could enhance early intervention efforts. Nonetheless, further research is needed to evaluate its long-term effectiveness, particularly in preschool populations.

CONCLUSION

This pilot initiative suggests that the Dedicated Promotion Team (DPT) plays a valuable role in improving oral hygiene among preschoolers through structured, school-based activities. The increase in Grade A plaque scores across all

participating preschools indicates the potential effectiveness of simple and age-appropriate interventions in shaping early oral health behaviours.

While the results are promising, limitations such as small sample size, short duration, and logistical issues should be acknowledged. Despite these challenges, the findings affirm that early oral health education can produce measurable improvements even within limited settings. Future studies should incorporate a control group, extend the follow-up period, and involve a broader sample to better assess long-term outcomes and the scalability of such programmes

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A STUDY ON ORAL HEALTH LITERACY AMONG THE SELECTED YOUNG ADULTS IN KEDAH

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ABSTRACT

Introduction: Oral health literacy (OHL) plays a pivotal role in determining the outcome of an individual's oral health behaviour and oral health status. However, it is often overlooked and inadequately assessed in the populations. Therefore, determining OHL of the selected young adults from the state of Kedah would show the progress and the effectiveness of oral health programmes that have been done in Kedah.

Methods: A cross-sectional study that employed a multistage sampling method was conducted involving randomly selected form six students from 31 schools in Kedah. Validated self-administered oral health literacy questionnaires were distributed. The descriptive statistics, univariate analysis and general linear model were used for data analysis using SPSS version 27.

Results: A total of 754 participants were involved in the study, comprises of Malays (88.5%), females (69.1%) and resided in rural areas (66.7%). The majority of participants (98.7%) have received an incremental dental care program throughout their school years. The overall mean OHLI score was 69.86 (SD=12.03). A statistically significant difference in OHLI-M scores is observed across the ethnic groups (p= 0.003), with Malay respondents having the highest mean score (M=70.32, SD=11.74). On the contrary, participants who smoked exhibited a low OHLI score with a lower adjusted mean score (M=60.61) and a negative impact (β =- 4.976).

Conclusion: These findings highlighted the need for a targeted education intervention to enhance OHL and promote preventive oral healthcare behaviours. Thus, assessing OHL is a crucial addition to determine the level of understanding among the populations in regards to shared health information.

Keyword: oral health, oral health literacy, young adult

INTRODUCTION

Oral health literacy (OHL) can be defined as “degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate decisions” (American Dental Association, 2010). A study by Priscilla (2019) showed that having an in-depth understanding of oral health demonstrates better oral health care practice and vice versa. In developed countries, oral health literacy is now considered as a new determinant for deciding oral health outcomes at the individual level. Several instruments have been developed over the years to measure health literacy and one of them was adapted and translated into Malay for the ease of use in the Malaysian population. The Malay version of Oral Health Literacy Instrument (OHLI-M) contains both reading comprehension and numeracy sections to measure a person’s ability to perform oral health literacy tasks that require reading comprehension and numeracy skills.

The Malaysian Ministry of Health launched the National Oral Health Strategic Plan 2022-2030 (NOHSP 2022 - 2030) which aims to improve the oral health status and quality of life for Malaysians. One of the strategies is to emphasize on extending oral healthcare coverage to the young adults. The young adults are defined as a person within the age range of 15 – 24 years old. In order to have an efficient delivery and exchange of oral health information, the assessment of oral health literacy (OHL) is crucial. Although there are already a few programmes accommodated to the young adults such as the continuation of incremental dental care, programme for trainee teachers in Institut Pendidikan Guru (IPG) and Transformation with 1 Smile Together (TW1ST) that focusses on community college students. However, without first assessing the level of OHL, it is difficult to determine whether the delivery of information has been effective.

The National Health and Morbidity Survey (NHMS) in 2019 revealed that among young adults aged 15 -19 only 48.8% utilized the outpatient oral healthcare services and these figures declined among those aged 20-24 at only 18.3%. Berkman (2011) found numerous studies that indicate poor oral health was strongly linked to low HL and lesser use of health services. This study aims to assess the level of oral health literacy and its associated factors among the selected young adults in the state of Kedah. The specific objectives of this study are as follows:

1. To investigate the level of oral health literacy among the selected young adults.
2. To determine the association (if exist) between oral health literacy with socio-demographic factors, oral health behaviour and oral health perception among the selected young adults.
3. To identify factors associated with mean OHLI score among the selected young adults.

This study is important as it can help us identify the level of comprehension of our stakeholders and further improve the quality of our oral health education and services towards them.

METHODOLOGY

This cross-sectional study was conducted across 11 districts in the state of Kedah using a multistage sampling approach. A total of 60 facilities with lower Form Six students were stratified into urban and rural areas. From these, 31 facilities were randomly selected, ensuring representation from both urban and rural settings. The calculated sample size was 583, which included a 20% allowance for potential dropouts. The samples were randomly selected among the lower form six students from each facility with the inclusion criteria of Malaysian nationality, aged between 18 to 23 years, and in good health. Samples were excluded if they were not permanent residents of Kedah or if they were unable to understand, read, or write in Malay.

The tool that was used for this study is the validated and adapted Malay language Oral Health Literacy Instrument (OHLI-M). In this study, the self-administered questionnaire was distributed to the participants through an online platform, Google Form. The questionnaire was divided into three domains:

Section A: Sociodemographic
Section B: Self-perceived oral health
Section C: Oral health practice and behaviour
Section D: Malay version oral health literacy instrument (OHLI-M)

The collected data were cleaned prior to analysis. For the OHLI-M questionnaire, the scoring formulation had been predetermined. Categorical variables were summarized as frequencies and percentages, while numerical variables were presented as means and standard deviations for normally distributed data, or as medians and interquartile ranges for non-normally distributed data. All analyses were performed using IBM SPSS Statistics version 27.

RESULTS

In this study, a total of 754 participants completed the self-administered questionnaire, resulting in a completion rate of 100%.

Table 1 shows the demographic distribution of respondents. The majority were female (69.1%), Malays (88.5%) and resided in rural areas (66.7%). Most respondents reported their parents having a Level II education (76.3%) and 69.1% had one or both parents employed. Nearly all respondents indicated participation in an incremental dental care program at their previous school (98.7%), and most were non-smokers (96.7%). Almost all respondents perceived their oral health status as

good (75.5%) and expressed satisfaction–with their current oral health condition (78.9%). However, 65.8% reported requiring dental treatment despite acknowledging good oral health. Regarding oral health practice, the majority maintained good habits, with 96.4% brushing their teeth twice or more daily. Unfortunately, only 20.2% were aware of the use of dental floss for cleaning between teeth. Most respondents reported using fluoridated toothpaste (86.6%) and replacing their toothbrushes according to the dentist's recommendation which is every 3 months or when it has split ends (71.0%).

Table 1: Demographic characteristics of respondents (N= 754)

Variables	n (%)
a) Demographic characteristics	
Gender	
Male	233 (30.9)
Female	521 (69.1)
Ethnic group	
Malay	667 (88.5)
Chinese	50 (6.6)
Indian	27 (3.6)
Others	10 (1.3)
Parent's education level	
Level I	104 (13.8)
Level II	575 (76.3)
Level III	75 (9.9)
Parent's employment status	
Employed	467 (61.9)
Self-Employed	86 (11.4)
Unemployed	201 (26.7)
Strata	
Urban	251 (33.3)
Rural	503 (66.7)
Received incremental dental care in previous school	
Yes	744 (98.7)
No	10 (1.3)
Smoking Status	
Yes	25 (3.3)
No	729 (96.7)
b) Self-reported Oral Health Status	
Oral health status	
Good	569 (75.5)
Moderate	181 (24.0)
Poor	4 (0.5)
Oral health satisfaction	
Satisfied	595 (78.9)
Unsatisfied	159 (21.1)

Require dental treatment	
Yes	496 (65.8)
No	258 (34.2)
c) Oral Health Practice	
Toothbrushing frequency	
Once or less daily	27 (3.6)
Twice or more daily	727 (96.4)
Cleaning in between teeth	
Dental floss	152 (20.2)
Toothbrush + toothpaste	492 (65.2)
Toothpick	69 (9.2)
Mouthwash	41 (5.4)
Type of toothpaste used	
Fluoridated toothpaste	653 (86.6)
Non-fluoridated toothpaste	101 (13.3)
Change of toothbrush	
Every 3 months or when it has split ends	535 (71.0)
Every 6 months	177 (23.5)
Every year or more	42 (5.6)

Table 2 shows the distribution of OHLI-M score based on the oral health literacy (OHL) levels defined by the questionnaire. More than one third of the respondents demonstrated a marginal level of oral health literacy (42.2%).

Table 2: Distribution of OHLI-M scores according to OHLI-M level. (N= 754)

OHL Levels	n (%)
Inadequate	145 (19.2)
Marginal	318 (42.2)
Adequate	291 (38.6)

As shown in Table 3, the mean OHLI-M score was significantly associated with the respondent's ethnic group, parent's employment status, residential strata, and perceived need for dental treatment. A statistically significant difference in OHLI-M scores was found across ethnic groups (p = 0.003), with Malay respondents having the highest mean score, 70.3 (SD=11.74), while Indian respondents had the lowest (M= 63.9, SD=16.37). Additionally, a statistically significant difference was observed based on parents' employment status (p=0.005). Respondents whose parents were employed had the highest mean score (M=70.9, SD=11.62), followed by those with self-employed parents (M=68.5, SD=12.83) and those with unemployed parents (M=67.8, SD=12.36). There was also a significant difference in the mean OHLI-M scores between urban and rural participants (p<0.001). Respondents had higher mean scores (M=71.1, SD=11.56) compared to urban respondents (M=67.2, SD=12.57). Based on the need for dental treatment, a statistically significant

difference in mean OHLI-M scores was also observed (p=0.009). Respondents who reported requiring dental treatment had higher mean scores (M=70.6, SD=11.62) those who did not (M=68.2, SD=12.66).

Table 3: Association between Mean OHLI-M score with sociodemography characteristics, self-reported oral health status and oral health practices. (N= 754)

Variables	n (%)	Mean OHLI-M score (SD)	*p-value*
a) Demographic characteristics			
Gender			
Male	233 (30.9)	69.505 (13.33)	0.611[a]
Female	521 (69.1)	70.018 (11.40)	
Ethnic group			
Malay	667 (88.9)	70.322 (11.74)	0.003[b]
Chinese	50 (6.6)	66.116 (11.78)	
Indian	27 (3.6)	63.899 (16.37)	
Others	10 (1.3)	73.828 (12.53)	
Parent's education level			
Level I	104 (13.8)	70.533 (12.47)	0.382[b]
Level II	575 (76.3)	69.540 (12.10)	
Level III	75 (9.9)	71.380 (10.82)	
Parent's employment status			
Employed	467 (61.9)	70.957 (11.62)	0.005[b]
Self-Employed	86 (11.4)	68.570 (12.83)	
Unemployed	201 (26.7)	67.862 (12.36)	
Strata			
Urban	251 (33.3)	67.294 (12.57)	<0.001[a]
Rural	503 (66.7)	71.140 (11.56)	
Received incremental dental care in previous school			
Yes	744 (98.7)	69.87 (12.08)	0.839[a]
No	10 (1.3)	69.09 (8.07)	
Smoking Status			
Yes	25 (3.3)	69.74 (11.2)	0.178[c]
No	729 (96.7)	71.06 (17.1)	
b) Self-reported Oral Health Status			
Oral health status			
Good	569 (75.5)	72.38 (18.4)	0.178[d]
Moderate	181 (24.0)	71.06 (14.5)	
Poor	4 (5.0)	73.69 (13.5)	
Oral health satisfaction			
Satisfied	595 (78.9)	69.90 (12.11)	0.857[a]
Unsatisfied	159 (21.2)	69.70 (11.77)	
Require dental treatment			
Yes	496 (65.8)	70.68 (11.62)	0.009[a]
No	258 (34.2)	68.26 (12.66)	

c) Oral Health Practice			
Toothbrushing frequency			
Once or less daily	27 (3.6)	69.98 (11.85)	0.270[a]
Twice or more daily	727 (96.4)	66.48 (15.98)	
Cleaning in between teeth			
Dental floss	152 (20.2)	72.12 (11.94)	0.105[b]
Toothbrush + toothpaste	492 (65.2)	69.44 (11.97)	
Toothpick	69 (9.2)	68.45 (11.67)	
Mouthwash	41 (5.4)	68.81 (13.04)	
Type of toothpaste used			
Fluoridated toothpaste	653 (86.6)	69.61 (12.02)	0.152[a]
Non-fluoridated toothpaste	101 (13.3)	71.45 (12.01)	
Change of toothbrush			
Every 3 months / when it has split ends	535 (71.0)	70.22 (12.02)	0.111[b]
Every 6 months	177 (23.5)	69.65 (11.93)	
Every year or more	42 (5.6)	66.21 (12.28)	

Note: [a]Independent t-test
[b]One Way ANOVA test
[c]Mann-Whitney U test, presented as median (interquartile range)
[d]Kruskal-Wallis test, presented as median (interquartile range)

Table 4 presents several factors associated with the mean OHLI-M score. Parents' employment status, strata, respondents' smoking status, need for dental treatments, practices in cleaning between teeth, and toothbrush replacement habits were significantly associated with the mean OHLI-M score. Parent's employment status had a significant impact on OHLI-M scores (p=0.005), with respondents of employed parents achieving the highest adjusted mean score (M=64.9, β=2.804), indicating better oral health literacy compared to those with self-employed parents and unemployed parents.

Significant differences in OHLI-M scores were also observed between urban and rural respondents (p=0.001), where rural respondents had higher adjusted mean scores (M=64.7), reflecting better oral health literacy. Smoking status also influenced scores (p=0.047), with non-smoker scoring higher (M=65.5) than smokers. Oral health practices such as flossing (M=72.9, β=3.723) and timely toothbrush replacement (p=0.038) were positively associated with OHLI-M scores. Respondents replacing toothbrushes every three months or when the bristles showed wear had higher scores (β=4.008), with scores declining as replacement intervals lengthened.

Table 4: Factors associated with the Mean OHLI-M score

Variables	n (%)	Adjusted Mean (SE)	*β coefficient*	*p-value*
a) Demographic characteristics				
Gender				
Male	233 (30.9)	63.16 (3.32)	0.122	0.902
Female	521 (69.1)	63.04 (3.44)	0[a]	-
Ethnic group				
Malay	667 (88.9)	64.27 (3.19)	-3.033	0.425
Chinese	50 (6.6)	61.72 (3.53)	-5.589	0.179
Indian	27 (3.6)	59.10 (3.99)	-8.203	0.065
Others	10 (1.3)	67.31 (4.82)	0[a]	-
Parent's education level				
Level I	104 (13.8)	63.11 (3.51)	-0.868	0.640
Level II	575 (76.3)	62.21 (3.36)	-1.767	0.234
Level III	75 (9.9)	63.98 (3.51)	0[a]	-
Parent's employment status				
Employed	467 (61.9)	64.95 (3.30)	2.804	0.005
Self-Employed	86 (11.4)	62.21 (3.58)	0.070	0.964
Unemployed	201 (26.7)	62.14 (3.40)	0[a]	-
Strata				
Urban	251 (33.3)	61.50 (3.37)	-3.203	0.001
Rural	503 (66.7)	64.70 (3.39)	0[a]	-
Received incremental dental care in previous school				
Yes	744 (98.7)	63.41 (2.87)	0.622	0.872
No	10 (1.3)	62.79 (4.64)	0[a]	-
Smoking Status				
Yes	25 (3.3)	60.61 (3.96)	-4.976	0.047
No	729 (96.7)	65.59 (3.13)	0[a]	-
b) Self-reported Oral Health Status				
Oral health status				
Good	569 (75.5)	68.02 (1.34)	0.847	0.890
Moderate	181 (24.0)	66.74 (1.40	-0.433	0.943
Poor	4 (5.0)	67.17 (6.14)	0[a]	-
Oral health satisfaction				
Satisfied	595 (78.9)	67.511 (2.41)	0.401	0.759
Unsatisfied	159 (21.2)	67.11 (2.42)	0[a]	-
Require dental treatment				
Yes	496 (65.8)	68.69 (2.31)	2.764	0.004
No	258 (34.2)	65.92 (2.43)	0[a]	-
c) Oral Health Practice				
Toothbrushing frequency				
Once or less daily	27 (3.6)	69.03 (2.04)	3.446	0.144
Twice or more daily	727 (96.4)	65.588 (3.07)	0[a]	-

Cleaning in between teeth				
Dental floss	152 (20.2)	72.97 (1.47)	3.723	0.033
Toothbrush + toothpaste	492 (65.2)	70.25 (1.16)	1.005	0.515
Toothpick	69 (9.2)	69.51 (2.11)	0.260	0.912
Mouthwash	41 (5.4)	69.25 (1.79)	0[a]	-
Type of toothpaste used				
Fluoridated toothpaste	653 (86.6)	69.53 (1.15)	-1.935	0.133
Non-fluoridated toothpaste	101 (13.3)	71.46 (1.59)	0[a]	-
Replacement of toothbrush				
Every 3 months or when it has split ends	535 (71.0)	70.21 (0.52)	4.008	0.038
Every 6 months	177 (23.5)	69.65 (0.90)	3.444	0.095
Every year or more	42 (5.6)	66.20 (1.85)	0[a]	-

Note: [a]This parameter was set to 0 because it is redundant.

DISCUSSION

The need to determine the oral health literacy (OHL) level in a population is of utmost importance. It allows dental health professionals to modify their approach and communication strategies for every patient. Oral health literacy may be a determinant of oral health (Naghibi et. al, 2013). Hence it is important to identify individuals with low OHL in the present study, who were less aware and less motivated towards oral healthcare. To achieve acceptable oral health status, an individual must first understand oral health in general, followed by ways to access information regarding oral health and finally recognize it.

The majority of participants had a ‘marginal’ and ‘adequate’ level of oral health literacy (80.8%), followed by 19.2% which are ‘inadequate’ levels. This result coincides with a study by Jaafar et. al (2020) which showed that the majority of undergraduates students in one of the public universities in Malaysia had an adequate level of oral health literacy. The majority of the respondents were involved in the school dental services (98.7%), where mandatory yearly dental screening, treatments and continuous oral health education are provided. This shows that the respondents still retain the information and knowledge from their time of involvement in the programme. Unfortunately, some respondents did have an inadequate level of OHL and maybe it was due to the questionnaire being administered in the Malay language. As Malaysia is a multiracial country, some variation in reading comprehension was expected, particularly among participants for whom Malay is not

their mother tongue. This suggests that individuals who are less proficient in Malay may benefit from simplified language and clear, straightforward instructions during oral health education and consultations, rather than the use of complex or technical terminology.

Several factors were found to be significantly associated with mean OHLI-M score namely parent's employment status, residential strata and the smoking status of the respondents. Parent's employment status is one of the factors that appear to be significantly associated with the mean OHLI-M score (p = 0.005). As discussed before, studies by Adil (2020), Lopes (2020) and Saddki (2022) have found the same relationship where parent's employment status and OHL level are positively correlated. A stable family income is associated with having better access to oral healthcare and oral health education.

Residential strata were also one of the factors associated with mean OHLI-M score. Unfortunately, there are no other studies that have proven strata as one of the associated factors with the level of OHL. National Health and Morbidity Survey (NHMS) in 2019 showed Malaysians aged 18 and older, those living in rural areas were less likely to seek professional dental care compared to urban residents. However, in recent years, more oral health services have become available in the rural areas through school dental services and oral health promotional programmes. This wider coverage means that even people from lower-income or rural backgrounds are now able to utilize oral health services and further improve their OHL.

Lastly, the smoking status of the respondents was also found to be associated with the mean OHLI-M score (p = 0.047). This shows that the participants who are an active smoker have lower mean OHLI-M score. Hoover (2015) reported that inadequate health literacy was significantly associated with current smoking compared with never smoking among African American adults in the US. Additionally, many studies found that lower health literacy is associated with smoking (Fawns-Ritchie et. al, 2018), higher smoking relapse rate (Steward et. al, 2014) and lower possibility in smoking cessation (Atri et. al, 2018). Nonetheless, there is still no evidence of having significant association between OHL with smoking status locally and globally.

LIMITATION

This study has few limitations. First, we measured the OHL among the selected young adults using a cross-sectional design. As a result, we are unable to examine the causality relationship between the two variables. Although few variables showed a statistically significant finding, there is no proof of the cause and effect relationship between the OHL and these variables. Second, although a variety of validated OHL questionnaires are available, this study employed the OHLI-M because it is reliable and has been translated into the national language, Malay. However, it is worth

noting that some participants were from ethnic minority backgrounds, and the results indicated that Malay participants had higher mean OHL scores compared to those from other ethnicities.

CONCLUSION

In conclusion, respondents with a higher mean OHLI-M score demonstrated not only a better understanding of oral health concepts but also the ability to process and apply information to their daily lives. The findings of this study highlight several important implications. Firstly, while the majority of the respondents showed adequate levels of OHL, there remain specific groups particularly those from lower socioeconomic backgrounds and non-Malay ethnicities who may not fully benefit from the existing oral health education efforts. This suggests that a “one-size-fits-all” approach to oral health promotion may not be effective.

Secondly, tailoring oral health education into simpler, culturally sensitive, and more engaging formats is essential to ensure inclusivity. For example, using multilingual resources, community-based outreach, and digital platforms may help reduce comprehension barriers. Strengthening school and community dental programs with contextualized messages can also empower disadvantaged groups to make informed decisions about their oral health.

Finally, these findings reinforce the importance of assessing OHL levels at the population level. Regular monitoring allows policymakers and practitioners to identify vulnerable groups, allocate resources more efficiently, and design targeted interventions that close gaps in understanding. By prioritizing OHL as a determinant of oral health, Malaysia can move towards more equitable and effective oral health communication strategies. Thus, ensuring that every community, regardless of background, has the opportunity to achieve better oral health outcomes.

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KUDAH: FROM WASTE TO WELLNESS – ADVANCING COMMUNITY IN INTEGRATING ENVIRONMENTAL AWARENESS AND HEALTHY LIVING IN PADANG TERAP

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ABSTRACT

Introduction: Vector-borne diseases such as Leptospirosis, Dengue, and Malaria continue to affect communities due to poor environmental hygiene. Padang Terap District reported two Dengue and one Leptospirosis outbreak in 2024. The act of littering creates breeding grounds for pests, contributing to the spread of these diseases. The KUDAH (*Kutip Sampah Sambil Riadah*) initiative was launched by the Padang Terap District Health Office to raise environmental health awareness, encourage litter clean-up practices, and promote physical and mental well-being through community-based recreational activities. This study aims to evaluate the effectiveness of the KUDAH initiatives.

Methodology: A quasi-experimental pre-post study was conducted over three months in selected recreational areas in Padang Terap. The participants involved healthcare workers and communities in guided recreational clean-up sessions included environmental awareness talks, physical activities and waste collection activities. Baseline data were collected on participants' anthropometric measurements, mental health status, and environmental health knowledge, attitude, and practice (KAP) through a structured survey. During each session, BMI and the weight of collected waste was recorded. Data were analysed using STATA with paired t-tests to assess pre-post differences.

Results: There was a statistically significant improvement in KAP scores, from 14.0 ± 2.6 to 15.1 ± 1.9 ($p=0.0293$), indicating increased awareness of environmental health. Average BMI decreased from 28.5 ± 4.1 to 28.1 ± 4.4 ($p=0.0406$), showing positive physical health impact. Mental health screening showed 100% of participants remained within normal range both before and after the program. Environmental clean-up efforts collected 3.8 kg of litter and filled one RORO bin, reflecting active engagement.

Conclusion: KUDAH successfully integrated environmental advocacy with healthy lifestyle promotion. The program demonstrated measurable improvements in knowledge, behaviour, and well-being. KUDAH is a model of sustainable, community-led health empowerment that embodies the principle of "Health for All"— starting from and returning to the community.

Keywords: Community health, environmental awareness, healthy lifestyle, KUDAH, recreational, waste management

INTRODUCTION

Vector-borne diseases such as Leptospirosis, Dengue, and Malaria remain pervasive public health threats in many tropical and subtropical regions of the world, including Malaysia. These diseases not only impact individual health but also place a significant burden on healthcare systems, especially in resource-limited settings. According to the World Health Organization (2022), vector-borne diseases account for over 700,000 deaths globally each year, with more than 3.9 billion people in over 120 countries at risk of contracting such illnesses. In the Malaysian context, environmental factors like poor waste management and urbanization without adequate infrastructure have exacerbated the transmission of vector-borne diseases.

In 2023, Padang Terap District recorded 10 cases of Leptospirosis and 2 cases of Malaria, while in 2024, two outbreaks of Dengue were declared in April and one outbreak of Leptospirosis occurred in June at Taman Eko Rimba Puncak Janing. These outbreaks underscore the need for sustained public health interventions aimed at controlling the breeding grounds of disease vectors, particularly through improved waste management and environmental cleanliness.

Littering and improper waste disposal create ideal conditions for mosquitoes and rodents to thrive, facilitating the transmission of vector-borne diseases. Moreover, unmanaged waste negatively affects community aesthetics, reduces the usability of public recreational spaces, and poses risks to local ecosystems. Public awareness and participation are key to combating these issues effectively. However, studies such as Tiong et al. (2021) indicate that knowledge and behavior related to environmental health remain inconsistent across different population groups in Malaysia.

To address these challenges, the Padang Terap District Health Office initiated KUDAH (Kutip Sampah Sambil Riadah), a multifaceted health promotion initiative that integrates environmental awareness with physical activity. The initiative leverages community engagement to promote cleanliness, raise awareness of the health risks associated with littering, and encourage healthier lifestyle practices. The program also aligns with Malaysia's broader "Healthy Settings" strategy, which advocates for community-led health improvement initiatives.

This technical report presents a comprehensive evaluation of the KUDAH program, focusing on its impact on environmental health knowledge, attitudes, and practices (KAP), physical health (as measured by body mass index or BMI), and mental well-being. Additionally, the report assesses the environmental impact of the program, specifically in terms of waste collection and community participation.

OBJECTIVES

The KUDAH initiative was designed with the overarching aim of enhancing environmental health awareness while simultaneously promoting healthy lifestyle practices among healthcare personnel and the wider community in Padang Terap District. This technical report evaluates the initiative's impact through four specific objectives:

Firstly, the program aimed to assess changes in environmental health knowledge, attitudes, and practices among participants. This evaluation sought to determine whether the KUDAH initiative effectively conveyed information about environmental risks and fostered positive behavioural change in waste management and personal responsibility.

Secondly, the initiative sought to evaluate physical health outcomes by measuring changes in participants' BMI before and after program participation. Given the rising prevalence of overweight and obesity among healthcare workers and the general population, the inclusion of physical activity components in KUDAH aimed to address this health concern.

Thirdly, the program evaluated mental health outcomes using validated screening tools. Mental well-being is an integral part of overall health, and workplace stress can contribute to mental health issues among healthcare workers. KUDAH incorporated mental health considerations to provide a holistic health promotion approach.

Finally, the program measured environmental engagement and impact by quantifying the volume and type of litter collected during the clean-up sessions. This data served as an indicator of participant involvement and the program's effectiveness in addressing local waste management issues.

METHODOLOGY

This evaluation adopted a quasi-experimental pre-post design conducted over three months from March to June 2024. The study design allowed for measurement of change in KAP scores, BMI, and mental health indicators among participants, while also assessing environmental outcomes. Given the nature of the intervention, randomization was not feasible, and all eligible participants were enrolled based on predefined criteria.

Participants included 36 healthcare staff from the Padang Terap District Health Office. Eligibility criteria required participants to have a BMI greater than 25, be physically healthy, and willing to engage in all program components. The cohort included staff from various departments, including clinical services, public health, and administration, ensuring diverse representation.

KUDAH sessions were held at three locations: Kampung Kuala Tualak (4 March 2024, 120 participants), Gunung Kerengga (16 May 2024, 52 participants), and Bukit Ahning (13 June 2024, 46 participants). Only the 36 staff members were evaluated for KAP, BMI, and mental health changes. Broader participation in clean-up activities supported environmental impact assessment.

Each session commenced with a structured environmental health awareness talk. Topics included the impact of littering on disease transmission, vector control strategies, and the role of individual and collective responsibility in waste management. Talks were delivered interactively by health officers.

Subsequently, participants undertook guided physical activities tailored to moderate exertion levels, such as group walking and stretching. These activities aimed to foster physical fitness and social bonding.

The final component involved litter collection in designated areas. Waste was sorted by type, weighed, and recorded. Data from these activities provided empirical measures of community engagement.

Data collection tools comprised:

- A 15-item KAP survey, adapted from previous studies (Tiong et al., 2021) and administered pre- and post-program via Google Forms. The survey assessed three domains—knowledge, attitude, and practice—using multiple-choice and Likert-scale items. In this study, no specific cut-off points were applied to categorize responses into “good” or “poor” levels. Instead, analysis focused on comparing mean scores and identifying improvements in participants’ responses between baseline and post-intervention. This approach allowed changes in knowledge, attitudes, and practices to be interpreted in relative terms rather than absolute thresholds.
- BMI measurements using standardized height and weight equipment, with BMI calculated as weight (kg)/height (m^2).
- Mental health assessments using GAD-2 and Whooley questionnaires, both validated for use in community health settings.
- Environmental metrics including the total weight of litter collected and RORO bin usage, recorded at each session.

Data were analysed using STATA 15. Paired t-tests assessed differences in pre- and post-program KAP scores and BMI. Mental health results were summarized descriptively, and environmental outcomes were reported in terms of volume and type of litter collected.

Ethical considerations included informed consent from participants and data confidentiality assurances. The study was approved by the Padang Terap District Health Office management.

RESULTS

The KUDAH initiative resulted in several significant outcomes, particularly in the areas of environmental health knowledge, attitudes, practices, physical health, and community engagement. A total of 36 healthcare staff members completed the full evaluation protocol, including KAP surveys, BMI assessments, and mental health screening.

Environmental Health Knowledge, Attitude, and Practice (KAP)

Baseline KAP survey results indicated that while general knowledge of environmental health was relatively high, specific knowledge areas required improvement. For instance, while over 97% of participants could correctly identify common environmental health risks such as river pollution, open burning, and chemical waste, only 83.3% recognized the risks associated with electronic waste, such as improper disposal of batteries and mobile devices. Post-intervention, knowledge in this area improved to 88.9%.

In terms of attitudes, participants' willingness to modify their lifestyle for the sake of environmental protection improved significantly. Agreement with the statement "I am willing to reduce personal comfort to protect the environment" rose from 52.8% pre-intervention to 63.9% post-intervention. Furthermore, the proportion of participants who cited a lack of time as a barrier to recycling decreased from 33.3% to 22.2%.

Practice-related improvements were the most pronounced. After participating in KUDAH, 26 out of 36 staff (72.2%) reported practicing recycling regularly compared to 20 staff (55.6%) at baseline. Similarly, 23 staff (63.9%) reported refusing plastic bags when shopping, up from 17 staff (47.2%) before the program. The number of staff who brought their own containers for food storage increased from 15 (41.7%) to 21 (58.3%), while those conserving energy at home and work rose from 22 (61.1%) to 27 (75.0%). Staff who initiated conversations with peers about environmental issues increased from 14 (38.9%) to 20 (55.6%). These findings demonstrate that a clear majority of participants adopted new environmental practices following the program, supporting the conclusion that KUDAH substantially influenced daily behaviours.

Physical Health (BMI)

BMI measurements indicated a statistically significant reduction in average BMI among participants, from 28.5 kg/m² to 28.1 kg/m² ($p < 0.05$). Although the reduction was modest, it provides early evidence that community-based interventions like KUDAH may contribute to promoting physical activity and supporting healthier outcomes. Notably, 22 out of 36 participants (61.1%) experienced a decrease in BMI following the program.

However, it should be recognized that BMI reduction over a relatively short period of three months could also be influenced by potential confounding factors, such as changes in participants' diet, personal exercise routines outside of KUDAH, seasonal variations in physical activity, or concurrent health interventions. While the structured physical activities included in KUDAH likely played a contributory role, the observed effect cannot be attributed solely to the program. This underscores the importance of cautious interpretation and the need for longer-term follow-up studies with better control for confounding variables to more accurately determine KUDAH's independent effect on BMI reduction.

Mental Health Screening

Mental health screening via GAD-2 and Whooley tools revealed that all participants remained within normal ranges for both anxiety and depression symptoms before and after the intervention. While quantitative data indicated stability rather than improvement, qualitative feedback from participants suggested enhanced mood, better social cohesion, and a sense of purpose due to active participation in KUDAH. These anecdotal reports underline the importance of including mental health dimensions in health promotion programs.

Environmental Outcomes

In terms of environmental impact, the program successfully engaged participants in waste collection activities. A total of 3.8 kg of litter was collected during the three events, with plastic making up approximately 65% of total waste. Additionally, one RORO bin with a standard capacity of approximately 3 metric tonnes (equivalent to about 10–12 m^3 of waste), was filled during the Kampung Kuala Tualak event, providing tangible evidence of the program's contribution to environmental cleanliness.

DISCUSSION

The KUDAH initiative demonstrated that integrated approaches to health promotion can yield positive outcomes across multiple domains. By combining education, physical activity, and environmental engagement, the program addressed both individual health behaviors and broader community health determinants.

The improvement in environmental health knowledge and attitudes reflects the effectiveness of the educational component, which was designed to be interactive and context-specific. Participants' increased willingness to sacrifice comfort and allocate time for environmentally friendly practices suggests a shift toward sustainable behavior, a key goal in public health interventions.

Physical health improvements, though modest, are important given the growing concern over non-communicable diseases in Malaysia. The reduction in BMI among

participants, coupled with increased awareness of physical activity benefits, highlights the value of incorporating movement into health initiatives.

The stability in mental health scores suggests that while KUDAH did not significantly alter anxiety or depression levels, it likely contributed to emotional well-being through enhanced social interaction and sense of achievement. Future studies should consider including validated quality of life assessments to capture these nuances.

From an environmental perspective, the waste collected and categorized demonstrates the program's success in raising environmental consciousness and promoting civic responsibility. The fact that most collected waste was plastic highlights the ongoing issue of plastic pollution in public spaces.

One limitation of this study is the relatively small sample size and the short duration of the intervention, which may limit the generalizability of findings. Future research should consider larger cohorts and longer follow-up periods to assess sustained behavioural change. Additionally, the reliance on self-reported data in KAP surveys may introduce response bias, although triangulation with objective measures such as BMI and waste collection records helps to strengthen the findings.

Despite these limitations, this study also has several strengths. KUDAH successfully integrated environmental education, physical activity, and community participation into a single, low-cost intervention that is both feasible and replicable. The program demonstrated measurable improvements across multiple domains—knowledge, attitude, practice, physical health, and environmental engagement—within a short period, highlighting its effectiveness as a community-based model. Importantly, KUDAH was designed with a sustainability plan: the activities can be incorporated into routine community health promotion programs, replicated in other districts, and supported by ongoing collaboration between the District Health Office, local councils, and community groups. This embedded approach increases the likelihood that KUDAH will be maintained over time, ensuring long-term impact on both environmental and community health.

CONCLUSION

KUDAH represents a successful model for integrating environmental awareness and healthy living into a single community-based intervention. The program effectively enhanced participants' knowledge, influenced their attitudes and practices, and improved physical health outcomes, while maintaining mental well-being. It also fostered community engagement in environmental stewardship, contributing to cleaner public spaces.

Given its success, KUDAH can be scaled and adapted for use in other districts, especially in areas with similar environmental health challenges. The initiative aligns

well with national health promotion goals and provides a cost-effective, participatory model for improving public health and environmental sustainability.

RECOMMENDATIONS

1. Scale-Up and Replication: Implement KUDAH in other districts using a standardized toolkit, allowing for adaptation to local needs.
2. Policy Integration: Advocate for integration of KUDAH into local and state-level health promotion policies.
3. Sustained Engagement: Establish annual cohorts and long-term follow-up to maintain behavioural changes.
4. Stakeholder Collaboration: Engage with NGOs, private sectors, and local councils to support and expand the program.
5. Enhanced Data Collection: Include qualitative feedback and longer-term impact assessments in future evaluations.

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APPENDICES



Appendix 6.1: Mental Health Talk by Ms. Syifaa' A mental health awareness session was conducted by Ms. Syifaa', Counselor from the Padang Terap District Health Office (PKD Padang Terap). The session focused on stress management, emotional well-being, and strategies for maintaining mental health in daily life. It was well-received by participants and contributed to the holistic health approach of the KUDAH program.



Appendix 6.2: Health Screening and BMI Assessment All KUDAH program participants underwent basic health screenings, including measurements of weight, height, and Body Mass Index (BMI). These assessments were conducted before and after the program to monitor changes in physical health status and to evaluate the impact of the program on participants' overall well-being.



Appendix 6.3: KUDAH Program with the Community of Kampung Kuala Tualak On 4th March 2024, the KUDAH program was conducted in collaboration with the local community of Kampung Kuala Tualak and supported by YIKED Bina Sdn Bhd. The program involved environmental cleanup activities, health promotion sessions, and community engagement aimed at raising awareness on environmental conservation and healthy living.



Appendix 6.4: KUDAH Program at Gunung Kerengga
On 23rd May 2024, the KUDAH program was held at Gunung Kerengga, organized by PKD Padang Terap. The program involved 52 participants, including staff and their family members. Activities included environmental conservation efforts, physical wellness activities, and health education, aimed at fostering a healthy lifestyle while promoting environmental



Appendix 6.5: KUDAH Program at Bukit Ahning
On 13th June 2024, PKD Padang Terap conducted the KUDAH program at Bukit Ahning, with the participation of 46 individuals. The program featured a series of activities centered on environmental awareness, physical health, and team-building. It provided an opportunity to reinforce sustainable practices while fostering unity and collaboration among participants.

BEYOND SIMPLE EXCISION: A BOLD STRATEGIC APPROACH TO RECURRENT PYOGENIC GRANULOMA

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ABSTRACT

Background: Pyogenic granuloma (PG) is a common, non-cancerous growth that often appears in the mouth, especially on the gums. Despite its name, it's not an infection or a true granuloma. Instead, it's an overgrowth of tissue, likely triggered by minor injury or irritation. These lesions can grow quickly and tend to bleed easily, causing discomfort or concern for patients. This report presents a specific case of pyogenic granuloma, detailing its presentation, diagnosis, and treatment approach.

Methodology: A patient was reported with a recurrence of painful gum swelling in the lower left posterior teeth region. Given the distinct clinical characteristics of the lesion, a combination of complete surgical excision using electrocautery with deep curettage followed by comprehensive root surface debridement to resolve this issue.

Results: The case's outcome is promising, as up to six months post operative follow-up revealed successful healing, healthy gingival tissue, and no lesion recurrence.

Discussion: Successful management of pyogenic granuloma depends on accurate diagnosis and the implementation of an appropriate treatment plan, followed by regular maintenance and follow-up to monitor for potential recurrence.

Keywords: Pyogenic granuloma, hyperplastic lesion, benign neoplasm, gingival swelling

INTRODUCTION

Oral Pyogenic Granuloma (OPG) is a benign vascular lesion that represents an exaggerated tissue response to local irritation or trauma. Despite its name, OPG is neither pyogenic nor a true granuloma histologically. It commonly affects the gingiva and is frequently observed in young adults and females, particularly during pregnancy due to hormonal influences (Silk et al., 2008). Clinically, OPG presents as a small, red, hemorrhagic, lobulated mass that bleeds easily on provocation, which can significantly impact oral hygiene maintenance and patient comfort (Epivatianos et al., 2005).

Although typically confined to soft tissue, OPG may occasionally exhibit aggressive behavior, such as alveolar bone loss or tooth mobility, leading to functional and aesthetic challenges (Angelopoulos, 1971; Goodman-Topper & Bimstein, 1994). Recurrence is also a notable concern if the underlying irritants are not eliminated or if remnants of the lesion persist post-treatment (Al-Noaman, 2020). This article aims to highlight the clinical significance of OPG by discussing its characteristic presentation, potential complications, and management strategies, emphasizing the importance of accurate diagnosis and complete removal to prevent recurrence.

METHODOLOGY

This report describes a recurrent case of painful oral pyogenic granuloma in a 14-year-old girl, 3 months after initial surgical incision in the lower left posterior mandible. The lesion *(*Figure 1,2) reappeared as a double lobulated exophytic lesion with area of ulceration present buccally (with est. size of 10 x 11mm, 5x4mm), single lobulated exophytic lesion with area of ulceration present lingually (with est. size of 10 x 11mm) , erythematous in pattern and sessile in shape, soft to firm in consistency and bleed easily. Radiographic imaging (Figure 3*)* revealed horizontal alveolar bone loss and a widened periodontal ligament space on affected teeth 34,35.

Management

Written informed consent was obtained from the patient’s guardian, and ethical approval was secured before intervention.

Local anesthesia was achieved using 2% lidocaine with 1:100,000 adrenaline administered via infiltration. The recurrent lesion, involving buccal and lingual lobulated masses, was completely excised using electrocautery and blade to minimize bleeding and thermal damage. A surgical margin of approximately 1–2 mm of clinically healthy tissue was included, and deep curettage was performed with removal of 2–3 mm of adjacent periosteum and associated granulation tissue to reduce recurrence risk. Hemostasis was achieved with electrocautery, and the surgical field was irrigated with sterile saline. Non-surgical periodontal therapy,

including thorough root surface debridement of teeth 34 and 35 using ultrasonic and hand instruments, was carried out in the same session.

The excised tissue was immediately fixed in 10% neutral-buffered formalin and sent for histopathological evaluation, which confirmed the diagnosis of oral pyogenic granuloma. Post-operatively, the patient was prescribed Ibuprofen 400 mg every 8 hours for one week and instructed to rinse with 0.12% chlorhexidine twice daily for two weeks. Oral hygiene instructions were reinforced, and the patient was scheduled for follow-up visits at one week, one month, three months and six months to monitor healing and prevent recurrence.



Figure 1: Buccal region of lower left premolar region (34,35)



Figure 2: Buccal and lingual of lower left premolar region (34,35)

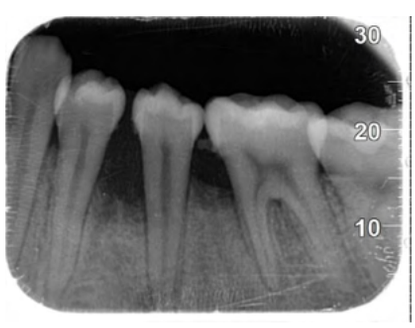


Figure 3: Intraoral periapical x-ray of lower left premolar region (34,35)

RESULTS

The patient's postoperative recovery was uneventful, and healing progressed satisfactorily. At the one-week review, the surgical site demonstrated satisfactory epithelialization with no signs of infection or dehiscence. At one-month follow-up (Figure 4), the tissues appeared healthy with complete epithelial coverage and no residual lesion. The patient reported no pain, discomfort, or functional impairment during mastication or oral hygiene practices.

Subsequent follow-up at three and six months (Figure 5,6) postoperatively confirmed stable healing with no evidence of recurrence. The patient remained asymptomatic throughout the follow-up period, with improved oral hygiene, reduced mobility and normal periodontal probing depths in the affected region.

Histopathological examination revealed a lesion lined by parakeratinized stratified squamous epithelium exhibiting areas of ulceration. The underlying connective tissue stroma showed proliferation of capillary-sized blood vessels lined by plump endothelial cells, intermixed with dense chronic inflammatory cell infiltrate predominantly composed of lymphocytes and plasma cells, confirming the diagnosis of pyogenic granuloma.

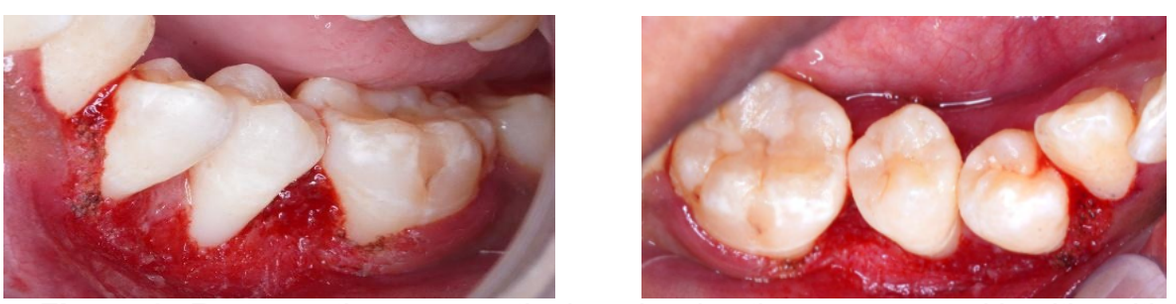


Figure 4: Postoperative one month view showing tissues appeared healthy with complete epithelial coverage

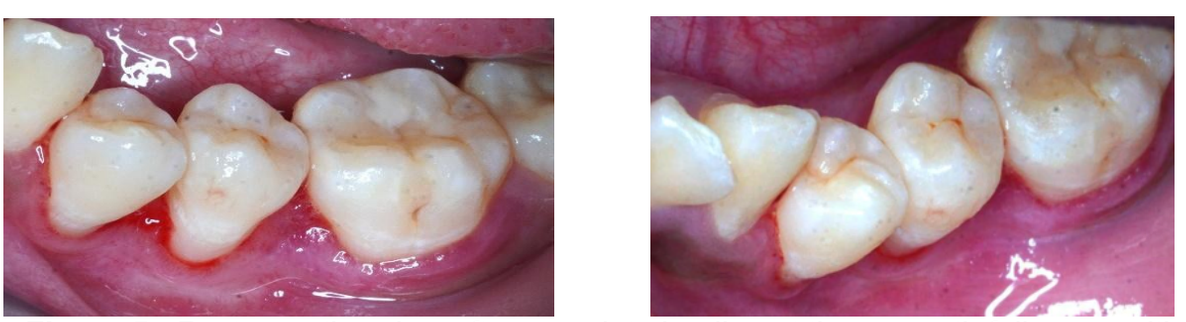


Figure 5: Postoperative view after complete healing at three-month follow-up with no evidence of recurrence.



Figure 6: Postoperative view after six months confirmed stable healing on tissue with improved oral hygiene and normal periodontal probing depths in the affected region

DISCUSSIONS

This case illustrates an uncommon presentation of oral pyogenic granuloma (OPG), notable for recurrence, a lesion size exceeding 3 cm, and alveolar bone involvement—features that are rarely observed in routine clinical practice (Rebolledo et al., 2010; Shenoy & Dinkar, 2006). Most OPGs present as small, localized soft tissue lesions, with recurrence generally linked to persistent local irritants or poor oral hygiene. In contrast, the patient in this case maintained satisfactory oral hygiene, suggesting that incomplete initial excision and lack of adequate follow-up were the primary contributors to recurrence.The recurrence rate for OPG varies from 5.8% to 16%, largely depending on the completeness of excision and elimination of etiologic factors (Al-Khateeb & Ababneh, 2003). Factors contributing to recurrence include retained lesion remnants, failure to address local irritants, and in rare cases, systemic or hormonal influences. In this case, absence of deep curettage and periosteal removal in the previous intervention likely permitted regrowth.

Previous reports describe OPG recurrence typically in association with inadequate surgical margins or when irritants persist (Goodman-Topper & Bimstein, 1994; Al-Noaman, 2020). Bone involvement, although rare, has been documented in pediatric cases and during pregnancy, with some cases requiring more aggressive surgical measures (Ababneh & Al-Khateeb, 2009). Our case aligns with these findings, reinforcing the importance of thorough surgical management to prevent recurrence. The chosen approach—excision using electrocautery combined with aggressive curettage and removal of 2–3 mm of adjacent periosteum—was guided by evidence that simple excision often fails when the lesion infiltrates deeper connective tissue (Al-Noaman, 2020). Electrocautery not only ensured precise excision with minimal intraoperative bleeding but also reduced bacterial contamination, potentially lowering recurrence risk. This comprehensive approach succeeded where simple excision had previously failed.

Recent literature suggests alternative management options, including laser excision (Diode, Nd:YAG, CO_2 lasers), which offer benefits such as enhanced hemostasis, reduced postoperative pain, and faster healing (Jafarzadeh et al., 2006; Verma et al., 2021). Sclerotherapy using sodium tetradecyl sulfate, cryotherapy, and topical agents

like corticosteroids or β-blockers have also been explored in recurrent or surgically challenging cases (Rai et al., 2018). While these modalities show promise, surgical excision with deep curettage remains the gold standard in cases involving bone loss, as observed in our patient.

This case underscores the need for a comprehensive surgical approach, particularly in recurrent OPG cases or when bone involvement is present. The inclusion of periosteum removal and meticulous debridement should be considered standard in such scenarios to reduce recurrence risk. Furthermore, clinicians must ensure regular postoperative follow-up and histopathological confirmation, as clinical features alone may mimic other vascular or neoplastic lesions such as hemangioma or Kaposi sarcoma (Kamal et al., 2012). Adopting evidence-based strategies, including electrocautery-assisted excision or laser technology where appropriate, can enhance treatment outcomes and patient safety.

CONCLUSION

This case highlights that recurrent oral pyogenic granuloma can present with atypical features such as alveolar bone loss and tooth mobility, emphasizing the need for comprehensive diagnostic evaluation to exclude malignancy. The successful outcome in this report suggests that complete surgical excision combined with aggressive curettage and removal of adjacent periosteum may be an effective approach for managing recurrent lesions, particularly when bone involvement is present. Regular follow-up remains essential to monitor healing and detect any recurrence.

Further research with larger case series and extended follow-up periods is recommended to validate the effectiveness of this technique and compare it with emerging modalities such as lasers, sclerotherapy, or minimally invasive approaches.

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PROJECTING A NEW TUBERCULOSIS CASES FOR YEAR 2025 & 2026 IN KEDAH USING SARIMA MODEL

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ABSTRACT

Background: Tuberculosis (TB) remained a significant public health problem that impact population health. The National Incidence Rate (IR) of TB in 2024 is 78 cases per 100,000 population compared to IR TB in Kedah is 65 cases per 100,000 population. However, the mortality rate is the same between national and Kedah which demonstrate the true IR could be higher. Therefore, this study aimed to project monthly new TB cases in 2025-2026.

Methodology: The study data obtained from National Tuberculosis Registry (NTBR) from 1st January 2013 until December 2024. After exploratory data analysis (EDA), the best fitted model is SARIMA (Sessional Autoregressive Integrated Moving Average) model (1,1,1) (1,1,1)12 have a lowest AIC value of 842. A study obtained approval from NMRR ID- 22-00844-ZT9 (IIR).

Results: The forecasting reveals that the number of TB cases in Kedah showing a continuous modest rise of TB cases as 2025 expecting 1424 (2025) and 1450 (2026).

Conclusion: Using SARIMA model in predicting TB cases is much simpler, less complicated, and reliable in projecting TB cases. This model helps the stakeholders in resource allocation and strategized preventive public health measure in defeating TB epidemics.

Keyword: Tuberculosis, Projection Model, ARIMA model

INTRODUCTION

Tuberculosis, caused by the *Mycobacterium tuberculosis*, is a major public health threat and leading infectious cause of death worldwide till this date (WHO, 2024). The reason it continuous to be a threat since ancient time. The reason was due to the unique natural history of tuberculosis such as a long incubation period, a significant proportion of latent TB infection, challenges in diagnosis, long treatment leads to frequent miss treatment poses continuous spread of Mycobacterium tuberculosis (Barberis et al., 2017).

According to the World Health Organization (WHO) about 10.8 million of new cases and 1.25 million death reported annually in the whole world in 2024 (WHO, 2024). In Malaysia, TB is a persistent endemic disease, and its incidence rate (IR) has shown as similar trend with incidence rate of 78 per 100,000 population in 2023 versus 77 per 100,000 population in 2025. Meanwhile in Kedah state, the incidence rate is plateau 65 per 100,000 in 2023 to 65 per 100,000 in 2024 (below than national IR). However, if compared to mortality rate 2024 in Kedah is higher (8.1 per 100,000) than national mortality rate in 2024 (8.0 per 100,000). Based on this statistic, it believes that the true incidence rate of TB in Kedah should be higher than national average. Therefore, that is the reason why forecasting is important to serve as a scientific reference to determine true IR in Kedah and for health authorities to optimize their control strategies and resource allocation (Mao et al., 2018).

Various type of forecasting models such as statistical time series models (ARIMA, ETS, and etc), mechanistic or compartmental models (SEIR, SIR and etc) and machine learning models such as random forest, artificial neural network (Chowell et al., 2020). Time-series forecasting models have proven to be powerful tools in infectious disease epidemiology. Unlike simple trend analysis, they can capture complex patterns such as seasonality and long-term trends, which are characteristic of TB incidence. The primary objective of this study is to project the number of new TB cases in Kedah for the years 2025 and 2026 using a statistical time series models based on historical data. The secondary objectives are to assess seasonal trends, and to evaluate the forecasting model accuracy.

METHODOLOGY

This study employs a retrospective time-series analysis approach using the Seasonal Autoregressive Integrated Moving Average (SARIMA) model. The data for this analysis consists of monthly records of new TB cases in Kedah (date of notification), obtained from the National Tuberculosis Registry (NTBR) of the Ministry of Health Malaysia. The data spans from 1st January 2015 to 31st December 2024, 10 years of data.

The flow of data analysis was started from exploratory data analysis (EDA) to determine the structure of data, followed by model fitness time series statistical model and evaluation of the model. The best fit model for this study is SARIMA model due to the data exhibit sessional pattern. The SARIMA model is represented by the notation SARIMA (p,d,q) (P,D,Q) S. Non-seasonal components (p, d, q): The p representing the number of past observations to be used. The d is the statistical properties do not change over time. The q showed the order of the moving average (MA) model and representing the number of past forecast errors to be used. The capital letter (P, D, Q) is the seasonal components. Finally, the S is a seasonal period and for this study s=12 months.

Multiple SARIMA models were fitted, and the optimal model was selected based on a combination of criteria, including the lowest values for the Akaike Information Criterion (AIC). The accuracy of the model was evaluated using performance metrics such as Mean Absolute Percentage Error (MAPE) and Mean Squared Error (MSE). Thus, best model for this study is SARIMA (1,1,1)(1,1,1)12 which showed to be best fit as AIC = 842 (the lowest) compared to SARIMA (1,1,2)(1,1,2)12 and SARIMA (2,1,1)(1,1,2)12. The accuracy evaluation by MAPE only 7.56% (less than 10% of error) and MSE 94.58 (lowest compared to other model) which indicates a reliable for short-term projections (Ab Rashid et al., 2023).

The data presented as line graph with calculated for the forecasted values each month from January to December 2024 and 2025 with the 95% confidence intervals (CI). These data analyses were done by using Python 3.11 with Stats Model. The study obtained approval from NIH (letter: NIH.800-4/4/1 Jld. 150 (33)).

RESULTS

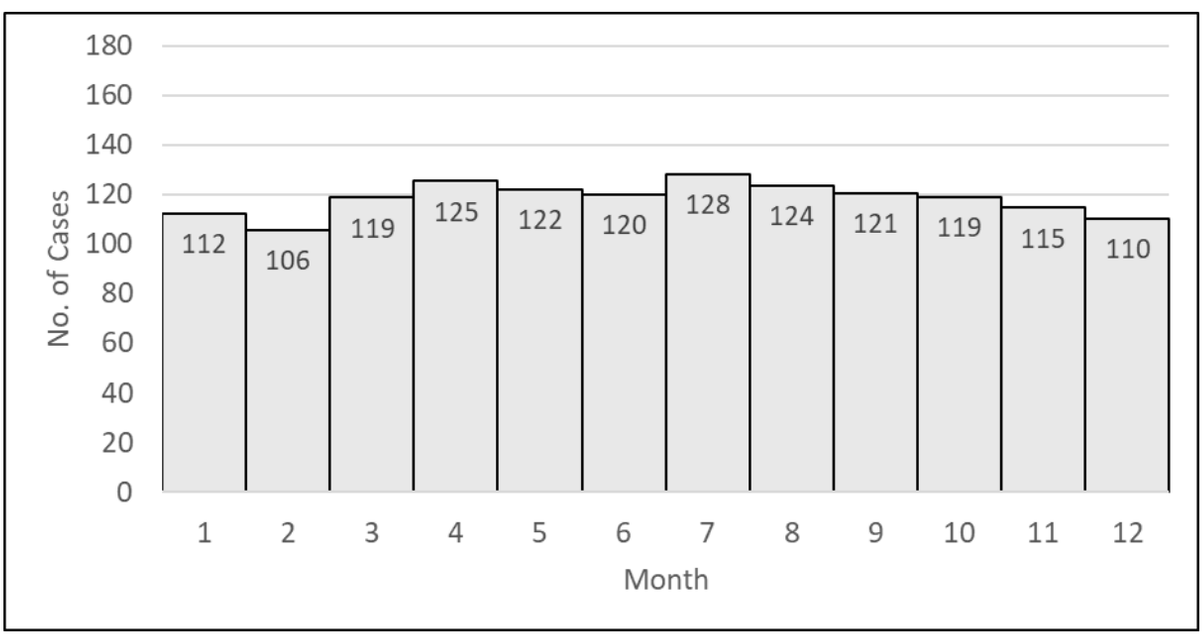


Figure 1: Average Monthly TB cases from January 2015 until December 2024 in Kedah

Figure 1 showed the highest TB cases peaked in July (128 cases) followed by April (125 cases) and (August 124 cases) over a period 10 years. The lowest are in February 106 cases, December 110 cases and January 112 cases.

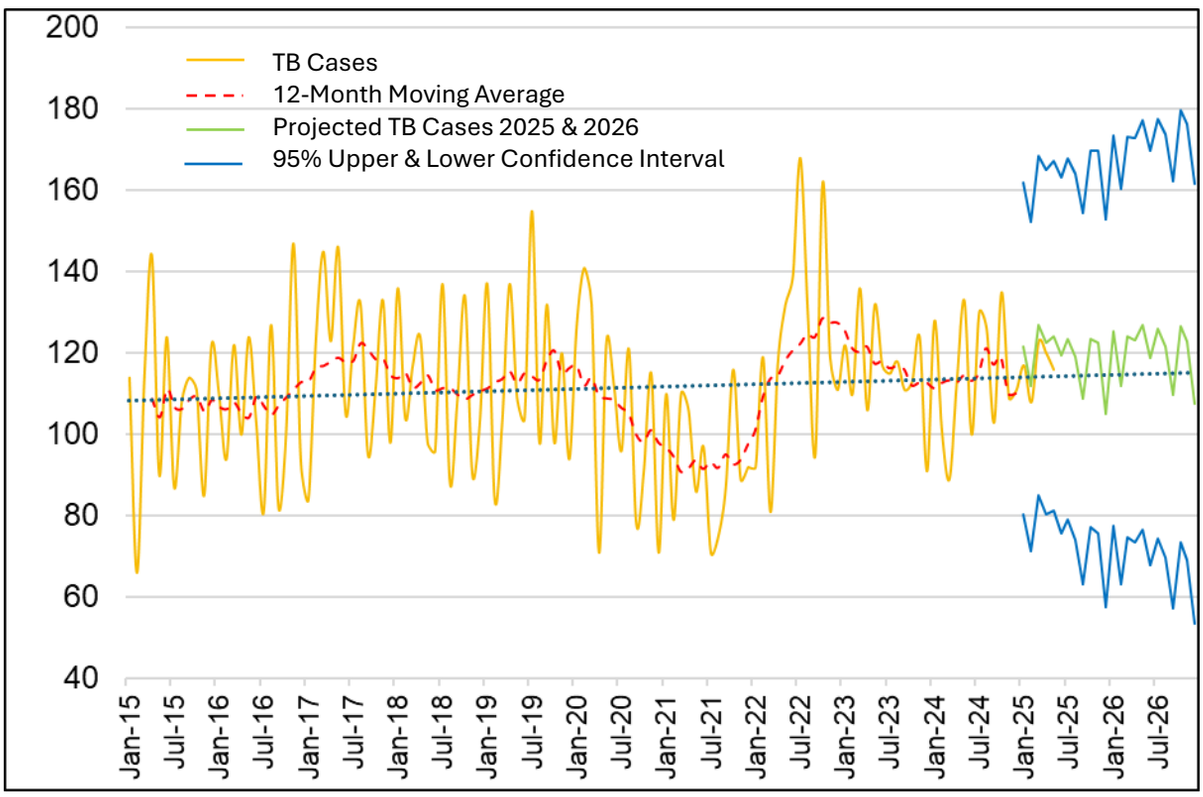


Figure 2: Monthly TB Cases & Forecast Cases with 95% CI in 2025-2026

Figure 2 showed 3 important results. The first one is the month TB cases from January 2015 until June 2025. The deepen number of cases are seen from July 2020 until January 2022 and then it rebound back to the highest TB cases ever recorded in June 2022 which was 168 cases.

The overall trend for this study is a modest increment of new TB cases for past 10 years. Forecasted data showed that the number of new TB cases in 2025 is predicted to be 1424 cases in which 3.5% increase from 2024 and year of 2026 is predicted 1450 cases in which 1.8% increase from 2025. The Equation: $y=0.025x + 3.74$ and the effect size $r^2 = 0.026$.

Table 1: Forecasted Number of TB Cases Each Month 2025 & 2026

Months	Forecasted No. Cases	Lower CI	Upper CI
Jan-25	121	80	162
Feb-25	112	71	152
Mar-25	127	85	168
Apr-25	123	80	165

May-25	124	81	167
Jun-25	119	76	163
Jul-25	123	79	168
Aug-25	119	74	164
Sep-25	109	63	154
Oct-25	123	77	170
Nov-25	123	76	170
Dec-25	105	57	153
Jan-26	125	77	173
Feb-26	112	63	160
Mar-26	124	75	173
Apr-26	123	73	173
May-26	127	77	177
Jun-26	119	68	170
Jul-26	126	74	177
Aug-26	122	70	174
Sep-26	110	57	162
Oct-26	127	73	180
Nov-26	123	69	176
Dec-26	107	53	162

The highest number of forecasted TB cases in May 2026 (127 cases), October 2026 (126 cases) and lowest number of TB cases in December 2025 (105 cases) and December 2026 (107 cases). It also exhibits sessional pattern lowest in December and continuous to peak up July until October.

DISCUSSION AND LIMITATIONS

The monthly TB cases for past 10 years exhibit a seasonal pattern, with the highest numbers observed in March and April, followed by July and August. Similar to findings from the National Forecast TB Study (Ab Rashid et al., 2023) as seasonality is not unique to Kedah rather than National. The lowest rates of Tuberculosis (TB) notification tend to occur in November and December annually. This trend can be attributed to adverse weather conditions, particularly during the rainy and flood seasons. Furthermore, individuals are less inclined to seek medical care at clinics or hospitals during the major holiday period, which spans from November to early January (Ab Rashid et al., 2023).

The forecast for new Tuberculosis (TB) cases in Kedah indicates continued stability through 2025 and 2026, with a marginal year-on-year increase. In comparison, the national projection for 2025 estimates a higher figure of 2,393 cases. This difference is attributable to the methodologies used; the national projection utilizes complex mechanistic models from the WHO (such as the SEIR TB model), which tend to yield higher forecasts than models based on observed data (WHO, 2024).

SARIMA is advantageous over SEIR for short-term TB case forecasting in real-world programmatic settings, especially when the focus is on seasonal trends, simplicity, and operational utility (Ab Rashid et al., 2023; Kalizhanova et al., 2024). However, the limitation of SARIMA, it has no understanding of the underlying disease process and solely based on historical data (Zhao et al., 2022). Thus, it cannot replace SEIR for better forecasting model. SEIR reflects the biological understanding of agent, the dynamic progression of TB transmission from latent versus fast pathway to active TB. Its also evaluating control strategies and analysing the impact of interventions (treatment, isolation, etc.) on disease spread (Abolmaali & Shirzaei, 2021; Das et al., 2021).

The implication of this study are significant for public health planning and strategically allocate resources, such as on human resources in which could ensuring sufficient number of staff, particularly in diagnostic laboratories and outpatient clinics, during peak months (Mandal et al., 2025). The resource on the pharmaceuticals is by optimizing the procurement and distribution of anti-TB drugs to avoid stock shortages when demand is highest. Lastly on targeted screening by focusing active case-finding efforts in specific districts or communities that historically contribute to the high case numbers, especially during the identified seasonal peaks(Mergenthaler et al., 2025).

CONCLUSION

This study validates the usefulness SARIMA model in projecting new Tuberculosis (TB) cases in Kedah for 2025 and 2026. By leveraging these projections, health authorities can optimize resource allocation and implement targeted interventions. These actions are designed to enhance TB control measures, ultimately contributing to the objective of reducing TB-related morbidity and mortality within the state.

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IMPLEMENTATION AND PERFORMANCE OF AN OPPORTUNISTIC COLORECTAL CANCER SCREENING PROGRAM IN KEDAH, MALAYSIA: A SEVEN-YEAR REVIEW (2018–2024)

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ABSTRACT

Background: Colorectal cancer (CRC) is among the leading causes of cancer-related morbidity and mortality in Malaysia. Recognizing the rising burden, an opportunistic CRC screening program was introduced in Kedah through primary healthcare clinics targeting individuals aged 50 to 75 years with no prior history of CRC. This article evaluates the implementation of the program from 2018 to 2024, focusing on coverage, outcomes, and challenges.

Methodology: A retrospective review of programmatic data from public health clinics across Kedah was conducted for the years 2018–2024. Key performance indicators assessed include screening uptake, iFOBT positivity rates, referral compliance, colonoscopy attendance, and diagnostic findings.

Results: Between 2018 and 2024, a total of 33,672 iFOBTs were conducted. Positivity rates ranged from 7.8% (2018) to 13.5% (2022). Of the 3,344 individuals referred for colonoscopy, only 1,120 (33.5%) underwent the procedure. The detection of precancerous polyps peaked in 2024 at 38.6%. Drop-out after referral remains a major barrier to achieving full screening impact.

Conclusion: The program shows promise in detecting early-stage CRC and polyps. However, substantial attrition following positive iFOBT results underscores the need to strengthen follow-up mechanisms and improve access to diagnostic services to maximize its public health benefit.

Keyword: colorectal cancer, opportunistic screening, iFOBT, Kedah, colonoscopy, primary care

INTRODUCTION

Colorectal cancer (CRC) is the second most common cancer in Malaysia and the third leading cause of cancer death (GLOBOCAN, 2020). The disease often progresses asymptomatically in early stages, highlighting the importance of early detection through screening. Population-based screening programmes are effective but remain underutilised in Malaysia due to limited resources, infrastructure, and public awareness (Paramasivam, 2024).

To mitigate these challenges, the Malaysian Ministry of Health has adopted opportunistic screening approaches at primary healthcare facilities. In Kedah, where CRC mortality is among the highest in the country, public health clinics have implemented the immunochemical faecal occult blood test (iFOBT) for asymptomatic individuals aged 50–75 years. This article presents findings from the programme's implementation from 2018 to 2024 and evaluates its effectiveness, challenges, and potential for scale-up.

METHODOLOGY

This cross-sectional descriptive study utilised data collected from 68 public health clinics in Kedah that offered iFOBT screening to eligible individuals from January 2022 to December 2024. Inclusion criteria included Malaysian citizens aged 50–75 years without a personal history of CRC or inflammatory bowel disease. Exclusion criteria included symptomatic individuals and those with prior colonoscopy within 5 years.

Screening was conducted through trained healthcare providers. Individuals with positive iFOBT results were referred for colonoscopy at designated hospitals. Data were extracted from the clinic records, and hospital colonoscopy databases. Variables analysed included age, sex, iFOBT results, colonoscopy uptake, and findings.

Data were analysed using descriptive statistics. Frequencies and percentages were calculated for all variables. Trends in screening uptake, positivity rates, colonoscopy attendance, and diagnostic findings were analysed and presented graphically over the seven-year period. All analyses were performed using Microsoft Excel and R Statistic.

RESULTS

Screening Uptake and iFOBT Positivity Rate

Over the seven-year review period, a total of 33,672 iFOBT tests were conducted as part of the opportunistic screening program. As shown in Figure 1, the number of

annual tests fluctuated, with the highest uptake observed in 2019 (n=6,926) and the lowest in 2021 (n=3,220).

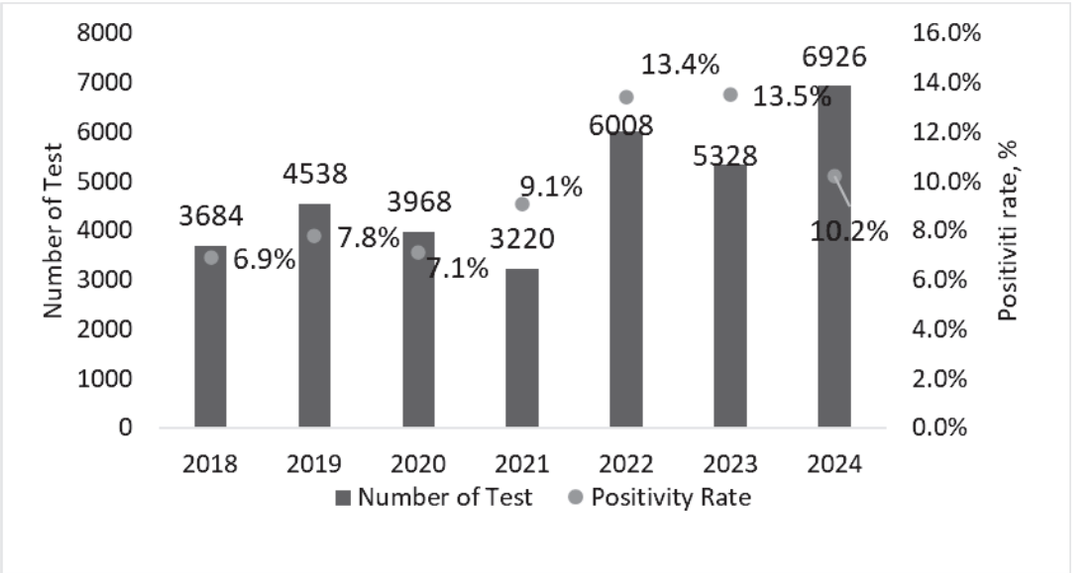


Figure 1: Number of Test from Year 2018-2024 (n=33,672)

The iFOBT positivity rate, representing the percentage of individuals with iFOBT positive result, varied annually, ranging from a low of 7.8% in 2018 to a high of 13.5% in 2022. In total, 3,344 individuals were referred for colonoscopy due to positive iFOBT results over the study period.

Referral Compliance and Colonoscopy Attendance

While primary care engagement in referring patients was high, a significant drop-out occurred between the referral and the diagnostic procedure. Figure 2 illustrates the rate of attendance for colonoscopy among those referred. The attendance rate showed significant variability, peaking at 82.3% in 2022 but dropping as low as 28.0% in 2021 and 32.5% in 2024.

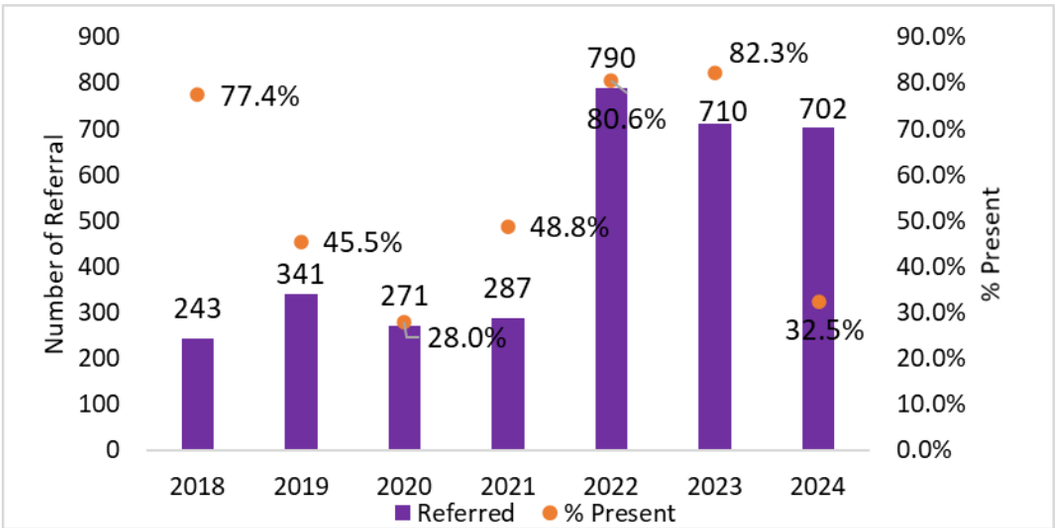


Figure 2: Referral and Present rate (n=3,344)

Colonoscopy Findings

A total of 1,120 colonoscopies were performed on patients who attended their referral. The diagnostic findings are summarized in Figure 3.

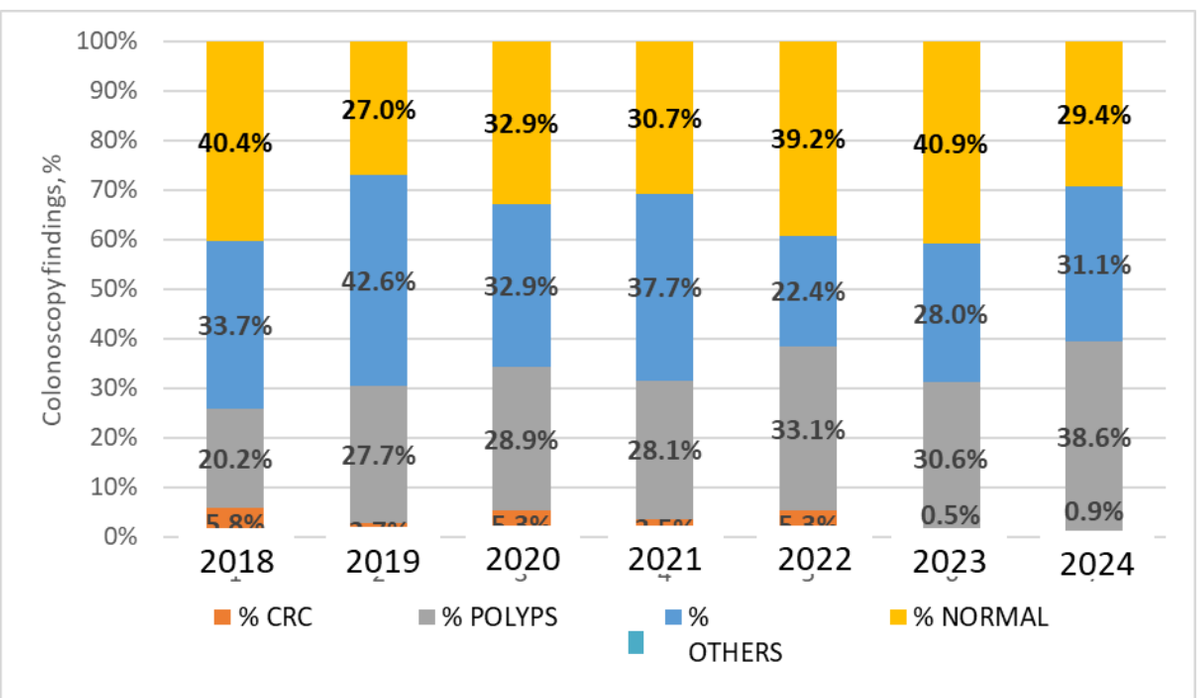


Figure 3: Colonoscopy Findings from 2018-2024 (n=1120)

The percentage of CRC detected among those undergoing colonoscopy ranged from 0.5% in 2023 to 6.8% in 2018. The detection of precancerous polyps is a key benefit of screening. The polyp detection rate was substantial, showing an increasing trend

in later years and peaking at 38.6% in 2024. While the proportion of colonoscopies with normal findings varied, with the highest rate in 2018 at 40.4% and the lowest in 2019 at 27.0%.

DISCUSSIONS

The screening programme demonstrated a reasonable positivity rate of 7.5%, aligning with other regional findings (Adefemi, 2024; Zhao et al., 2023). Colonoscopy uptake among those with positive iFOBT was 69%, which, while higher than some national averages (Bujang et al., 2021; Mohl et al., 2023; Sekhon Inderjit Singh et al., 2023), still reflects room for improvement, especially in rural areas.

The cancer detection rate (1.3%) among all screened individuals is comparable with international benchmarks (WHO, 2020). The adenoma detection rate of 15.4% among those who underwent colonoscopy suggests that the programme was effective in identifying premalignant lesions, which is a critical objective of CRC screening (Duvvuri et al., 2021; Gong et al., 2023).

Despite relatively high positivity, nearly one-third of individuals with positive iFOBT did not complete colonoscopy. Barriers included fear of procedure, financial concerns, distance to hospitals, and low health literacy, echoing patterns seen in similar Malaysian studies (Ramanathan et al., 2022; Tin, 2024). Ensuring access to colonoscopy remains a key limitation of opportunistic screening.

The opportunistic colorectal cancer (CRC) screening program implemented within Kedah's primary care settings possesses several notable strengths. By embedding the screening process into routine clinical visits, the program successfully leveraged existing patient-provider interactions, eliminating the need for large-scale community mobilisation. This approach enhanced accessibility and uptake, particularly among individuals already engaged with the healthcare system. The use of the immunochemical faecal occult blood test (iFOBT) further contributed to the program's feasibility, as it is both cost-effective and logistically manageable within primary care infrastructure. Importantly, the program demonstrated clinical value through its ability to detect early-stage cancers and precancerous lesions (adenomas), thereby supporting its role in reducing CRC morbidity and mortality (Cianci et al., 2024; Tanase et al., 2025).

Despite these strengths, several weaknesses were evident. A key limitation was the incomplete follow-up for individuals with positive iFOBT results, particularly the suboptimal colonoscopy uptake, which undermines the downstream effectiveness of the screening pathway as what mentioned in other study (ZHI, 2022). This issue was further exacerbated by inconsistent data reporting and variability in record-keeping across clinics, which hampered comprehensive evaluation of outcomes. Moreover, rural disparities were prominent, as patients from more remote areas exhibited lower

colonoscopy completion rates, highlighting inequities in healthcare access, awareness, and logistical support.

Nevertheless, the program also presents several opportunities for enhancement. The integration of CRC screening processes into electronic health records as more and more health clinics in Kedah already started their Cloud-based Clinic Management System (CCMS) programme could streamline tracking and improve both data quality and patient follow-up. Additionally, partnerships with community leaders for example KOSPEN, Panel Penasihat Klinik Kesihatan, and local organisations such as National Cancer Society Malaysia may bolster trust and awareness, particularly in underserved rural populations (Kale et al., 2023). Task-shifting strategies, such as training nurses or health educators to deliver patient navigation and counselling, could further enhance follow-up compliance and reduce the burden on physicians.

However, several external threats could impede the program's sustainability (Bastin, 2021). In the wake of the COVID-19 pandemic, national health priorities and resource allocation have shifted heavily toward infectious disease management, potentially side-lining non-communicable disease (NCD) interventions like CRC screening. Public fear, stigma, and misconceptions about cancer and invasive procedures may also deter individuals from participating in screening or undergoing colonoscopy. Finally, the extent of these capacity constraints in Kedah remains to be quantified; however, any mismatch between demand and endoscopy capacity can lead to delays in diagnostic evaluation and timely treatment (Richards-Kortum et al., 2024).

Given the programme's success in early detection, Kedah's CRC opportunistic screening initiative could be further improved in the near future. Addressing weaknesses in colonoscopy access, public health communication, and data integration is essential. Future plans should include hybrid models that blend opportunistic and population-based strategies while strengthening referral pathways.

CONCLUSION

The opportunistic CRC screening programme in Kedah shows promising outcomes in terms of test positivity, adenoma detection, and cancer identification. However, challenges remain, particularly in ensuring complete follow-up with colonoscopy. Scaling and sustaining this model require strategic investment in infrastructure, workforce, and community engagement.

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COMMUNITY-BASED LEPROSY DETECTION VIA LaKAR PROGRAM IN PADANG TERAP

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ABSTRACT

Background: Leprosy, caused by *Mycobacterium leprae*, affects the skin, nerves, eyes, and respiratory tract. Between 2018 and 2023, five cases were reported in Kampung Kubu, with three showing epidemiological links. A lack of structured multidisciplinary efforts for active case detection remains a key challenge. In response, the Kedah State Health Department and PKD Padang Terap initiated the LaKAR program (Training, Detect, Analyze, Treat, Refer) to screen all residents and raise awareness**.**

Methodology: This active surveillance initiative involved Public Health Officers conducting risk assessments and interviews to identify close contacts, followed by medical examinations by Medical Officers. Suspected cases were referred to dermatologists for Skin Slit Smear (SSS) testing. Community leaders helped mobilize participation. Data on clinical and epidemiological findings were analyzed using Excel.

Results: Of 87 residents approached, 50 consented to screening. Among them, 11 (22%) had skin lesions, 3 (6%) reported paraesthesia, and 2 (4%) showed deformities. Of 7 referred for SSS, 1 tested positive and was referred to Hospital Sultanah Bahiyah for further management.

Conclusion: The LaKAR program in Kampung Kubu demonstrated effective multidisciplinary collaboration and strong community engagement. Continued implementation is crucial for improving awareness, early detection, and treatment of leprosy.

Keywords: Community health, leprosy, LaKAR, active case detection

INTRODUCTION

Leprosy, or Hansen's disease, is a long-term infectious illness caused by *Mycobacterium leprae*. It primarily targets the skin, peripheral nerves, mucous membranes, and eyes, potentially resulting in severe complications if not treated promptly. Although the disease is curable with early detection and multidrug therapy (MDT), it remains a public health challenge in endemic regions due to delayed diagnosis, social stigma, and ongoing transmission risks (CDC, 2024).

In endemic areas, leprosy persists due to various environmental, genetic, and socio-economic factors. Effective disease control requires active surveillance, community participation, and early case detection. Public health interventions, such as screening programs and health education, are crucial in ensuring timely diagnosis and treatment, thereby preventing disabilities and reducing further spread.

In 2024, Malaysia recorded a total of 277 leprosy cases. Meanwhile, Kedah specifically reported 11 cases of leprosy, compared to 8 cases in 2023. There are seven leprosy-endemic localities in the state of Kedah, including Taman Nilam, Langkawi (6 cases), Kampung Kubu (4 cases), Depo Tahanan Sik (4 cases), Kampung Teluk Bulang (3 cases), Lunas Industrial Area (2 cases), Sungai Tiang (2 cases), and a school in Simpang Kuala (2 cases) (JKN Kedah, 2025).

The Tuberculosis and Leprosy Unit of JKN Kedah, in collaboration with Padang Terap District Health Office, organized the LaKAR Program in Kampung Kubu, Padang Terap, on July 17th until 18th July 2024, on day 1 of was more on theory session meanwhile day 2 was the Active Case Detection (ACD) in Kampung Kubu. The program also saw participation from 10 other districts, comprising specialists, medical officers, paramedics, assistant environmental health officers, and medical laboratory technologists.

Kampung Kubu, located in Mukim Kurong Hitam, has a population of 324, with most residents working in the agricultural industry. The nearest health facilities is Klinik Desa Padang Balai (2.5km) and 30km from Hospital Kuala Nerang. Since 2018, three cases have been confirmed as leprosy, and one additional case was detected during the LaKAR activity. Investigations found that the first three cases were social contacts who frequently met at the surau (prayer hall), while the fourth case is the wife of the second case.

This report explores the importance of leprosy case detection in endemic regions, the role of community involvement, and the strategies implemented to strengthen disease control and prevention efforts.

OBJECTIVE

To determine incidence of leprosy case via ACD program and risk factor associated in community.

METHODOLOGY

This study employed a community-based cross-sectional study (door-to-door survey) to detect leprosy cases in Kampung Kubu, Padang Terap an endemic area in Kedah. The LaKAR Program was conducted as an active case detection (ACD) initiative to screen residents, identify potential cases, and provide early treatment to prevent further transmission.

The target population included all residents of the village, with a specific focus on individuals exhibiting skin related symptoms or known contact with leprosy patients. A total of 87 residents participated in the screening program, with 50 individuals undergoing skin examinations for suspected leprosy lesions.

Data collection was carried out through clinical examinations, laboratory tests, and epidemiological assessments. The ACD teams were divided into 3 teams comprised; Medical officers and Family Medicine Specialist conducted physical examinations to assess skin lesions, nerve involvement, and sensory impairments (Diagram 1). Individuals with suspected symptoms were referred to Dermatologist for further evaluation. 11 individuals underwent Skin Slit Smear (SSS) and 1 positive case was referred to the Dermatology Department at Hospital Sultanah Bahiyah for confirmatory diagnosis and treatment. Meanwhile the Public health officers conducted interviews to identify close contacts, assess living conditions, and evaluate potential risk factors such as genetic predisposition, hygiene practices, and socio-economic status.

In this study, the independent variables included age, gender and clinical presentation (e.g., presence of skin lesions, paraesthesia, or deformities). These variables were examined to assess their association with leprosy detection. The dependent variable was defined as the number of confirmed leprosy cases identified through the LaKAR Program.

The data was obtained from the Tuberculosis and Leprosy Unit of JKN Kedah. Statistical analyses were performed using Excel software.

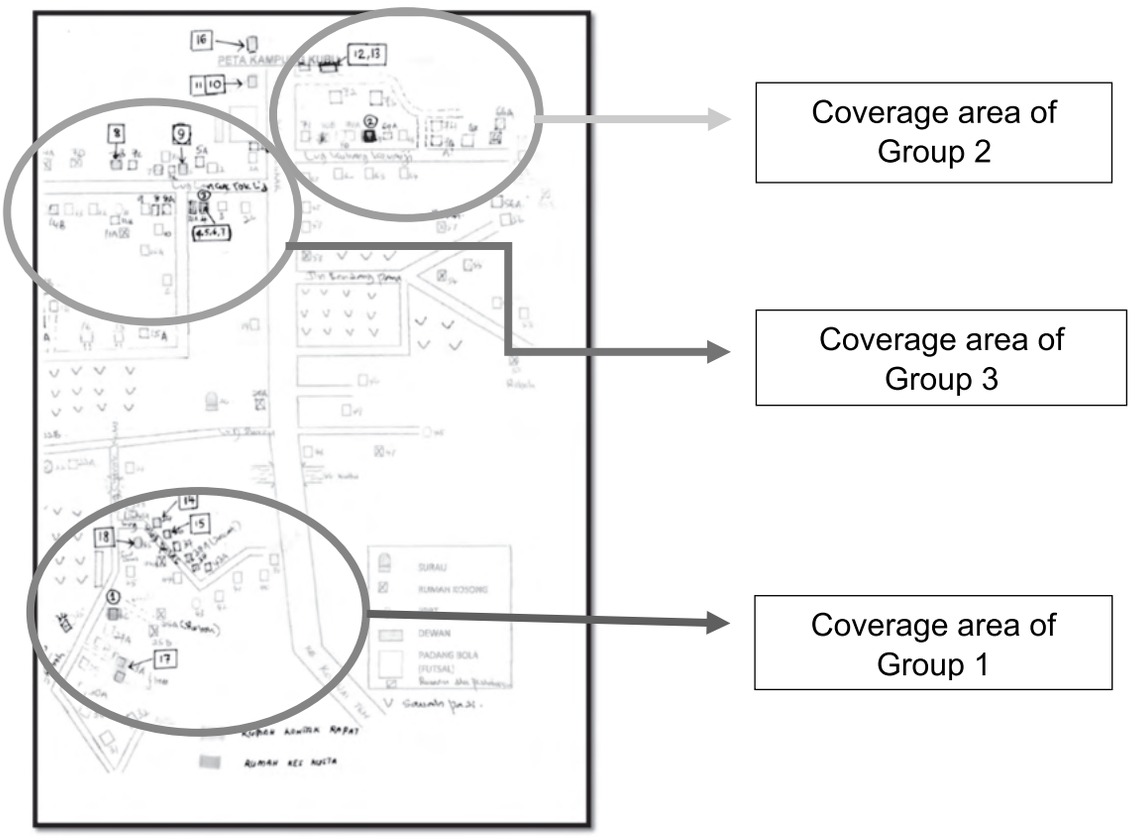


Figure 1: Map of the LaKAR Program, Kampung Kubu

RESULTS

In total, 87 residents of Kampung Kubu were screened during LaKAR. Figure 1 shows the sociodemographic data of residents screened.Majority of the residents were 25-64 years old (54%) and female (57.5%).

Table 1: Sociodemographic data of the Leprosy screening (N=87)

Variables		Frequency (n)	Percentage (%)
Age group	< 5 years	7	8.0
	5-14 years	9	10.3
	15-24 years	5	5.7
	25-64 years	47	54.0
	≥ 65 years	19	21.8
Gender	Male	37	42.5
	Female	50	57.5

Data were analysed using descriptive statistics to assess the prevalence of residents presented with clinical presentations of leprosy until proven otherwise using SSS testing. Among 50 cases screened, 22% with skin lesions, 6% with paraesthesia and 4% of the cases had deformity (Table 2). Those 11 cases (22%) with skin lesion were all referred to the Dermatologist for further assessment, 7 cases were undergoing SSS testing. 1 confirmed positive Leprosy case was identified and referred for further treatment (Table 3). This case was enlisted as a close contact with her husband diagnosed as Leprosy in 2018.

Table 2: Clinical presentation of residents screened (N=50)

Variables		Frequency (n)	Percentage (%)
Skin lesions	Present	11	22
	Absent	39	78
Paraesthesia status	Present	3	6
	Absent	47	94
Deformity status	Present	2	4
	Absent	48	96

Table 3: Number of cases referred to Dermatologist (N=11)

Variables		Frequency (n)	Percentage (%)
Performed SSS		7	63.6
Not Performed SSS		4	36.4
Result (N=7)	Positive	1	14.3
	Negative	6	85.7

DISCUSSION

LaKAR program in Kampung Kubu underscores the vital role of proactive public health measures in managing leprosy within the endemic regions. With several documented cases and evident epidemiological links, Kampung Kubu is a significant focal point for early detection and community-based screening efforts. Since predicting the likelihood of developing leprosy is complex and uncertain, and given that the use of multidrug therapy (MDT) alone has not significantly reduced the incidence of new cases, there is a growing need for innovative active case detection (ACD) strategies in both high- and low-endemic countries. Leprosy diagnosis largely relies on clinical examination, which requires skilled healthcare professionals. Therefore, active case-finding efforts should be integrated with preventive measures to interrupt disease transmission. Current preventive strategies focus on early

diagnosis and timely treatment and can be enhanced by administering single-dose rifampicin as post-exposure chemoprophylaxis (SDR-PEP) to contacts of confirmed cases. Additionally, the Bacillus Calmette-Guérin (BCG) vaccine serves as immunoprophylaxis, particularly in newborns, offering protection against both leprosy and tuberculosis (Gutierrez et al., 2023). Through the concerted collaboration between the Unit Tibi&Kusta, JKN Kedah and the Padang Terap District Health Office, a total of 87 residents were screened, with 50 individuals undergoing focused skin examinations. However, for LaKAR in Kampung Kubu, there were no chemoprophylaxis or Single Dose Rifampicin (SDR) given in view of limited stock of Rifampicin.

A notable outcome of this initiative was the participation of 87 residents, all of whom provided verbal consent. This response reflects the effectiveness of prior awareness campaigns and engagement strategies, which likely contributed to reducing stigma and encouraging residents to partake in health screenings. A total of 50 out of 87 eligible residents participated in the skin examination, indicating relatively good community engagement for a door-to-door screening program. Empowering the community has proven essential in addressing challenges such as delayed diagnosis and underreporting in remote or high-risk areas. By training the local health workers, involvement of community leaders, and active participation of individuals affected by leprosy in advocacy efforts fosters local ownership of leprosy control and elimination initiatives. This inclusive strategy transforms communities into key drivers of the response, promoting both engagement and responsibility in addressing the disease. By strengthening local capacity, this model not only enhances access to healthcare services but also supports long-term, sustainable progress. Additionally, reducing dependency on external support makes this approach more resilient and vital in the journey toward achieving Zero Leprosy (Fastenau et. al., 2024).

Additionally, the detection of residents with suspicious skin lesions and the confirmation of one positive case through Skin Slit Smear (SSS) testing emphasize the ongoing risk of undiagnosed leprosy within the locality. The fact that some individuals had visible skin symptoms but had not previously sought medical help points to the need for ongoing health surveillance, frequent outreach initiatives, and stronger referral systems to ensure timely care. Raising awareness about the symptoms of leprosy and encouraging early care-seeking behavior are critical factors closely associated with improved understanding of the disease. Various methods used to enhance awareness will be documented throughout the process. Promoting awareness is an essential requirement for countries progressing through the stages of transmission interruption and disease elimination (WHO, 2023).

Looking ahead, it is imperative to secure a consistent supply of essential medications, enhance dermatological services at the community level, and continue building trust through sustained health education efforts. While the LaKAR program has successfully initiated crucial steps toward better disease detection and control, lasting progress will depend on sustained engagement, adequate resources, and

cross-sector collaboration. Choudhary S et al. reported that sustained activities were closely linked to community support, effective leadership, a strong desire for learning, and members' firm belief in the value of self-help groups (Choudhury S et al., 2023).

Limitations

While the LaKAR program in Kampung Kubu offered important insights into early leprosy detection, several limitations should be acknowledged. The program was geographically limited to a single locality, involved only 87 individuals, and was conducted over just one day on a working weekday. This restricted scope limits the generalizability of findings, as they may not reflect the broader epidemiological situation in Kedah. Additionally, the short duration may have led to missed cases and limited understanding of long-term trends (Mallick T. et al., 2025).

The screening approach primarily targeted visible clinical signs—skin lesions, paraesthesia, and deformities. However, leprosy can present with subtle or atypical symptoms, particularly in early or subclinical stages. Relying solely on these signs risks underdiagnosis and missed opportunities for early intervention.

Diagnostic limitations were also present. Of those referred, only a few underwent slit skin smear (SSS) testing, and more sensitive diagnostic methods—such as polymerase chain reaction (PCR), histopathology, or serological tests—were not utilized. This could lead to false negatives and hinder accurate disease assessment.

Finally, the program did not implement Single Dose Rifampicin (SDR) as post-exposure prophylaxis (PEP) for close contacts. SDR is a well-established preventive strategy, shown to reduce leprosy risk by 72% over an average follow-up of 74 months (Banstola et al., 2024). Its absence limits the program's effectiveness in preventing future transmission.

CONCLUSION

In total, 87 residents were screened, resulting in 11 referrals to dermatologists, with one confirmed case of leprosy identified. The program was carried out successfully, thanks to the strong collaboration between the LaKAR team and the residents of Kampung Kubu. Effective communication among team members from multiple districts, including representatives from the Kedah State Health Department, also contributed significantly to the program's success. It is hoped that similar initiatives will continue in the future to raise public awareness about leprosy and emphasize the importance of early diagnosis and treatment.

RECOMMENDATION

Future research should include a cost-effectiveness analysis of the LaKAR program for leprosy case detection. This would provide valuable insights into the balance between program costs and the health benefits achieved, allowing policymakers and

healthcare planners to assess its sustainability, justify resource allocation, and explore potential expansion to other communities or regions.

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TWO-STAGE SURGICAL MANAGEMENT OF GINGIVAL RECESSION USING ALLOGRAFT AND CONNECTIVE TISSUE GRAFT IN THE UPPER ANTERIOR TEETH: CASE REPORT

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ABSTRACT

Background: Gingival recession (GR) is the apical migration of the gingival margin relative to the cemento-enamel junction (CEJ), exposing root surface. It can cause hypersensitivity and aesthetic concerns, potentially affecting the patient's quality of life. This case report presents two-stage surgical management of Recession Type 1 (RT1) in the maxillary anterior region using an acellular dermal matrix (ADM) and connective tissue graft (CTG).

Methodology: A 30-year-old Malay male presented with hypersensitivity and root exposure from teeth 13 to 23, with 2–4 mm of GR. Initial treatment involved a tunnelling technique with frenectomy and placement of ADM. The graft is then stabilized with sutures to ensure it remained in place. Nine months later, a second-stage procedure was performed to address residual GR at teeth 12 and 11. Modified coronally advanced Tunnel (MCAT) was performed with placement of CTG which harvested from the palate. The flap was coronally advanced and sutured without tension.

Results: Postoperative healing was uneventful at both the one- and two-week follow-up visits. At six months, the initial surgery yielded stable gingival margins and complete root coverage for all treated teeth except 12 and 11. Following CTG placement, further root coverage was attained, with improved tissue thickness. The patient reported a resolution of hypersensitivity, especially when consuming cold beverages.

Conclusion: This case demonstrates that a sequential approach using ADM followed by CTG can be an effective and predictable option, especially in aesthetic zones. It highlights the value of combining less invasive techniques with gold-standard grafting to optimize both functional and aesthetic results.

Keyword: Acellular dermal matrix, allograft, connective tissue grafts, gingival recession, root coverage

INTRODUCTION

Gingival recession (GR) is a commonly encountered periodontal condition characterized by the apical displacement of the gingival margin relative to the cemento-enamel junction (CEJ), resulting in root surface exposure. This condition may arise from various factors, including periodontal disease, mechanical trauma, malocclusion, and frenal pull. Clinically, GR can lead to root sensitivity, root caries, plaque retention, and aesthetic compromise, thereby affecting oral health-related quality of life (OHRQoL).

Historically Miller's classification guided prognosis, but its reliability is limited by not accounting for interproximal attachment (Miller, 1950). The newer Cairo et al. classification uses interproximal clinical attachment loss and defines Recession Type 1 (RT1) as recession without interproximal attachment loss (Cairo et al., 2011). RT1 defects typically correspond to Miller Class I/II and have the highest predictability of complete root coverage.

Several surgical techniques have been developed to manage GR, with the connective tissue graft (CTG) regarded as the gold standard due to its predictable outcomes (Tatakis et al., 2015). However, acellular dermal matrix (ADM) grafts have emerged as viable alternatives, particularly in cases where donor site morbidity is a concern (Zhang et al., 2022). Despite ADM's advantages, including reduced surgical time and the elimination of a second surgical site, it may be limited by higher cost and variability in clinical outcomes.

This report presents a staged surgical approach combining ADM and CTG in the management of multiple RT1 recessions in the maxillary anterior region, demonstrating improved aesthetic and functional outcomes.

METHODOLOGY

Case Presentation

A 30-year-old Malay male presented to the Periodontic Specialist Unit at Klinik Pakar Pergigian Kota Setar with complaints of hypersensitivity and visible root exposure in the upper front teeth. The patient expressed a strong desire for aesthetic improvement and relief from sensitivity, especially during the intake of cold beverages. He was systemically healthy,a non-smoker, and good oral hygiene.

Intraoral examination revealed bilateral buccal gingival recession in teeth 13-23 (FDI numbering: upper right canine to upper left canine) (Figure 1). Baseline measurements of recession depth presented in the Table 1. Probing depths were less than 3 mm, with no bleeding on probing. Interproximal bone and attachment levels were intact on periapical radiographs, consistent with Cairo RT1 classification. The frenulum exhibited high attachment to the papilla between 11 and 21, exerting slight tension.



Figure 1: Baseline photograph

Non-Surgical Procedure

Non-surgical management of GR primarily focuses on preventing further recession and addressing any associated issues like sensitivity or aesthetics. This involved meticulous oral hygiene by using a soft-bristled toothbrush and proper technique, are essential to prevent further GR and inflammation, desensitizing treatments, and full mouth scaling and polishing.

Surgical Procedure

Two-stage surgical plan was proposed: initial treatment with ADM to minimize donor site morbidity and enhance soft tissue volume, followed by a second-stage CTG for sites with incomplete root coverage.

Stage 1 (Figure 2) involved frenectomy of upper labial frenum and tunnelling with placement of ADM at all upper canines and incisors. Tunneling procedure is a minimally invasive surgical technique which involved creating a tunnel-like space beneath the gingival tissue without making extensive incisions. Under local anaesthesia, a frenectomy was performed to eliminate tension from the upper labial frenum. Through intrasulcular and tunnelling incisions (split-thickness flap without vertical releasing incisions), a continuous tunnel was created extending from tooth 13 to 23. Tunneling instruments are used to minimize trauma and promoting tissue healing. An acellular dermal matrix allograft (ADM) – a collagen scaffold – was trimmed to cover all recessions and inserted into the tunnel. The ADM graft was hydrated and positioned with its basement membrane side facing the root (Henderson et al., 2001) and coronally advanced to the CEJ level. It was stabilized using internal horizontal mattress 5-0 non-resorbable monofilament polypropylene sutures. Interrupted and sling sutures were employed to adapt the grafts and flaps without tension. Primary closure was achieved without tension. Post-operative care included analgesics, chlorhexidine rinses, and instructions to avoid mechanical trauma. Post-operative healing was uneventful, with satisfactory graft integration and no signs of infection or dehiscence.



Figure 2: Stage 1: Frenectomy of Upper Labial Frenum and Tunneling + ADM at Teeth 13, 12, 11, 21, 22, 23

At 6-month re-evaluation, teeth 13, 21–23 showed complete or near-complete coverage (0–1 mm residual recession), but teeth 11 and 12 each still had 2 mm and 3 mm recession, respectively. Keratinised tissue width (KTW) across the treated zone had increased to ~3–4 mm, compared to ~1 mm baseline. The patient's sensitivity had decreased but persisted on 11 and 12. Given the remaining aesthetic defect on the maxillary centrals, a second surgery was planned: MCAT with autogenous CTG. MCAT is a combination of a coronally advanced flap and a tunnel approach.

In Stage 2 (Figure 3), subepithelial connective tissue graft of ~1.5 mm thickness was harvested from the left palatal premolar area using trap-door technique. The CTG was inserted into the tunnel and positioned over the exposed roots of 11–12, then the flap was coronally advanced and sutured without tension at the CEJ. Post-operative healing showed improved soft tissue thickness and complete root coverage at teeth 11 and 12 by 3 months.

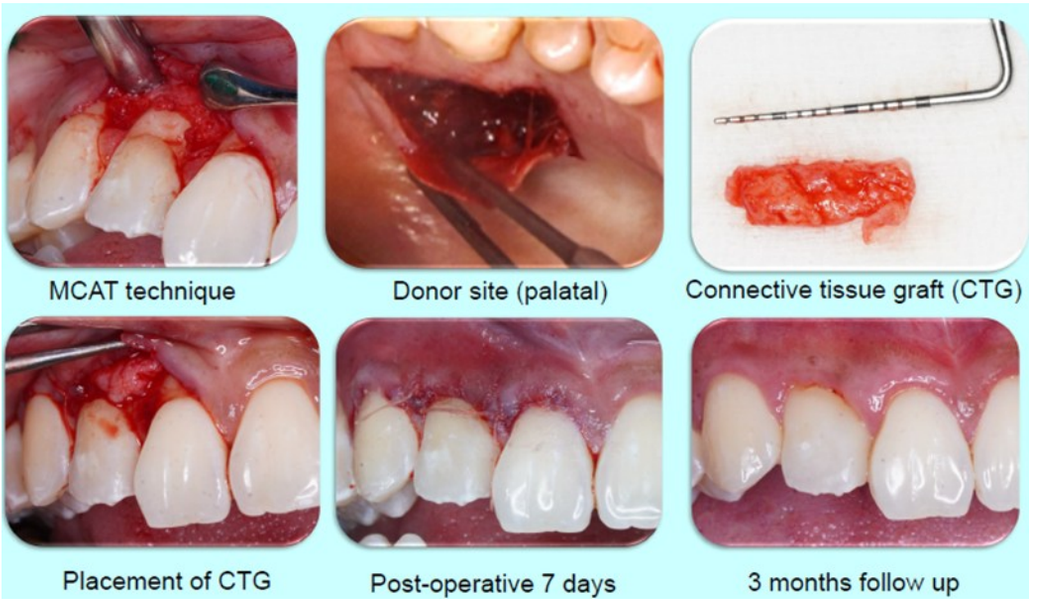


Figure 3: Stage 2: Modified Coronally Advanced Tunnel (MCAT) + CTG at Teeth 11 and 12

All measurements (recession depth, KTW, probing depths) were recorded with a UNC-15 probe at baseline, 6 months (pre-Stage 2), and 12 months post-initial surgery (6 months post-Stage 2). The patient's root sensitivity was assessed by visual analogue scale (VAS, 0–10) and the patient completed a satisfaction survey on aesthetics and discomfort.

RESULTS

Figure 4 and Table 1 summarises the clinical outcomes. After Stage 1 (ADM graft), teeth 13, 21, 22, 23 achieved essentially complete coverage (residual 0–1 mm). Teeth 11 and 12 still had 2 mm and 3 mm recessions. After Stage 2 (MCAT+CTG), both 11 and 12 were fully covered (0 mm recession). Thus, overall root coverage was 100% at all treated sites. Mean recession depth reduced from 3.17 mm (±0.75) at baseline to 0 mm at final. The increase in attached gingiva was notable: mean KTW in the anterior segment increased from about 1.0 mm to ~3.2 mm. Probing depths and clinical attachment remained healthy (3 mm or less) at all sites.



Figure 4: Post-operative 6 months for Stage 1 and Stage 2

Table 1: Gingival recession (GR) depths at baseline, 6-month and 12-month follow-up.

Tooth	Baseline GR (mm)	After Stage 1 (6 months)	After Stage 2 (12 months)
13	3	0	0
12	4	2	0
11	4	2	0
21	3	0	0
22	2	0	0
23	3	0	0

The patient's reported sensitivity (VAS, 0–10 scale) decreased from 8 (baseline) to 1 at 12 months. He expressed high satisfaction (VAS 10/10) with the aesthetic outcome and resolution of pain. On a yes/no questionnaire, he indicated "yes" to being satisfied with treatment outcome and rated aesthetic improvement as 10/10. No adverse events or flap necrosis occurred. Healing photos at 1 year show a harmonious gingival margin and thickened biotype with no scarring (Figure 5).



Figure 5: Final result

DISCUSSIONS

This case demonstrated that staged tunnelling grafting procedures can successfully treat multiple adjacent RT1 recessions in the aesthetic zone. Stage 1 combined frenectomy with a coronally advanced tunnel and ADM (an allograft) across six teeth. Stage 2 used CTG in an MCAT on the remaining deficits. The final result was complete root coverage at all sites, with increased keratinised tissue and patient relief of hypersensitivity.

Our approach reflected several established principles: first, eliminating frenum pull was recommended when an aberrant frenum is presented, as it can tension gingiva and contribute to recession (Sæthre et al., 2021). Performing frenectomy early helped stabilize the midline and allowed tension-free coronal advancement. Second, the tunnelling/MCAT technique preserved papillae and avoided vertical incisions, yielding better blood supply and aesthetics (Elbana et al., 2025).

The choice of graft material in each stage highlighted a trade-off: ADM versus CTG. Autogenous CTG remained the “benchmark” with the best predictability for complete coverage (Greenwell et al., 2000; Tatakis et al., 2015). The consensus report explicitly stated that subepithelial CTG provided the best root coverage outcomes, whereas ADMs or enamel matrix derivatives are viable alternatives (Tatakis et al., 2015). CTG added tissue thickness and keratinised gingiva effectively. In our case, the second-stage CTG provided the final millimetres of coverage on the central incisors; its use was justified for these high-demand aesthetic teeth. Indeed, meta-analyses confirmed CTG yielded significantly greater increase in keratinised tissue width compared to ADM (Zhang et al., 2022). In our patient the KTW increased by roughly 2–3 mm, paralleling reported of 0.6 –1.1 mm gains in treated sites (Molnár et al., 2022; Zucchelli & De Sanctis, 2000).

By contrast, ADM (or collagen matrix substitutes) avoided a palatal donor site, reducing patient morbidity and operative time (Elbana et al., 2025). Early evidence and reviews suggested ADM can achieve high initial coverage: Henderson et al. reported ~93–95% mean root coverage with ADM grafts on multiple recessions (Henderson et al., 2001). In our Stage 1, ADM led to complete coverage on most sites, except the two largest defects. However, meta-analyses indicate that long-term relapse can occur with ADM (Zhang et al., 2022). They found no difference in mean percentage root coverage between ADM and CTG immediately, but CTG maintained more keratinised tissue. In our case a second stage was needed for complete coverage. Another study had similarly reported that tunnelling with ADM yields good but slightly less coverage than CTG alone (Molnár et al., 2022).

A recent randomised clinical trial by comparing MCAT+CTG versus MCAT+collagen matrix for single RT1 defects and found both equally effective, with mean root coverage ~97% in 6 months (Elbana et al., 2025). It is concluded that using a collagen matrix “increased patient satisfaction and reduced tissue morbidity and surgical time” relative to CTG, reflecting our patient’s experience: avoiding palatal

surgery reduced pain and he expressed high satisfaction. However, that study did not find a KTW difference between groups, and our outcome suggested CTG may have contributed to the thicker gingiva on 11–12.

In this case report, a second-stage surgery was then performed to further enhance root coverage and soft tissue thickness due to partial root coverage at teeth 11 and 12. Even though RT1 cases generally have a good prognosis, several factors may have limited the initial coverage. These include the large initial depth of recession (> 3 mm) on teeth 11 and 12, the thin gingival biotype at these sites, and the need to preserve blood supply by avoiding excessive flap tension in Stage 1. Stage 1 established a healthier tissue bed and increased keratinized gingiva width, setting the stage for successful root coverage in Stage 2 with the connective tissue graft.

From a patient-centered perspective, we emphasized that the patient's chief complaint was sensitivity and appearance, not the precise millimetre of coverage. Root coverage procedures should aim for true end points: resolution of hypersensitivity, a pleasing pink margin, and comfort (Mounssif et al., 2018). Our patient's VAS sensitivity score dropped from 8/10 to 1/10 after the complete coverage. This aligns with evidence that surgical root coverage suppresses dentinal hypersensitivity in ~70% of cases (Antezack et al., 2022). Notably, the evidence reported that CTG-augmented CAF shows somewhat better sensitivity relief (73% suppression) than CAF with collagen substitutes (61%), which may explain the final elimination of sensitivity in our case. The patient's aesthetic satisfaction was also excellent, consistent with high Pink Esthetic Scores reported after MCAT+CTG in other series.

This case also illustrates the importance of personalized treatment planning, combining surgical techniques tailored to specific site limitations and patient preferences.

CONCLUSION

A staged approach involving initial ADM application followed by CTG in residual recession sites offers a predictable, patient-centered strategy for the management of generalized RT1 gingival recession. The combination ensures optimal aesthetic and functional outcomes with minimized patient discomfort. Further studies with larger samples are needed to standardize such protocols and confirm their long-term success.

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DISTRIBUTION OF DIABETES MELLITUS COMPLICATIONS IN PRIMARY HEALTHCARE FACILITIES, KULIM, KEDAH: AN ANALYSIS OF NATIONAL DIABETES REGISTRY DATA, 2024

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ABSTRACT

Introduction: Diabetes mellitus (DM) complications pose a significant burden on Malaysia's primary healthcare system, yet district-level data on their distribution remain limited. This study describes the prevalence of DM complications among patients managed exclusively in primary healthcare facilities under the Ministry of Health (MOH) in Kulim District, Kedah, using data from the National Diabetes Registry (NDR).

Methods: A cross-sectional analysis of 9,049 DM patients registered in the NDR across Kulim's primary healthcare clinics (Klinik Kesihatan) in 2024 was conducted. Descriptive statistics were used to analyze six complications: retinopathy, ischemic heart disease (IHD), nephropathy, cerebrovascular disease (CeVD), diabetic foot ulcer (DFU), and amputation.

Results: Among patients managed in primary care, retinopathy was the most prevalent complication (5.90%), followed by IHD (4.71%) and nephropathy (3.69%). Facility-level variations were observed, with Klinik Kesihatan Merbau Pulas reporting the highest nephropathy rate (12.06%).

Discussion: The findings highlight the need for targeted interventions in primary care settings, particularly for retinopathy and nephropathy. As the NDR excludes hospital and private-sector patients, these results reflect the burden managed at the primary care level and should not be generalized to all DM populations.

Keywords: Diabetes Mellitus, Complications, Healthcare Facilities, NDR, Burden

INTRODUCTION

Diabetes mellitus (DM) complications impose a profound clinical and economic burden on healthcare systems globally. In Malaysia, microvascular and macrovascular complications—including retinopathy, nephropathy, ischemic heart disease (IHD), and diabetic foot ulcers—account for 60% of DM-related hospitalizations (MOH, 2023) and drive substantial disability-adjusted life years (DALYs). For patients, these complications lead to vision loss, kidney failure, and cardiovascular events; for the healthcare system, they necessitate costly long-term management (e.g., dialysis for nephropathy consumes RM500 million annually under MOH) (Mustapha et al., 2020).

In Malaysia, 80% of DM patients are managed in primary healthcare (PHC) facilities under the Ministry of Health (MOH), yet district-level data on complication distribution remain sparse. National estimates suggest nephropathy prevalence of 12.7% and retinopathy at 11.1% (MOH, 2023), but these aggregate figures mask local disparities, particularly in rapidly urbanizing districts like Kulim, Kedah. The National Diabetes Registry (NDR) provides a unique opportunity to address this gap, as it captures PHC-managed patients—precisely the population least documented in hospital-centric studies.

Existing research on DM complications in Malaysia predominantly focuses on tertiary care settings (e.g., Ismail et al., 2021), while PHC-based studies are limited to urban centers like Kuala Lumpur (Lee et al., 2022). Kulim District, with its mix of urban and rural subdistricts (DOSM, 2024), exemplifies the need for localized data: demographic shifts, uneven healthcare access, and varying screening intensity may complicate direct comparisons with national averages. For instance, retinopathy prevalence in PHC settings may appear artificially low if fundus imaging is inconsistently available—a known challenge in resource-constrained clinics (MOH, 2023).

This study aims to describe the distribution of DM complications among patients treated exclusively in primary healthcare facilities in Kulim District using 2024 NDR data. By focusing on PHC-managed cases, we avoid conflating hospital-referred severe complications with the true burden handled at the community level, thereby informing targeted interventions for Kulim's MOH clinics.

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METHODOLOGY

Study Design

This cross-sectional study analysed diabetes mellitus (DM) complication data from the National Diabetes Registry (NDR) for Kulim District, Kedah.

Study Population

The study includes all DM patients registered in the NDR, who received care at Ministry of Health (MOH) primary healthcare facilities (Klinik Kesihatan) in Kulim District, with records captured up to and including December 2024. Patients managed in hospitals, private clinics, or other non-MOH facilities were excluded, as these settings are not represented in the NDR. After applying these criteria, the final sample consisted of 9,049 patients from six primary healthcare clinics in Kulim District, namely KK Karangan, KK Kulim, KK Merbau Pulas, KK Lunas, KK Padang Serai, and KK Bandar Kulim

Study Period

The study period comprised three phases: data extraction conducted between January and March 2024 (including all records up to December 2023), data analysis undertaken from April to June 2024, and manuscript preparation completed between July and September 2024.

Variables and Operational Definitions Complications were defined as per NDR diagnostic criteria:

Retinopathy: Clinical diagnosis via fundus imaging or ophthalmologist report.

Nephropathy: eGFR <60 mL/min/1.73m² or persistent proteinuria (urine ACR ≥30 mg/g).

Ischemic Heart Disease (IHD): Documented diagnosis of angina, myocardial infarction, or coronary revascularization.

Cerebrovascular Disease (CeVD): Stroke or transient ischemic attack (TIA) confirmed by imaging.

Diabetic Foot Ulcer (DFU): Active ulceration (Wagner Grade ≥1) with DM as primary etiology.

Amputation: Major (above ankle) or minor (below ankle) limb loss due to DM complications.

Case Definition: All complications represent ever-diagnosed conditions (not limited to 2024 diagnoses).

Statistical Analysis

Data cleaning was performed using Microsoft Excel, while statistical analyses were conducted with R software version 4.4.3. Descriptive statistics were applied to summarise the characteristics of the study population, with frequencies and percentages reported for categorical variables, including the prevalence of diabetes complications. Facility-level comparisons of complication prevalence were expressed as proportions with corresponding 95% confidence intervals to enable interpretation of variability across clinics. Records with incomplete complication status (n = 127, 1.4%) were excluded from the analysis. As the study was descriptive in nature, no inferential statistical tests were applied.

RESULT

Overall burden of DM Complication

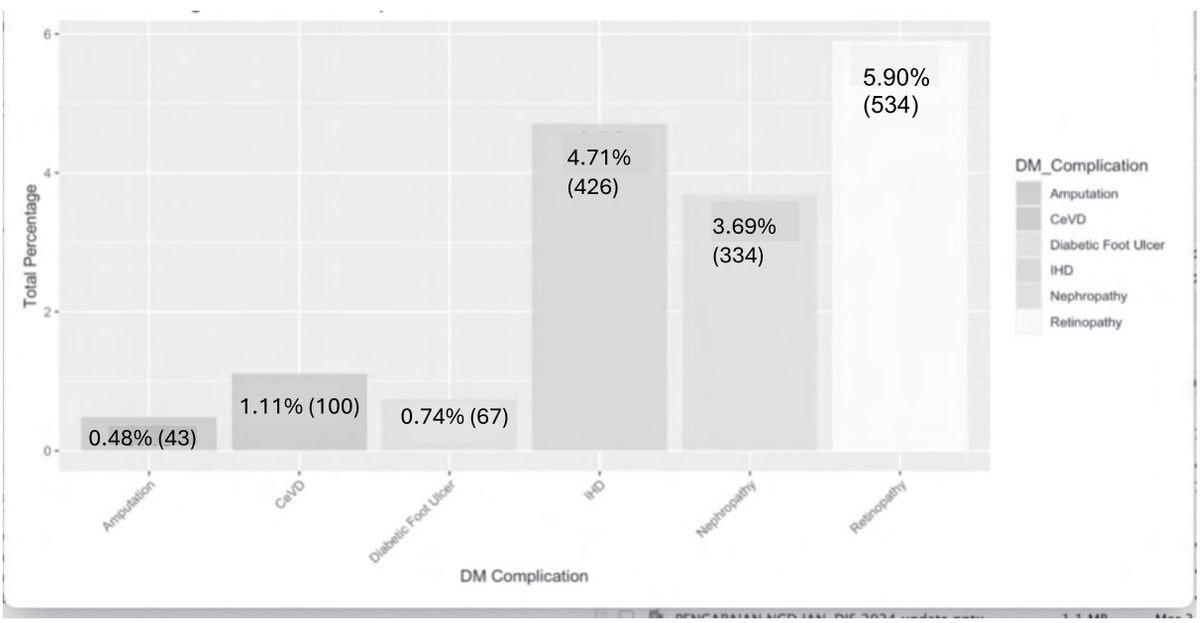


Figure 1: DM Complications in Kulim District up to 2024

Among the 9,049 DM patients registered in the NDR in Kulim District up to 2024, retinopathy is the highest, affecting 5.90% of patients, followed by IHD at 4.71%. Other complications, such as Nephropathy (3.69%) and Cerebrovascular Disease (CeVD) (1.11%), contribute to the burden on the healthcare system. Diabetic Foot Ulcer and Amputation are less common but still pose challenges, with percentages of 0.74% and 0.48%, respectively as shown in Figure 1.

DM complications across various healthcare facilities

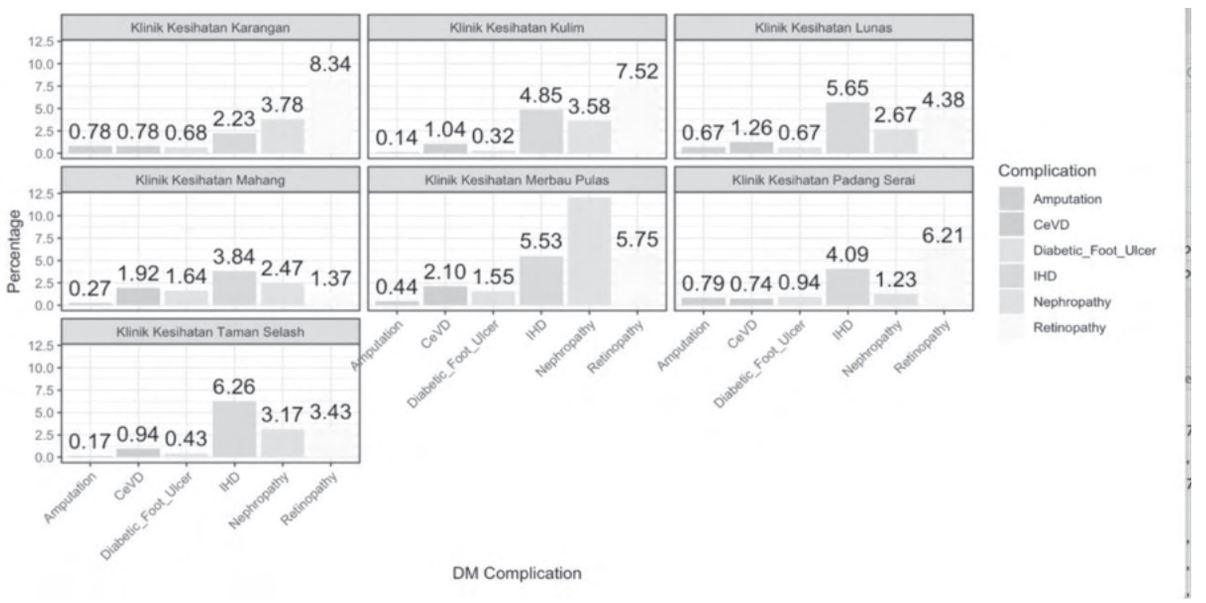


Figure 2: DM Complications across various healthcare facilities in Kulim District up to 2024

Figure 2 shows that in Kulim District, Klinik Kesihatan Karangan recorded the highest rates of Retinopathy (8.34%) and Nephropathy (3.78%), while Klinik Kesihatan Kulim showed high Retinopathy (7.52%) and IHD (4.85%). Klinik Kesihatan Merbau Pulas reported the highest Nephropathy rate (12.06%). Meanwhile, Klinik Kesihatan Lunas and Klinik Kesihatan Padang Serai had lower overall complication rates but still reported cases of Diabetic Foot Ulcer and Amputation.

DISCUSSION

The findings from this study provide valuable insights into the distribution of diabetes complications among patients managed within primary healthcare facilities across Kulim District. Our analysis revealed that retinopathy represents the most prevalent complication at 5.90%, followed by ischemic heart disease (4.71%) and nephropathy (3.69%). These patterns merit careful interpretation within the context of primary care delivery in Malaysia, particularly when comparing with other studies conducted in different healthcare settings.

While the observed pattern of retinopathy predominance appears superficially similar to findings from Garofolo et al.'s (2019) hospital-based study in Italy, it is crucial to recognize the fundamental differences in patient populations between these studies. The substantially higher complication rates reported in the Italian cohort (41.6% for retinopathy) most likely reflect their hospital-referred population with more advanced

disease, rather than indicating any exceptional glycemic control in our primary care sample. This distinction is essential for proper interpretation of our results, as primary care registries naturally capture patients at earlier disease stages compared to hospital-based studies.

The comparison with Malaysia's national data (MOH, 2023) reveals interesting variations that warrant discussion. While our study found retinopathy to be the most common complication, national data showed higher prevalence of nephropathy (12.70% nationally versus 3.69% in Kulim). This discrepancy may be partially explained by several factors: the national data's inclusion of hospital-treated cases where more severe complications are managed; potential regional variations in screening practices; and possible differences in risk factor profiles between Kulim's population and national averages. The relatively higher retinopathy detection in our study may reflect the established retinal screening programs in primary care, which facilitate earlier identification of eye complications compared to other microvascular outcomes.

The facility-level analysis uncovered important variations that have significant implications for service delivery. Klinik Kesihatan Karangan's elevated rates of both retinopathy (8.34%) and nephropathy (3.78%) could potentially indicate several scenarios: particularly effective screening programs that detect more early cases; a patient population with longer diabetes duration or specific risk factors; or possibly variations in documentation practices. Similarly, the strikingly high nephropathy rate at Klinik Kesihatan Merbau Pulas (12.06%) suggests this facility may benefit from enhanced renal protection strategies and more frequent kidney function monitoring, though further investigation would be needed to determine the exact contributors to this finding.

Several limitations of this study must be acknowledged when interpreting these results. First, our exclusive focus on primary care patients means we have not captured cases referred to hospitals, potentially leading to underestimation of more severe complications. Second, the observed prevalence rates may be influenced by variations in screening intensity between facilities - for instance, retinopathy may appear disproportionately common because eye screening is more routinely implemented than other complication screenings. Third, the cross-sectional nature of our data prevents assessment of how complication rates may be changing over time. Finally, without individual patient data, we cannot adjust for potential confounding factors such as diabetes duration or glycemic control levels.

These findings suggest several practical recommendations for diabetes management in Kulim District. Facilities with particularly high retinopathy rates, such as Klinik Kesihatan Karangan and Klinik Kesihatan Kulim, should ensure robust systems are in place for follow-up of screen-positive cases to prevent vision loss. For Klinik Kesihatan Merbau Pulas, where nephropathy rates are notably elevated, additional

renal protection strategies and more frequent kidney function monitoring may be beneficial. All facilities should work toward standardizing their screening methods across different complications to ensure more comparable data in future assessments. Importantly, future research should aim to link primary care data with hospital records to obtain a more complete understanding of complication burden across the entire healthcare continuum.

The observed patterns underscore the importance of maintaining and strengthening complication screening programs in primary care, while also highlighting the need for tailored approaches that address specific facility-level patterns. By combining population-wide screening initiatives with targeted interventions for high-risk groups and facilities, healthcare providers in Kulim District can work toward reducing the burden of diabetes complications while improving patient outcomes across the region.

RECOMMENDATIONS

Pejabat Kesihatan Kulim should emphasise targeted interventions and tailored resource allocation to address facility-specific complication patterns, as a one-size-fits-all approach is inadequate. Specialised services such as retinal screening at clinics with high retinopathy rates and enhanced renal monitoring at facilities with elevated nephropathy cases should be prioritised. A comprehensive strategy is needed, combining staff training to strengthen screening and management capacity, standardised evidence-based protocols across all clinics, and equitable resource distribution. At the population level, public health campaigns focusing on lifestyle modification, complication awareness, and treatment adherence through schools, community programmes, and local organisations will be crucial. By integrating clinic-level interventions with community-based prevention efforts, Pejabat Kesihatan Kulim can develop a balanced approach that addresses both immediate management needs and long-term reduction of diabetes complications across the district.

CONCLUSION

The findings highlight notable variations in complication profiles across facilities, underscoring the importance of facility-specific approaches to diabetes management. While methodological factors such as screening practices and population differences must be considered when comparing across studies, the consistent facility-level patterns provide valuable insights for local healthcare planning. These results advocate for tailored quality improvement initiatives that address each clinic's unique complication profile while maintaining district-wide standards. At a broader level, the findings can inform district-level planning and policy development by guiding resource allocation and prioritization of services, thereby strengthening the precision and effectiveness of diabetes care delivery within Kulim District's primary care network.

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PREVALENCE AND FACTORS ASSOCIATED WITH TB SUCCESS RATE IN KULIM DISTRICT FROM 2020 - 2024

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ABSTRACT

Background: Tuberculosis remains a major health challenge in Malaysia. Treatment success serves as a key indicator of program performance, and identifying its drivers is essential for refining care and halting transmission. This study aims to determine the prevalence and factors associated with treatment success among TB patients in Kulim District from 2020 to 2024.

Methodology: We conducted a cross-sectional study using TB data from the National TB Registry (NTBR) from 2020–2024. A simple random sampling approach was used to select participants. Treatment outcomes were classified as follows: “successful” included patients who were cured or completed treatment, while “unsuccessful” included those who failed treatment, died or defaulted. Descriptive statistics and multiple logistic regression analyses were performed in R.

Results: In total, 419 TB patients were included. Among them, 345 achieved treatment success. The prevalence of treatment success was 82.3% (95% CI: 78.3%–85.9%). Receiving treatment in government facilities was associated with substantially lower odds of treatment success (AOR = 0.13; 95% CI 0.03–0.38; $p < 0.001$) and female patients had 3.88-fold higher odds of treatment success than male patients (AOR = 3.88; 95% CI 1.72–9.21; $p = 0.001$) after adjustment for other predictors.

Conclusion: The treatment success prevalence rate was 82.3%, substantially below Malaysia’s 2025 target of 90%. Achieving the national 90% target will require gender-sensitive support strategies, system-level improvements in government facilities, and strengthened adherence interventions efforts to keep patients on treatment for the recommended duration.

Keywords
Tuberculosis, Treatment Success, Treatment Outcome, Registry, Factor Associated

INTRODUCTION

Tuberculosis (TB) continues to pose a major global health threat, despite advances in healthcare and disease prevention efforts. Recently the World Health Organization (WHO) highlighted a resurgence of TB, which has now overtaken COVID-19 as the world's most deadly infectious disease in 2023. With an estimated 8.2 million new cases reported, urgent action is required to address the ongoing burden of TB (Suvvari, 2025). The WHO has set a global benchmark for TB treatment, aiming for a success rate of at least 90% by 2025(World Health Organization, 2022). In alignment with this international goal, Malaysia's National Strategic Plan for TB control has also established a target of achieving a 90% treatment success rate by 2030 (Ministry of Health Malaysia, 2021). As such, treatment success is a key indicator for evaluating the effectiveness of national TB control programmes (Kumar et al., 2024). These targets emphasize the ongoing commitment to improving TB outcomes and reducing the disease burden at both global and national levels.

The African region accounts for approximately a quarter of the world's TB cases, yet its treatment success rate (TSR) stands at just 79%, falling short of the End TB target of 90%. Considerable disparities exist in TSR among countries within sub-Saharan Africa, and overall rates have gradually decreased over recent years. In Uganda, although the TSR has risen from 72% in 2019 to 78% in 2020, it remains below the 95% threshold recommended by the WHO (Opito et al., 2024). In Malaysia, TB treatment cohorts from 2015 to 2019 revealed an overall treatment success rate ranging from 79% to 81%. Among previously treated TB cases, excluding relapse, the treatment success rate was lower, varying between 54% and 65% during the same period. For patients with TB-HIV co-infection, treatment outcomes remained suboptimal, with success rates between 53% and 57%. Notably, the treatment success rate among children was comparatively higher, ranging from 89.9% to 92.4% for cohorts diagnosed from 2015 to 2019. However, outcomes for rifampicin-resistant or multidrug-resistant TB (RR/MDR-TB) cases, assessed from 2013 to 2018, were less favourable, with success rates spanning from 32% to 69% (Ministry of Health Malaysia, 2021). Overall, these trends indicate that despite some improvements, most TB treatment cohorts—especially among high-risk groups—continue to fall short of national and global targets, highlighting the ongoing challenge of achieving the End TB goals in both regional and local contexts.

Several factors have been found to influence the success of pulmonary tuberculosis (PTB) treatment. Patients who are clinically diagnosed with PTB and those with HIV/AIDS co-infection are less likely to achieve successful treatment outcomes. In contrast, individuals supported by community volunteers during their treatment are more likely to experience positive treatment results (Tumusiime et al., 2022). Furthermore, studies have indicated that women, younger patients, those without additional medical conditions, individuals with extrapulmonary TB, those with smear-negative pulmonary TB, and newly diagnosed TB cases are more likely to achieve

favourable treatment results (Kumar et al., 2024). These findings highlight the need to address associated factors in TSR, suggesting that targeted interventions for high-risk groups and strengthened community support could play a crucial role in improving overall treatment outcomes.

Although substantial progress has been made in TB prevention and control globally, treatment success rates (TSR) remain below the WHO target of 90%, especially among high-risk populations and in specific local settings. In Malaysia, such disparities are also observed at the district level, where variability in TSR may reflect differences in patient profiles, health service access, and adherence support. This underscores the importance of continuous monitoring and evaluation of treatment outcomes at the local level. Therefore, this study aims to determine the prevalence and identify the factors associated with TB treatment success among patients in Kulim District from 2020 to 2024. The findings will contribute to evidence-based, locally relevant strategies and support Malaysia's National Strategic Plan for Tuberculosis Control 2021–2030 in strengthening district-level interventions.

METHODOLOGY

Design and setting

This study employed a cross-sectional design to evaluate treatment outcomes among tuberculosis (TB) patients within Kulim District over a five-year period. Data were obtained from the National Tuberculosis Registry (NTBR), a centralized electronic system managed by the Ministry of Health Malaysia. For the purpose of this study, records of all individuals diagnosed with TB and registered in the NTBR from 1 January 2020 to 31 December 2024 in Kulim District were extracted and analysed. The dataset included relevant sociodemographic and clinical information, enabling the assessment of treatment success and associated factors within the local context.

Inclusion and Exclusion Criteria

This study included all tuberculosis patients aged 18 years and above and Malaysian nationality. Cases were excluded if there was incomplete data on independent variables or if treatment outcome information was missing, such as patients who were transferred to another state or classified as defaulters (Dashuki et al., 2025). Further exclusions were made for cases involving multidrug-resistant tuberculosis (MDR-TB), those still undergoing treatment at the time of data collection, and cases in which the TB diagnosis was subsequently revised.

Sample size estimation

The sample size was determined using two different formulas. For estimating the prevalence of TB treatment success, a single proportion formula was applied. To assess factors associated with treatment success, a two proportions formula was utilized. Both calculations were performed using the Sample Size Calculator (web)

(Wan Nor Arifin, 2025). The largest required sample size was 419, as derived from the single proportion formula, and this figure was adopted for the study.

Operational Definition

Treatment success or favourable treatment outcomes was defined as the sum of cases who were cured and completed treatment whereas all the other outcomes (treatment failed, died, loss to follow-up and not evaluated) were considered unsuccessful or unfavourable treatment outcomes (Tok *et al.*, 2020)

Variables

The variables analysed in this study were divided into independent and dependent variables. The independent variables comprised sociodemographic characteristics, namely age, gender, level of education, occupation, smoking status, and the healthcare facility where treatment was received. Age was categorised into three groups: 18–39 years, 40–59 years, and ≥60 years, consistent with previous Malaysian TB research, which reported that the majority of TB patients fell within the 40–59 years group and demonstrated higher treatment success rates compared to younger and older patients (Dashuki et al., 2025). Clinical characteristics, including diabetes mellitus status and the anatomical site of TB infection, were also considered as independent variables.

The dependent variable was treatment success, defined as either the patient being cured or having completed the full course of the prescribed TB treatment regimen. This outcome served as the primary measure for evaluating the effectiveness of TB treatment among the study population.

Statistical Analysis

Data were analysed using descriptive statistics to summarise the characteristics of the study population and the prevalence of treatment success rates. Subsequently, multiple logistic regression analysis was performed to identify factors independently associated with successful TB treatment. Both analyses were conducted using R software version 4.4.3.

RESULT

Sociodemographic and clinical characteristics of the study population

Table 1 shows the sociodemographic and clinical characteristics of 419 tuberculosis patients in Kulim District who were included in the study. Among 419 TB patients, most were male (64%) and aged 18–39 years (39%). About half were employed (51%), and the majority had formal education (99%). Most were treated in government facilities (80%) and had pulmonary TB (78%). Non-smokers accounted for 73%, and only 5.5% had diabetes mellitus.

Table 1: Sociodemographic and clinical characteristics of Tuberculosis Patients in Kulim District from 2020–2024 (N = 419)

Variables	n (%)
Sociodemographic	
Gender	
Male	269 (64%)
Female	150 (36%)
Age (years)	
18–39	164 (39%)
40-59	161 (38%)
≥60	94 (11%)
Occupation	
Employed	212 (51%)
Unemployed	207 (49%)
Education	
Informal	4 (1.0%)
Formal	415 (99%)
Facilities (place of treatment)	
Private	83 (20%)
Government	336 (80%)
Clinical Characteristics	
Anatomy	
Pulmonary	325 (78%)
Extrapulmonary	80 (19%)
Pulmonary and Extrapulmonary	14 (3.3%)
Smoking	
No	307 (73%)
Yes	112 (27%)
Diabetes Mellitus	
No	396 (95%)
Yes	23 (5.5%)

Prevalence of tuberculosis success rate in Kulim district in 2020-2024

The prevalence of tuberculosis treatment success in Kulim District from 2020 to 2024 was 82.3%, with a 95% confidence interval of 78.3% to 85.9%.

Table 2: Tuberculosis treatment outcomes in Kulim District, 2020–2024 (N = 419)

Treatment Outcome	n (%)
Successful (cured + completed)	345(82.3)
Unsuccessful (failed, died, loss to follow up, not evaluated)	74(17.7)
Total	419(100)

Factors associated with tuberculosis success rate in Kulim District, Kedah

In the multiple logistic regression analysis as shown in Table 3, two variables were found to be significantly associated with tuberculosis treatment success. Patients

managed in government facilities had significantly lower odds of treatment success compared to those treated in private facilities (AOR = 0.13; 95% CI: 0.03–0.38; $p < 0.001$). Female patients had significantly higher odds of treatment success compared to males (AOR = 3.88; 95% CI: 1.72–9.21; $p = 0.001$).

Table 3: Multiple Logistic Regression Model of Factors Associated with Tuberculosis Treatment Success in Kulim District from 2020–2024 (N = 419)

Variables	Adjusted OR (AOR)	95% CI	*p*-value
Sociodemographic			
Gender			
Male	-	-	
Female	3.88	1.72, 9.21	0.001
Age(years)			
18–39	-	-	-
40-59	0.86	0.44, 1.68	0.7
≥60	0.36	0.17, 0.76	0.008
Occupation			
Employed	-	-	
Unemployed	0.61	0.27, 1.31	0.2
Education			
Informal	-	-	
Formal	5.04	0.58, 44.3	0.12
Facilities (place of treatment)			
Private	-	-	
Government	0.13	0.03,0.38	0.001
Clinical Characteristics			
Anatomy			
Pulmonary	-	-	
Extrapulmonary	1.98	0.79, 5.38	0.2
Pulmonary and Extrapulmonary	0.36	0.07, 1.73	0.2
Smoking			
No	-	-	
Yes	0.59	0.26, 1.32	0.2
Diabetes Mellitus			
No	-	-	
Yes	0.78	0.17, 4.16	0.8

Intercept = 2.165
No multicollinearity detected (all GVIFs < 2)
Hosmer–Lemeshow p-value = 0.557
Classification accuracy = 81.6%
AUC = 0.755

DISCUSSION

Prevalence of tuberculosis success rate in Kulim district, Kedah

This study included a total of 419 tuberculosis cases from the period 2020 to 2024. The prevalence of successful TB treatment in Kulim district was 82.3%, representing those that completed treatment or were cured during the study period. According to the World Bank (2024), the treatment success rate for new and relapse tuberculosis

(TB) cases in Malaysia was 81% in 2022, reflecting modest progress but still falling short of the WHO End TB Strategy target of at least 90%. This rate is also substantially higher than that reported in a study conducted among tuberculosis and HIV co-infected patients in Kelantan and Klang Valley, which documented a treatment success prevalence of 57.1% and 53.4% (Romaino et al., 2022). Although this suggests relatively good performance in Kulim compared to the national rate, it still falls short of the World Health Organization's (WHO) End TB Strategy target of ≥90% (WHO, 2015), as well as the Malaysia National Strategic Plan for TB Control 2021–2030, which similarly aims for a treatment success rate of at least 90% (Ministry of Health Malaysia, 2021).

When compared regionally, China achieved a treatment success rate (TSR) of 95% for drug-sensitive tuberculosis in 2022, far exceeding Malaysia's national TSR of 81% and Kulim District's TSR of 82.3% (World Bank, 2023; WHO, 2023). China's high TSR is likely underpinned by well-coordinated national systems, including community-based DOTS, digital adherence technologies, comprehensive home-based follow-up, and universal health insurance coverage that ensures timely diagnosis, prompt treatment initiation, and consistent adherence monitoring (Pan et al., 2023).

These differences underscore the need for Malaysia to strengthen adherence interventions, standardize DOTS across sectors, and improve outcome monitoring—especially at the district level. Aligning local strategies with NSPTB 2021–2030, particularly Pillar 3 (Patient-Centred Care) and Pillar 5 (Monitoring & Evaluation), will be essential to close this performance gap and progress toward WHO's treatment success benchmarks.

Factors associated with tuberculosis success rate in Kulim District, Kedah

This study identified gender and the type of facility managing TB as statistically significant predictors of TB treatment success. Female gender was strongly associated with treatment success, with female patients having nearly four times higher odds of successful outcomes compared to males (AOR = 3.88; 95% CI: 1.72–9.21; p = 0.001). This finding is supported by local evidence from Malaysia. Chee Cheong et al. (2022) found that female pulmonary TB patients experienced shorter delays from symptom onset to treatment initiation in Selangor, indicating more proactive health-seeking behaviour, a crucial factor in treatment adherence. Internationally, Horton et al. (2016) conducted a meta-analysis and reported consistently poorer TB outcomes among males in low- and middle-income countries, including higher default rates and treatment failures. Pedrazzoli et al. (2014) also reported better compliance among female TB patients in Pakistan.

In the Malaysian context, particularly in semi-urban districts like Kulim, male patients may face challenges such as rigid work schedules, greater mobility, and stigma,

which impede treatment adherence. In contrast, female patients often benefit from more stable support systems and more frequent interactions with healthcare services. These findings highlight the importance of gender-responsive TB care, in line with Pillar 3: Patient-Centred Care of Malaysia's National Strategic Plan for Tuberculosis Control 2021–2030 (Ministry of Health Malaysia, 2023).

The second key factor associated with treatment success was the type of facility managing TB. In our study, TB patients managed in government facilities had markedly lower odds of treatment success (AOR = 0.13; 95% CI 0.03–0.38) compared to those in private facilities. A paediatric study in Malaysia (2013–2017, MyTB v2.1) also demonstrated a facility-related factors, children treated in public hospitals were less likely to achieve success than those treated in public clinics (AOR = 0.38; 95% CI 0.25–0.58). Importantly, the paediatric study highlighted that hospital patients typically represent more severe cases, which may explain their poorer outcomes (Awaluddin et al., 2020). Unlike our broader comparison of "government vs. private," that study was limited to children and specifically contrasted hospital versus clinic settings within the public sector. Taken together, these findings suggest that facility type and the clinical complexity of patients managed are important determinants of TB treatment success. This underscores the need to strengthen patient-centred services, enhance adherence support, and ensure that government facilities are adequately resourced to manage both routine and complex TB cases.

Previous studies have identified several factors significantly associated with TB treatment success rate, but these associations were not observed in our study. In Negeri Sembilan, higher educational attainment was linked to greater treatment success (Dashuki et al., 2025), while in Belagavi, India, younger age groups showed higher odds of success (Kumar et al., 2024). In Kepong, Kuala Lumpur, unemployment was associated with unsuccessful treatment (Arsad & Ismail, 2021), and in Addis Ababa, Ethiopia, diabetes mellitus was a significant predictor of poor outcomes (Adane et al., 2023). Similarly, a multicenter Malaysian study found smoking to be a major barrier to treatment success (Khan et al., 2020). In Kelantan, among TB–HIV patients, the anatomical site of TB was significantly associated with treatment success (Romaino et al., 2022). In contrast, our study did not find significant associations with education, age, occupation, diabetes, smoking, or TB site. Instead, gender and type of treatment facility emerged as the key determinants of treatment success in our population.

To the best of our knowledge, this is the first study in Kedah to determine the prevalence and factors associated with TB TSR at the district level, thereby filling a critical gap in localized TB programme data and supporting more targeted decision-making within the state. However, several limitations should be acknowledged. The retrospective design and reliance on secondary surveillance data may introduce information bias due to potential misclassification or missing outcomes, thus limiting internal validity. Additionally, as a cross-sectional study, the direction of causal

associations cannot be determined, and external validity may be limited due to the focus on a single district, potentially reducing generalizability to other settings with different epidemiological characteristics or healthcare system performance.

Overall, these findings underscore the need for gender-responsive interventions to mitigate disparities in TB treatment success. In addition, strengthening the quality and capacity of government facilities is essential, given the significantly lower odds of treatment success observed among patients managed in Kulim district.

CONCLUSION

The overall treatment success rate for tuberculosis in Kulim District between 2020 and 2024 was 82.3% (95% CI: 78.3–85.9%), which is significantly below the national and WHO target of 90%. These findings point to the urgent need for gender-sensitive approaches and targeted interventions to improve treatment outcomes, alongside broader programmatic efforts to reach the national 90% treatment success target. While limited to one district, this study provides important evidence to guide programmatic interventions and supports Malaysia's National Strategic Plan for Tuberculosis Control 2021–2030.

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EPIDEMIOLOGICAL CHARACTERISTICS AND VIRAL EVOLUTION OF HFMD OUTBREAK IN KULIM DISTRICT FROM 2022-2024

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ABSTRACT

Introduction: Hand, foot, and mouth disease (HFMD) is a contagious illness primarily affecting children under five, caused by enteroviruses. The dynamic nature of HFMD's etiology, with its evolving viral strains, contributes to the challenge of controlling outbreaks. A rise in HFMD outbreaks in Kulim District from 2022 to 2024 highlights the need to describe epidemiological trends and viral evolution for effective prevention and control.

Methods: This cross-sectional study was conducted using notified HFMD data from CDCIS E-Notification and Laporan Wabak from 2022 to 2024. Descriptive analysis was employed to describe the epidemiological trends and viral evolution of the outbreaks.

Results: From 2022 to 2024, a total of 20 HFMD outbreaks were reported in Kulim District, accounting for 121 cases, with the number of outbreaks increasing each year, from 6 in 2022 to 8 in 2024. Outbreaks primarily affected younger children, particularly those under 5, showing a clear increasing trend. Malay individuals consistently dominated the outbreaks, and males accounted for a higher proportion of cases. Kulim consistently had the highest number of outbreaks compared to other subdistricts, with kindergartens being the most affected facilities. A shift in viral strains was observed, with Enterovirus 71 being the most prevalent in 2022, followed by a shift to Coxsackie A16 and Pan Enterovirus in 2024.

Discussion: These findings emphasize the need for targeted prevention in high-risk groups, especially young children and those in kindergartens. Regular viral monitoring of circulating enteroviruses is crucial to identify new strains and adjust control strategies effectively.

Keywords: HFMD, Outbreak, Epidemiology, Viral Evolution

INTRODUCTION

Hand, foot, and mouth disease (HFMD) is a widespread febrile illness that predominantly affects children under five, though it can also impact older children and adults. HFMD outbreaks in children younger than five have been documented globally, with the primary pathogens being Coxsackievirus A16 (CVA16), enterovirus A71 (EV-A71), and more recently, Coxsackievirus A6 (CVA6). Since 1997, HFMD has become endemic in the Asia Pacific region, with periodic outbreaks reaching epidemic levels (Chavan et al., 2023).

HFMD is transmitted through direct contact with fluids from the body of an infected person, such as saliva and blister fluid, as well as through the faecal-oral route. While the disease is typically self-limiting and lasts less than a week, with skin rashes on the hands, feet, or buttocks and mouth ulcers, delays in diagnosis and treatment can result in severe complications like meningitis, encephalitis, and polio-like paralysis, which may be fatal. The first HFMD outbreak in Malaysia was recorded on April 1, 1997, and the disease has since emerged as a major public health concern with outbreaks recurring every two to three years. In 2018, cases surged to 76,776 nationwide, representing a sharp increase from the previous year, with all states affected and Selangor recording the highest burden at 21,282 cases (Rajamoorthy et al., 2022). At the national level, Malaysia has experienced a substantial surge in HFMD notifications. As of the 17th epidemiological week in 2025, a total of 99,601 cases were reported, reflecting a 266% increase compared to 27,236 cases during the corresponding period in 2024(Yusof, 2025). Similar trends have been observed at the state level. In Kedah, 1,016 HFMD cases were recorded in the first half of 2022, marking an increase of nearly 50% compared to the equivalent period in 2019, prior to the COVID-19 pandemic. The distribution of cases was not uniform across the state, with higher concentrations documented in districts such as Kuala Muda, Kota Setar, and Padang Terap (Zulkifli, 2022). These findings highlight those multiple districts within Kedah contribute to the overall burden of HFMD.

The majority of infections are more common in male children than in females (7-9). Male children tend to form strong social connections and engage in more physical interactions with peers, which may increase their susceptibility to infection. Settings such as kindergartens and nurseries are particularly vulnerable to the spread of HFMD due to the frequent close contact among children as they spend time and play together in shared spaces (Wan Mohamad et al., 2021).

Hand, foot, and mouth disease (HFMD) is a viral exanthem most frequently attributed to coxsackieviruses within the Enterovirus genus. The primary serotypes responsible are Coxsackievirus A16 and Enterovirus A71. More recently, Coxsackievirus A6 has also been recognized as a significant cause of HFMD globally. Additionally,

Coxsackievirus A10 has been linked to more severe forms of the disease. Other serotypes, including Coxsackievirus A4 to A7, A9, B1 to B3, and B5, have occasionally been associated with HFMD, though less frequently (Amanda M. Guerra; Emily Orille; Muhammad Waseem, 2023). Globally, HFMD has been widely reported across various continents, for instance, Bulgaria and Hungary experienced HFMD epidemics related to Enterovirus 71 (EV71) in 1975 and 1978, respectively. The Netherlands recorded two notable outbreaks predominantly linked to EV71 in 1986 and again in 2007. In the United Kingdom, a significant outbreak in 1994 identified Coxsackievirus A16 (CoxA16) as the leading causative agent. Vietnam experienced a major national HFMD surge in 2011 with ~112,370 cases and 169 deaths reported across all provinces; subsequent severe outbreaks associated with EV-A71 were reported again in 2018.These events highlight the widespread nature and ongoing public health burden posed by HFMD worldwide (Hu et al., 2024). Significant outbreaks of HFMD linked to EV71 have been repeatedly reported throughout the Asia–Pacific region since the late 1990s. Malaysia's first documented EV71 outbreak occurred in Sarawak (East Malaysia) in April 1997 and spread to Peninsular Malaysia by June, affecting over 4,000 children and causing 41 deaths. While CVA16 was also detected, only EV71 was linked to fatalities, with CVA16 tending to appear during or between EV71 outbreaks. (Fong et al., 2021).

HFMD is a nationwide concern in Malaysia, with increasing cases reported in multiple states, including Kedah. National surveillance data have consistently demonstrated cyclical surges in HFMD incidence, particularly since the large-scale outbreaks in 2018. Within Kedah, HFMD notifications have also shown an upward trend, mirroring the national pattern. Kulim has been among the districts in Kedah reporting a higher burden of HFMD cases and recurrent outbreaks over recent years.

While extensive research has been conducted on HFMD, detailed analyses focusing on the evolution of viral strains and their epidemiological impact in Kulim District are limited. Thus, the aim of this study is to describe the epidemiological characteristics and patterns of viral evolution of HFMD in Kulim District during the period 2022 to 2024.

METHODOLOGY

Study Setting

This study was designed as a cross-sectional study conducted in the Kulim District. The study area was chosen due to its epidemiological importance, being one of the most urbanized and densely populated districts in Kedah, with consistently high reports of HFMD cases and outbreaks. The study period covered the years 2022 to 2024, a timeframe selected to capture recent patterns of HFMD transmission and to reflect the current epidemiological situation in the district. By focusing on this period, the study aims to provide timely insights into both the epidemiological characteristics and the viral evolution of HFMD within the local context.

Case Defintion

According to the Case Definitions of Infectious Diseases in Malaysia 3rdEdition, HFMD cases were defined as clinical case definition and laboratory criteria for diagnosis. Clinical case definition of HFMD is any child of 10-year-old and below with mouth or tongue ulcer; maculopapular rashes and /or vesicles on palms and soles and with or without history of fever. Laboratory criteria for diagnosis is any case that has clinical symptom and positive for virus Coxsackieviruses (CV) A16, A5, A9, A10, B2, B5; and Enterovirus 71 and other enteroviruses which could cause HFMD, isolated or detected from stool or vesicle fluid or mouth ulcer or saliva. The HFMD outbreak is defined as the occurrence of two or more cases in the same locality within the incubation period of 6 days (Ministry of Health Malaysia, 2017).

Study Population

All notified cases of 2,870 confirmed HFMD cases recorded between 2022 and 2024 were included in this study; no conventional sampling method was applied, as the entire case population was analysed. Data were retrieved from the Communicable Disease Control Information System (CDCIS) e-Notification platform, the official surveillance database for notifiable diseases in Malaysia. Within CDCIS, HFMD cases are categorized as either sporadic or outbreak-associated. The classification is determined by the District Health Office during outbreak investigations, and cases linked to an outbreak are documented through outbreak notification records and corresponding line listings. For this study, 121 cases that were labelled as outbreak-related in CDCIS were extracted and analysed separately to differentiate their epidemiological features from sporadic cases.

Study Tools

Data on notified HFMD cases in Kulim District were obtained from the national electronic communicable disease notification system, known as the Communicable Diseases Control Information System (CDCIS) E-Notification. The system is managed by the District Health Office of Kulim and provides a comprehensive record of HFMD cases, facilitating accurate data collection for the study. Additionally, for HFMD outbreak data, information was collected from the "Laporan Akhir Wabak HFMD," which further supplemented the dataset and provided detailed insights into outbreak-specific trends. The variables considered in this study comprised both independent and dependent variables. Independent variables included temporal factors (month and year of notification), demographic characteristics (gender, age group, and ethnicity), geographical distribution (subdistrict of residence), type of healthcare facility reporting the case, and virological profile (viral serotype identified). The dependent variable was the occurrence of HFMD outbreak.

Data Analysis

Descriptive statistical analyses were conducted using R software (version 4.4.3). Categorical variables such as gender, age group, ethnicity, type of healthcare facility, subdistrict of residence, and outbreak status were summarized as frequencies and

percentages. Temporal trends were assessed by examining monthly and yearly distributions of HFMD cases. Viral serotype distribution was also summarized descriptively to explore circulating patterns across the study period.

RESULTS

Epidemiological Characteristics: Temporal Distribution of HFMD Outbreak from 2022-2024

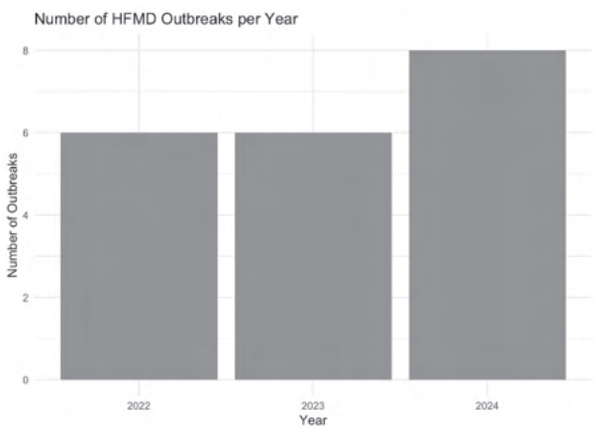


Figure 1: Number of HFMD Outbreaks per Year

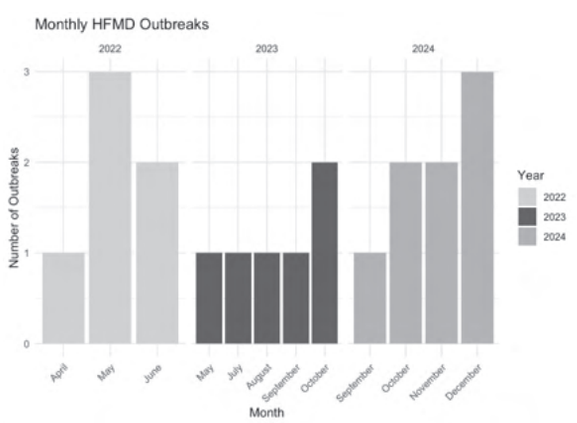


Figure 2: Number of HFMD Outbreaks per Monthly

Figure 1 & 2 shows the number of confirmed HFMD outbreaks in Kulim District across monthly in three consecutive years—2022, 2023, and 2024. From 2022 to 2024, a total of 20 HFMD outbreaks were reported in Kulim District, accounting for 121 cases. These outbreaks included 6 in 2022, 6 in 2023, and 8 in 2024. In 2022, the peak occurs in May, with a sharp decline in June, indicating a significant but short-lived outbreak during the middle of the year. In 2023, there is a pattern of relatively stable outbreaks, with May, July, August, and September each experiencing 1 outbreak, followed by a slight increase in October with 2 outbreaks. In 2024, the trend shifts with December witnessing the highest number of outbreaks at

3, marking a significant increase compared to earlier years. This indicates that the outbreaks in 2024 became more pronounced later in the year, particularly in December, suggesting a shift toward a more concentrated outbreak period during the end of the year. Overall, the result shows both stable and fluctuating outbreaks, with a tendency for increasing activity in the latter months of each year, especially in 2024.

Epidemiological Characteristics: Sociodemographic Distribution of HFMD Outbreak from 2022-2024

Table 1: Sociodemographic Distribution of HFMD Outbreak from 2022-2024

Characteristic	**2022** n = 43[1]	**2023** n = 25[1]	**2024** n = 53[1]
Age in years			
<1	0.0 (0.0%)	0.0 (0.0%)	5.0 (9.4%)
1	3.0 (7.0%)	5.0 (20.0%)	13.0 (24.5%)
2	7.0 (16.3%)	0.0 (0.0%)	6.0 (11.3%)
3	10.0 (23.3%)	0.0 (0.0%)	10.0 (18.9%)
4	11.0 (25.6%)	0.0 (0.0%)	4.0 (7.5%)
5	5.0 (11.6%)	10.0 (40.0%)	6.0 (11.3%)
>5	7.0 (16.3%)	10.0 (40.0%)	9.0 (17.0%)
Ethnicity			
Chinese	2 (4.7%)	0 (0%)	17 (32%)
Indian	1 (2.3%)	0 (0%)	0 (0%)
Malay	40 (93%)	25 (100%)	36 (68%)
Gender			
Female	19 (44%)	10 (40%)	19 (36%)
Male	24 (56%)	15 (60%)	34 (64%)
Subdistrict			
Kulim	23 (53%)	14 (56%)	28 (53%)
Lunas	0 (0%)	5 (20%)	25 (47%)
Padang Serai	20 (47%)	6 (24%)	0 (0%)
Type of Facility			
Kindergarten	43 (100%)	15 (60%)	44 (83%)
Preschool	0 (0%)	10 (40%)	9 (17%)

[1]n (%); Median (Q1, Q3)

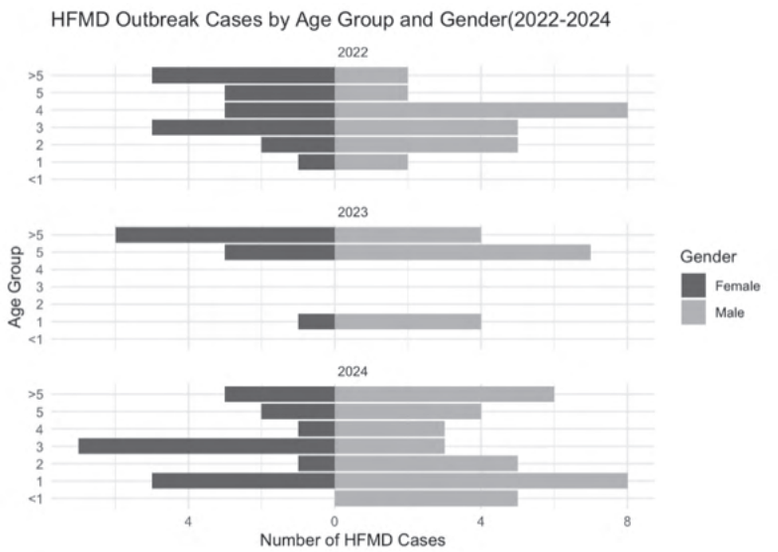


Figure 3: Trend of HFMD Outbreak by Age group & Gender

Age group

The age distribution of HFMD outbreaks varied over the years. In 2022, most cases occurred among 3- and 4-year-olds. In 2023, outbreaks shifted to primarily affect children aged 5 and above, with younger age groups reporting fewer cases. By 2024, incidence increased again among 1-year-olds and infants. Overall, outbreaks predominantly affected children under five, with age patterns fluctuating each year.

Gender

The gender distribution of HFMD outbreaks remained fairly balanced but showed a gradual increase in male cases over time: males accounted for 56% of cases in 2022, 60% in 2023, and 64% in 2024. Although males were consistently more affected, the gender gap was not substantial.

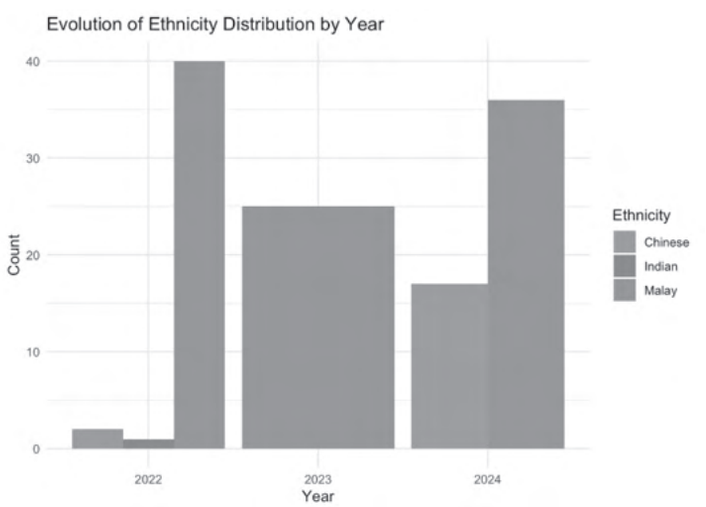


Figure 4: Trend of HFMD Outbreak per year by Ethnicity

Ethnicity

Malay individuals consistently represented the majority of HFMD outbreaks. In 2022, Malays accounted for 93% of cases, with smaller proportions among Chinese and Indian populations. In 2023, all cases were among Malays. By 2024, Malay cases declined to 68% while Chinese cases rose to 32%, though Malays remained the most affected group.

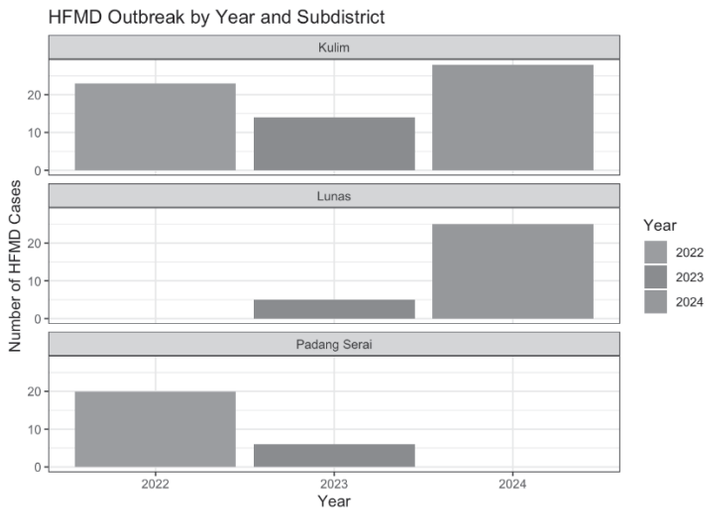


Figure 5: Number of HFMD Outbreak by Year and Subdistrict

Subdistrict

Out of the 17 subdistricts, only Kulim, Lunas, and Padang Serai reported HFMD outbreaks between 2022 and 2024. Kulim consistently contributed the largest share of cases throughout the period, although a notable shift was observed with Lunas showing a substantial rise, particularly in 2024. In contrast, Padang Serai experienced a marked decline, ultimately reporting no outbreaks in 2024, reflecting a redistribution of cases among the subdistricts. In 2022, Kulim accounted for 53% of outbreaks, followed closely by Padang Serai with 47%, while Lunas reported none. The pattern shifted in 2023, with Kulim maintaining dominance at 56%, Lunas emerging with 20%, and Padang Serai decreasing to 24%. By 2024, Kulim remained stable at 53%, while Lunas rose sharply to 47%. Padang Serai, however, reported no outbreaks that year, marking a complete decline.

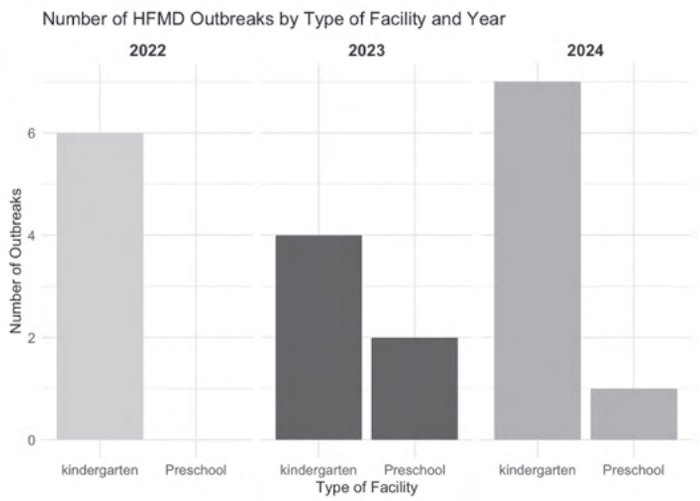


Figure 6: Number of HFMD Outbreak by Type of facility and Year

Type of Facility

HFMD outbreaks occurred only in kindergartens and preschools during the study period. In 2022, all outbreaks were in kindergartens. In 2023, there was a shift with preschools accounting for 40% of outbreaks, but by 2024, kindergartens again predominated. This indicates a temporary increase in preschool outbreaks in 2023, followed by a return to kindergarten as the primary setting in 2024.

Viral evolution of HFMD Outbreak from 2022-2024

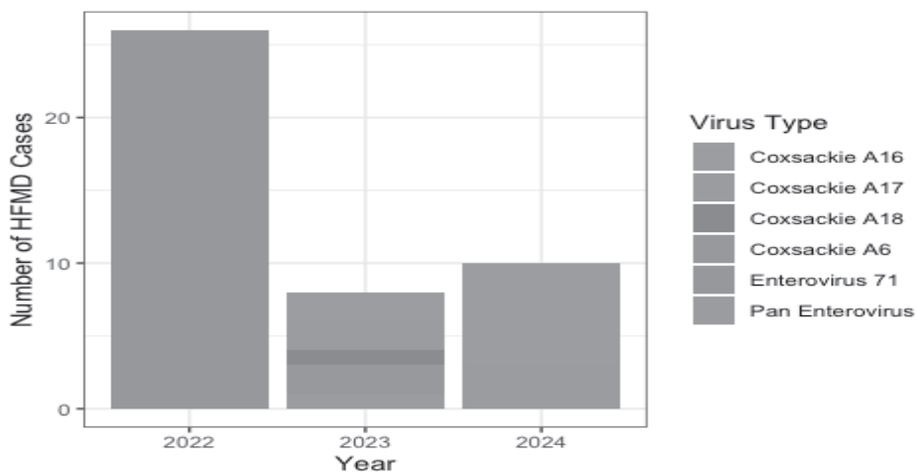


Figure 7: Viral evolution of HFMD Outbreak from 2022-2024

The viral profile of HFMD outbreaks changed markedly over the three years. Enterovirus 71 dominated in 2022 but was not detected in 2023 or 2024. In 2023, there was a shift to various Coxsackieviruses—including A16, A17, A6, and A18—while Pan Enterovirus appeared in a small proportion of cases. By 2024, Coxsackie A16 became the most common strain, with Pan Enterovirus persisting and no detection of Enterovirus 71. These findings indicate a shift from Enterovirus 71

dominance in 2022 to a broader variety of Coxsackieviruses and Pan Enterovirus in subsequent years.

DISCUSSION

Epidemiological Characteristics: Temporal Distribution of HFMD Outbreak from 2022-2024

The peak in HFMD cases during May 2022 could be linked to the timing of the Raya Aidilfitri celebration, which occurred on May 2, 2022. During this festive period, many people travel to visit family and friends, often participating in large gatherings where close contact among children is common. Such social interactions, especially in crowded settings, facilitate the spread of contagious diseases like HFMD. Additionally, the increased mobility and socialization during this time may have contributed to a heightened risk of transmission, leading to a surge in cases following the celebration.

In 2023, the distribution of outbreaks appeared relatively stable, with one outbreak reported in May, July, August, and September, followed by a modest increase in October when two outbreaks were documented. This rise may be linked to school reopening, as kindergartens and nurseries are particularly vulnerable environments for HFMD transmission (Wan Mohamad et al., 2021). In these settings, children spend extended periods together in shared spaces and engage in frequent close interactions, which substantially increase the risk of viral spread.

In contrast, 2024 displayed a different pattern, with December recording the highest number of outbreaks (n=3). While this coincided with the year-end school holiday period, the rise cannot be explained by school closure alone. HFMD is highly infectious, and earlier studies have shown that clusters often emerge in settings with high child-to-child interaction, such as family gatherings, including the so-called “birthday week effect (Jiang et al., 2024).” Evidence further suggests that children frequently spend time in residential areas, which account for the majority of their outdoor activities, creating opportunities for direct contact with symptomatic peers. Recreational venues, such as parks and playgrounds, also represent potential sites of transmission, as contaminated surfaces may act as reservoirs for enteroviruses. For instance, Li et al. reported a 7% positivity rate of enteroviruses on amusement equipment in public playgrounds (Hu et al., 2020). These factors combined—social gatherings, residential play, and shared recreational facilities—may have amplified transmission during the December holiday season, contributing to the surge observed in 2024.

Epidemiological Characteristics: Sociodemographic Distribution of HFMD Outbreak from 2022-2024

Overall, there is a trend of increasing outbreaks in younger children, particularly those under the age of 5, with fluctuations across the years. HFMD is generally more prevalent among younger children, especially those under 5 years old, due to immature immune system and clustering at the pre-kindergarten stage (Zhu et al., 2023).

While Malay children continue to represent the largest proportion of HFMD cases in Kulim, our data indicate that the share of cases among Chinese and Indian children has significantly increased over the study period, resulting in a relative decline in the Malay proportion. These shifts are unlikely to reflect genetic susceptibility but rather differences in parental knowledge, childcare practices, and awareness of HFMD. For example, Rajamoorthy et al. (2022) conducted a cross-sectional survey among 485 parents in Selangor, Malaysia, finding that only 34.4% had good knowledge of HFMD whereas 78.1% had good awareness. Notably, that study revealed that Malaysian Chinese and Indian parents had lower odds of good awareness than Malay parents (adjusted odds ratios ~0.48 and ~0.44, respectively).

Male cases consistently represented the majority, accounting for 55% in 2022, 58% in 2023, and 54% in 2024. Similarly, studies in other regions, such as Hubei Province, China, have found that male cases were 1.39 times more prevalent than female cases (Zhou et al., 2023). This trend could be partially explained by the fact that boys are generally more active and tend to spend more time outdoors, increasing their exposure to infectious diseases like HFMD (Li et al., 2023). Additionally, cultural factors may play a role, as caregivers in many Asian countries are more likely to seek medical care for boys than for girls, potentially leading to higher reporting and treatment rates for male children (Fong et al., 2021).

The study also found that the HFMD infections was higher in Kulim subdistrict. The subdistrict of Kulim is characterized by significant industrial zones and densely populated settlements. This is primarily due to the fact that areas with higher per capita disposable income among urban residents also tend to have higher population density and more frequent economic activities, which in turn facilitate the spread of HFMD within the community (Wang et al., 2025).

The increasing trend of HFMD outbreaks is observed in children under 5 years old, which corresponds with the fact that kindergartens typically cater to this age group. This could be attributed to a reduction in maternal antibodies as infants transition to the weaning process, combined with increased interactions with other children in group settings. A similar trend has been reported in other countries, where HFMD

cases are most common in children who have not yet reached school age, highlighting the vulnerability of this age group to the disease (Fong et al., 2021).

Overall, the HFMD outbreak trends from 2022 to 2024 highlight the patterns of the disease's distribution that influence disease transmission. These patterns underscore the need for targeted interventions and awareness campaigns, particularly in areas with higher population density and among ethnic groups with limited awareness of the disease, to effectively mitigate the spread of HFMD.

Viral evolution of HFMD Outbreak from 2022-2024

Overall, result shows a significant change in the dominant viral strains causing HFMD outbreaks over the three years, with Enterovirus 71 being the most prevalent in 2022, followed by a shift to various Coxsackieviruses in 2023, and a continued presence of Coxsackie A16 and Pan Enterovirus in 2024. This pattern mirrors trends observed in Guangdong, China, where the detection rate of EV-A71 was minimal at only 0.03% in 2024, a decline that has been attributed to higher antibody levels in the population following vaccination. Additionally, the emergence of the antigenically distinct B1c subtype of Coxsackievirus A16, which rose sharply to 75.42% of detections in 2024 compared to just 12.24% in 2023, has contributed to the changing dynamics of the HFMD epidemic (Zeng et al., 2025), similar to the shift observed in the Malaysian context.

The absence of Enterovirus A71 (EV-A71) in the HFMD outbreaks of 2023 and 2024 can be explained by the cyclical pattern of EV-A71 epidemics, as observed in previous research. First documented in Malaysia in 1997, EV-A71 caused significant outbreaks and numerous deaths. Since then, the virus has followed a pattern of cyclical epidemics, which are influenced by various factors. These cyclical patterns can be driven by changes in the pathogen's antigenicity, variations in the immunity of the host population, and environmental factors. Additionally, new outbreaks are often accompanied by shifts in the virus's genotype, contributing to the emergence of different viral strains (NikNadia et al., 2016).

The increasing trend of HFMD outbreaks among children under 5 years old in 2024 may help explain the shift in the dominant viral strain to Coxsackievirus A16 (CoxA16). As this age group remains more susceptible due to lower antibody levels—evidenced by the meta-analysis showing significantly higher CoxA16 antibody levels in children over 5 years old—the virus may have adapted to target this vulnerable population. With greater exposure and a larger pool of susceptible individuals in younger children, CoxA16 may have emerged as the dominant strain, capitalizing on the immune gaps in this age group (Li et al., 2021).

The presence of pan-enterovirus results likely reflects a change in the testing strategy, where broader PCR detection methods were used, capable of identifying

enteroviruses without specifying the exact strain. It may also point to the emergence of uncharacterized or newly evolving strains not covered by the current subtyping panels. This shift presents challenges in interpreting trends and comparing data with previous years. this changing pattern requires a recalibration of surveillance and response strategies. The decline in EV71 and rise of Cox A16 and pan-enterovirus cases may indicate a lower overall disease severity as shown in the study in Guangzhou, but the inability to subtype a large portion of cases limits as highlighted in the above paragraph, limit the capacity to detect emerging virulent strains. There is a need to enhance molecular surveillance to ensure early identification of new variants and to inform vaccination and prevention strategies.

A limitation of the study is that it focused on a Kulim district, which may limit the generalizability of the findings to other areas or regions. The results may not fully capture the variability in outbreak dynamics, viral strains, or transmission patterns that could occur in different districts or settings. Furthermore, contextual factors such as differences in local healthcare infrastructure, population density, and environmental conditions were not assessed in this study, even though they could influence both the occurrence and severity of HFMD outbreaks. In addition, the sample was randomly taken during the outbreak, meaning not all cases of the outbreak were included. This could lead to sampling bias, as certain groups of individuals, such as those with mild symptoms or those who did not seek medical care, may be underrepresented. As a result, the findings may not fully reflect the entire spectrum of the outbreak or the transmission dynamics.

CONCLUSION AND RECOMMENDATION

This study highlights a significant increase in HFMD outbreaks in Kulim District from 2022 to 2024, with younger children, particularly those under 5, being most affected. The outbreaks showed a rising trend over the years, with Kulim consistently reporting the highest number of cases compared to other subdistricts in Kulim. Malay individuals and males were more commonly affected, and kindergartens emerged as the most impacted facilities. A notable shift in viral strains occurred, with Enterovirus 71 dominating in 2022, followed by Coxsackie A16 and Pan Enterovirus in 2024. These findings underline the dynamic nature of HFMD outbreaks and the need for ongoing surveillance. Continued monitoring of HFMD outbreaks, particularly in children under 5, should be prioritized to track evolving trends in age distribution and viral strains. Strengthened prevention measures should focus on kindergartens and childcare facilities, including routine health screening of children, prompt isolation of symptomatic cases, regular disinfection of shared toys and surfaces, reinforcement of hand hygiene practices, limiting group activities during outbreak peaks, and strengthening parental awareness through health education programs. Additionally, ongoing monitoring of circulating viral strains, such as Coxsackie A16 and Pan Enterovirus, is essential to quickly identify and respond to emerging strains. Further

research into risk factors in HFMD cases could help tailor more targeted interventions for high-risk populations.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to the Director-General of Health Malaysia for the approval and continuous support that made this research possible. Our heartfelt thanks also go to the Kulim District Health Office for their invaluable assistance in providing access to data, facilitating administrative processes, and offering guidance throughout the study period. Their collaboration and commitment to public health have been essential to the successful completion of this research.

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HEALTHY SETTING PROJECT: TRANSFORMATION OF KULIM MUNICIPAL COUNCIL STAFFS TOWARDS A HEALTHY LIFESTYLE

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ABSTRACT

Introduction: A healthy lifestyle is essential for maintaining physical, mental and emotional well-being. With rising cases of non-communicable diseases such as obesity, diabetes and hypertension, adopting a healthy lifestyle is more crucial than ever. MPKK was chosen as the project site due to the invitation and its strategic potential as a model healthy workplace.

Methods: This is a cross-sectional study conducted on July 25, 2024, at the MPKK office, involving 30 randomly selected MPKK employees. We included both genders, regardless of comorbidities. Activities included conducting a health screening of MPKK employees, holding talks on healthy lifestyle and dangers of smoking and referring clients to a smoking cessation clinic. Health screening data collected and analysed using Microsoft Excel.

Results: A total of 30 clients were selected, and most of them are over 40 years old. The majority (14 clients) have a body mass index in the overweight group (BMI 25-29 kg/m^2). A total of 18 clients (60%) were identified as active smokers and most were conventional cigarette smokers.13 clients (43.3%) had high blood pressure but majority had normal blood glucose level (26, 87%). 10 clients have been referred to Quit Smoking Clinic at our District Health Clinic. After six months only 1 client have successfully quit smoking.

Discussion: This project proved the effectiveness of health interventions in the workplace. While significant progress has been made, a more comprehensive and long-term strategy is required to ensure sustained health improvements among MPKK employees. The integration of technology, increased employee participation and robust policy enforcement will be crucial for future success.

Keywords: Health promotion, employees, non-communicable disease, smokers, quit smoking

INTRODUCTION

Non-communicable diseases (NCDs) like cardiovascular diseases, diabetes, cancer, and chronic respiratory illnesses are a major cause of illness and death globally. The World Health Organization (WHO) states that non-communicable diseases (NCDs) are responsible for around 74% of worldwide fatalities, with cardiovascular diseases having the highest percentage, followed by cancers and diabetes (Organization, 2009). The rising occurrence of NCDs is closely linked to alterable risk factors such as poor diets, lack of exercise, tobacco consumption, and excessive alcohol intake (*GBD_2021_Booklet_FINAL_2024.05.16*, n.d.). These behavioral risks are additionally exacerbated by urban development, inactive habits, and work settings that restrict physical movement (Ng et al., 2014).

Non-communicable diseases (NCDs) such as obesity, diabetes, and hypertension also represent major public health burdens in Malaysia (Organization, 2009), exacerbated by unhealthy lifestyle behaviors and tobacco use. According to the National Health Morbidity Survey (NHMS) 2023, 2 in 5 adults with diabetes remain undiagnosed, and 40% of adults avoid health screening. Furthermore, findings from the GATS Malaysia 2023 reveal a 19.0% smoking prevalence among adults, with higher rates in men (35.7%).

A key focus is the prevention and management of both communicable and noncommunicable diseases, which continue to be among the top causes of mortality and disability worldwide. Efforts to tackle these health challenges play a crucial role in global health security by reinforcing health delivery and monitoring systems, thereby improving emergency preparedness, particularly in settings with limited resources. These programs not only strive to enhance health results but also alleviate the economic impact tied to the early onset of diseases and premature deaths (Kostova et al., 2017).

Healthy setting interventions are increasingly gaining prominence in the global health arena. These initiatives are holistic approaches designed to enhance health outcomes and support well-being across diverse populations and environments. They encompass a range of elements, including reforms in public health policy, community participation, and customized healthcare strategies that cater to the varied health requirements worldwide.

Establishing a healthy workplace environment necessitates a comprehensive strategy that encompasses various facets of employee well-being, organizational culture, and physical infrastructure. The World Health Organization emphasizes the collaborative effort between workers and managers in fostering a continuous improvement process aimed at safeguarding and promoting the health, safety, and well-being of all employees while ensuring the sustainability of the workplace (Stoewen, n.d.). This approach involves a careful consideration of identified needs

across several key areas, including health and safety concerns within the physical work environment and the psychosocial work environment, encompassing the organization of work and the prevailing workplace culture (Stoewen, n.d.). Initiatives aimed at promoting health in the workplace are essential for empowering employees to take control of their well-being by identifying health issues, improving their health, and sustaining a healthy work environment (Dwicahyaningtyas et al., 2021a)

Workplace health initiatives have gained recognition as an important avenue for promoting health, demonstrating effectiveness in enhancing the well-being of workers and generating positive outcomes for businesses (Jose & Ogata, n.d.). A healthy workplace encompasses both a healthy environment and healthy practices, with healthy practices yielding short-term benefits and a healthy environment contributing to long-term advantages (Othman et al., 2020). Prioritizing employee health within organizations yields substantial individual and organizational benefits, which include decreasing absenteeism and enhancing productivity (González & Cutiva, 2023a)

Workplaces provide an ideal setting for health interventions, enabling early detection, education, and behavioral support. This study reports the implementation and outcomes of a Healthy Setting Project at Kulim Municipal Council (MPKK), designed to improve employee health status and create a replicable model for similar organizations. Additionally, it aids in the early identification and intervention of non-communicable diseases and raises awareness to decrease tobacco consumption (Kostova et al., 2017)

METHODOLOGY

Study design

This study was a cross-sectional study.

Study population

30 participants were randomly selected from the MPKK staff. All participants were above 18 years old and regardless of having co-morbidity or not. No exclusion criteria as we accepted all the sampling participants provided by the MPKK human resources.

Data collection method

Data collection consisted of interviews with the 30 participants who were selected randomly by the human resources department. Data were collected using a health screening form prepared by the Non-Communicable Disease Control Unit of the District Health Department. The health screening form variables included client descriptions such as identification data, gender and race, age, underlying diseases, family history and smoking status. The health screening part included body mass index calculation, blood pressure and blood glucose measurements. The date were

analysed using Excel for descriptive analysis. Apart from that, we give educational sessions focusing on healthy lifestyle practices and the dangers of tobacco use. Smoking cessation support through referrals to Quit Smoking Clinics for identified active smokers, and follow-up at two-month intervals to monitor progress and provide continued support. The treatment for smoking cessation such as nicotine replacement therapy was prescribed to the clients to assist them in quitting smoking.

Ethical consideration

All participants provided informed consent prior to enrolment in the program, although formal ethical approval was not required as the intervention was part of a routine community health screening initiative.

RESULTS

A total of 30 participants were analysed in this study. The mean age of participants was 41.7 years. The standard deviation of 12.3 indicates moderate variability in age among the participants. There were 22 males and 8 females involved (Figure 1).

The majority of participants (46.7%, n=14) were classified as overweight (BMI 25–29 kg/m²), while an equal number (26.7%, n=8) were either obese or had a normal BMI (Figure 2). The prevalence of obesity and overweight among MPKK staff (73.4%) was higher compared to the national obesity and overweight prevalence reported in the NHMS 2023 study, indicating a greater burden of weight-related health risks within this workplace setting. However, no definite assessment of dietary and lifestyle habits among this group of participants was made.

The prevalence of elevated blood glucose among MPKK staff was 13%, which is comparable to the prevalence reported in the NHMS 2023 study, indicating a similar level of diabetes risk within this workplace population (Figure 5). The prevalence of high blood pressure among MPKK staff (43.3%) was slightly higher compared to the national prevalence of 30% reported in NHMS 2023, aligning with trends observed in older age groups (Figure 4). All 30 participants demonstrated good mental health status, as indicated by negative findings on the Whooley screening test.

A total of 60% (n=18) were active smokers, predominantly using conventional cigarettes (Figure 3). Ten participants were referred to a Quit Smoking Clinic; one successfully quit after six months. Others show reduced cigarettes per day. During the intervention, referred smokers received follow-up support through counselling sessions at the Quit Smoking Clinic, which included individualized behaviour change strategies and access to nicotine replacement therapy.

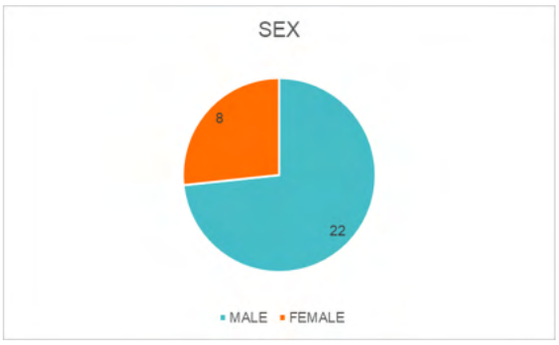


Figure 1: Count of participants by sex

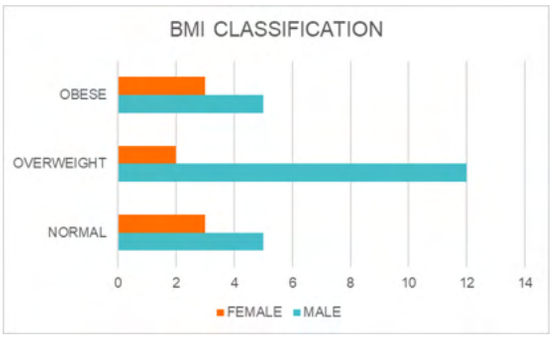


Figure 2: BMI classification of participants

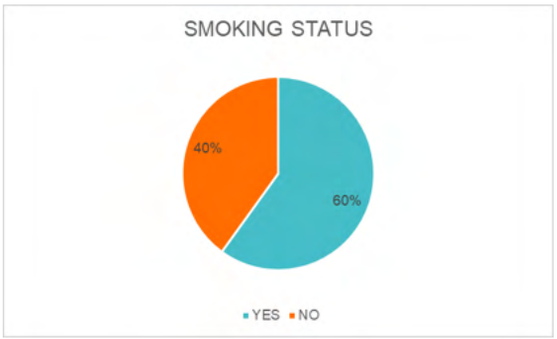


Figure 3: Percentage of smokers

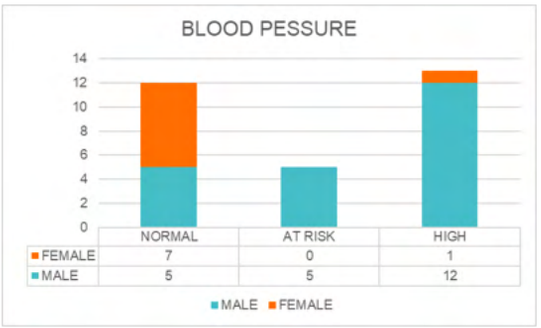


Figure 4: Blood pressure classification

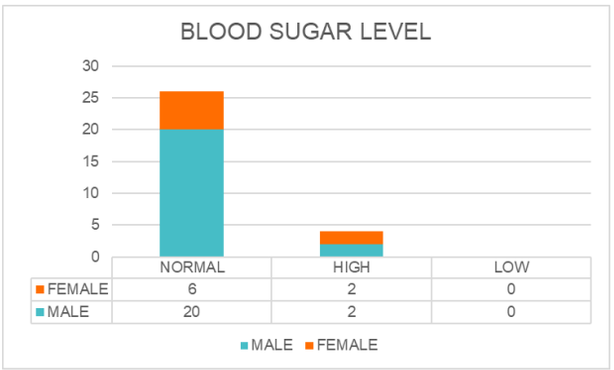


Figure 5: Blood sugar level classification

DISCUSSIONS

The results highlight the considerable presence of changeable NCD risk factors and tobacco consumption among MPKK staff. Health screenings and smoking cessation initiatives at the workplace can significantly enhance awareness and encourage early changes in behaviour(Abdulrahman et al., 2020).

Nonetheless, just one participant managed to stop smoking, suggesting that lasting behavioral change necessitates more comprehensive support, such as regular

counseling, digital alerts, and nicotine replacement therapies.

Other studies conducted in the general population have similarly reported a significant reduction in tobacco usage with the use of an effective health campaign (Pechmann & Reibling, 2006)

The initiative is in accordance with the WHO Healthy Workplace Framework and Malaysia's KOSPEN strategy. Comparable research (Abdulrahman et al., 2020; Javanmardi et.al,2025; Javanmardi et al., 2025a)) indicated enhanced health results when interventions included systematic follow-up and modifications in organizational policy

The findings of this project share several similarities with previous workplace health intervention studies. Consistent with research conducted in Indonesia (Dwicahyaningtyas et al., 2021b) and systematic reviews (Javanmardi et al., 2025b), this project demonstrated that workplace-based programs are effective in raising health awareness, promoting early detection of non-communicable disease (NCD) risk factors, and encouraging employees to adopt healthier behaviours. Similar to other studies, the project also emphasized the workplace as an ideal entry point for smoking cessation interventions, with participants reporting reductions in cigarette consumption following health talks, counselling, and referral to cessation clinics. These outcomes align with the World Health Organization's Healthy Workplace Framework, which underscores the importance of employer–employee collaboration in fostering sustainable health improvements (Stoewen, n.d.).

Despite these similarities, important differences were also observed. The smoking cessation success rate in this project was modest, with only one participant successfully quitting smoking after six months, while others reduced daily cigarette consumption. By contrast, systematic reviews (Javanmardi et al., 2025b) reported higher quit rates in programs that employed multi-component strategies, including individualized counselling, nicotine replacement therapy, incentive schemes, and digital reminder systems. This highlights the limitation of relying primarily on referral and periodic follow-up without integrating more intensive behavioural support. Additionally, the scope of intervention in the MPKK project was narrower, focusing mainly on health screening, awareness talks, and smoking cessation referrals. In contrast, other workplace health promotion programs often incorporate structured physical activity sessions, dietary modification strategies, stress management training, and policy-level changes, resulting in broader and more sustainable health outcomes (González & Cutiva, 2023b).

Finally, methodological differences also warrant consideration. The MPKK study involved a relatively small sample size (n=30) with descriptive analysis, limiting generalizability and the ability to measure long-term impact. In contrast, larger-scale interventions and systematic reviews often employed pre- and post-intervention

designs with longer follow-up, enabling stronger evidence of effectiveness (Javanmardi et al., 2025b; Othman et al., 2020). These differences suggest that while the MPKK Healthy Setting Project successfully initiated positive changes, future workplace interventions should adopt a more comprehensive, multi-component, and longitudinal approach to achieve sustained health improvements.

Limitations

This study has several limitations. One limitation was the cross-sectional nature of this study. Therefore, we acknowledge our inability to establish causality in every component of variability. The small sample size of the study (n=30) and the absence of a control group hinder the broader applicability of the results, and the limited follow-up time prevents evaluation of long-term effects.

However, this also constituted a strength of this study, as to the best of our knowledge, this is one of the first studies conducted in MPKK and directed referral of active smokers to the stop smoking clinic.

Recommendations

Future initiatives should expand participant numbers, integrate continuous monitoring, and implement workplace policies (e.g., smoke-free zones, scheduled exercise breaks) to ensure sustainability. It is recommended that this project be expanded into an intervention study with a structured pre- and post-assessment design to measure the effectiveness of healthy lifestyle initiatives. The intervention should include comprehensive components such as promoting healthy eating habits and encouraging active lifestyles, with regular monitoring and evaluation to assess behavioral changes and health outcomes over time.

CONCLUSION

The Healthy Setting Project at the Kulim Municipal Council effectively assessed the health of its employees and launched initiatives to promote healthy lifestyle habits. The initiative also improved understanding of the early prevention of non-communicable diseases and fostered a decrease in tobacco use. These results demonstrate the success of health interventions in the workplace and highlight the possibility of implementing comparable programs in other organizations.

ACKNOWLEDGEMENT

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RESTORING SMILES, RESTORING LIVES: MANDIBULAR IMPLANT OVERDENTURES FOR SEVERELY RESORBED RIDGES

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ABSTRACT

Background: The 2020 National Oral Health Survey of Older Adults (NOHSA) revealed a substantial gap between prosthesis usage and prosthodontic needs among elderly Malaysians, specifically requiring complete dentures. As Malaysia anticipates becoming an aged nation by 2040, the demand for effective oral rehabilitation is set to increase. For severe cases of mandibular ridge resorption, implant-retained overdentures present a reliable and evidence-based solution to enhance both function and quality of life.

Methodology: This case series details the rehabilitation of two completely edentulous patients with severely resorbed mandibular ridges using two-implant retained overdentures. The first patient presented with recurrent denture fractures due to limited inter-implant space, resulting from existing mini-implants (⌀<3 mm). A new cobalt-chrome reinforced overdenture was fabricated to enhance strength. The second patient, who had an atrophic mandibular ridge, received two Straumann ⌀3.3 mm x 10 mm implants placed in the interforaminal region. Following osseointegration, locator attachments were integrated into the mandibular dentures. During follow-up, the stability, function, and patient satisfaction with the prostheses were assessed.

Results: Denture retention and stability improved in both patients. Post-treatment evaluations showed significant enhancements in chewing efficiency, phonetics, comfort, and social confidence. Overall patient satisfaction was high.

Conclusion: Implant-retained overdentures have demonstrated clinical effectiveness in elderly patients with atrophic ridges. Given the demographic shift towards an aged population, implant-based rehabilitation is crucial to address the growing prosthodontic needs.

Keyword: Implant overdenture, edentulism, geriatric dentistry, oral rehabilitation

INTRODUCTION

Edentulism remains a significant public health concern among Malaysia's ageing population, with profound impacts on nutrition, speech, self-esteem, and overall quality of life. The 2020 National Oral Health Survey of Adults (NOHSA) has highlighted a marked disparity between the prosthodontic needs of the elderly and the actual uptake of dental prostheses, with only 16.3% utilizing prosthetic solutions despite 48.4% being in need, and 1.8% specifically requiring complete dentures. This gap is expected to widen as Malaysia transitions into an aged nation by 2040, underscoring the urgent need for practical, accessible, and durable oral rehabilitation strategies for the elderly.

One of the major challenges in prosthodontics is the rehabilitation of patients with severely resorbed mandibular ridges, where conventional complete dentures often fail to deliver adequate retention, stability, and comfort (Burns, 2004). These anatomical limitations negatively affect masticatory efficiency, speech, and overall patient confidence, often reducing social interaction and quality of life. In recent years, implant-retained overdentures have become a well-supported alternative, providing significantly improved prosthesis stability and enhance oral function, especially for individuals with diminished alveolar bone support (Chang et al., 2015).

Despite the well-documented advantages of implant-retained overdentures, their adoption within public dental healthcare systems remains limited. Common barriers include concerns regarding treatment cost, surgical complexity, and patient eligibility. However, recent advancements in implant technology and prosthetic design—such as the development of mini-implants and reinforced denture bases—have broadened the scope of viable treatment options, making implant-supported solutions more accessible, even for patients with severe ridge resorption (Melescanu Imre et al., 2011).

This case series presents the clinical management and outcomes of two elderly patients with severely resorbed mandibular ridges, each rehabilitated using two-implant retained overdentures with different implant systems and prosthetic designs. By documenting their treatment journeys, this report aims to highlight the practical considerations, challenges, and solutions encountered in such cases. It also emphasizes the relevance of implant-based rehabilitation for dental practitioners in Kedah and similar settings, supporting Malaysia's broader objectives for promoting healthy and dignified aging.

CLINICAL REPORT

Case 1

A 75-year-old male patient presented to the Prosthodontic Postgraduate Clinic at Universiti Teknologi MARA (UiTM) seeking new dentures. The patient was wearing a maxillary complete denture and a repaired mandibular complete denture with a fracture line in the middle. His chief complaints were multiple times of fractured mandibular denture and the need for better chewing with stable prostheses. Clinical examination revealed a completely edentulous maxillary and mandibular arch with three existing mini-implants (⌀<3 mm).

Treatment Plan

Detailed examination of the existing prostheses showed Class III edge-to-edge occlusion teeth arrangement. The mandibular complete acrylic denture was repaired with multiple fracture lines at the middle of the denture. The occlusion was compromised due to the incorrect fitting during the repair of the mandibular denture. The treatment options were discussed with the patient, and the treatment plan was established. A new maxillary acrylic complete denture and mandibular implant-retained complete overdenture with reinforced cobalt chrome framework were considered for the treatment.

Treatment Procedure

An orthopantomogram radiograph (OPG) was taken prior to treatment planning, and one fractured implant on the lower left region of the mandible was noted (Figure 1). The decision was made to keep the fractured implant in the mandible as a ‘sleeping implant’ to help preserve the alveolar ridge.

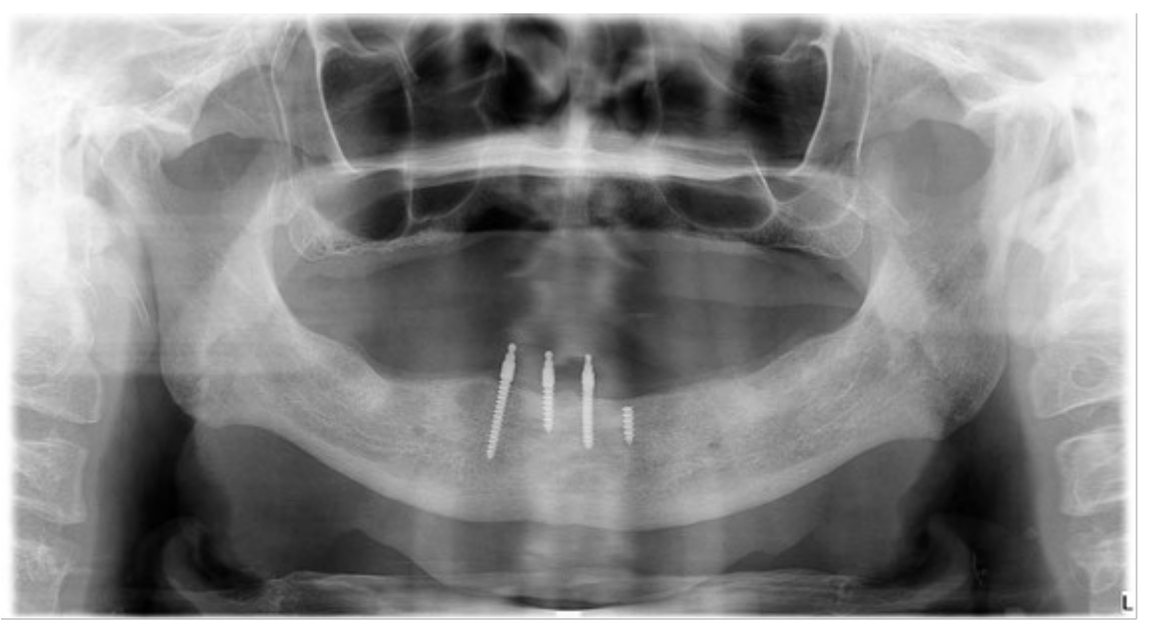


Figure 1: Orthopantogram (OPG) with 3 mini-implant with unknown brand and one sleeping implant on the mandible.

Denture fabrication

Study casts were obtained from preliminary impressions, and custom trays were fabricated using autopolymerizing acrylic resin. Maxillary border moulding was done with a green stick compound, followed by a definitive impression using zinc oxide eugenol. A monophase polyvinylsiloxane (Aquasil, Dentsply Sirona, USA) was used for the mandibular arch. Centric relation was recorded using Exabite® (GC, USA), and occlusal vertical dimension was confirmed. A facebow record was taken, and master casts were mounted on a semi-adjustable articulator. The cobalt-chrome mesh framework with locator openings was tried intraorally and later incorporated into the denture base (Figure 2a and 2b). Teeth were arranged in Class I with bilateral balanced occlusion and heat-cured.

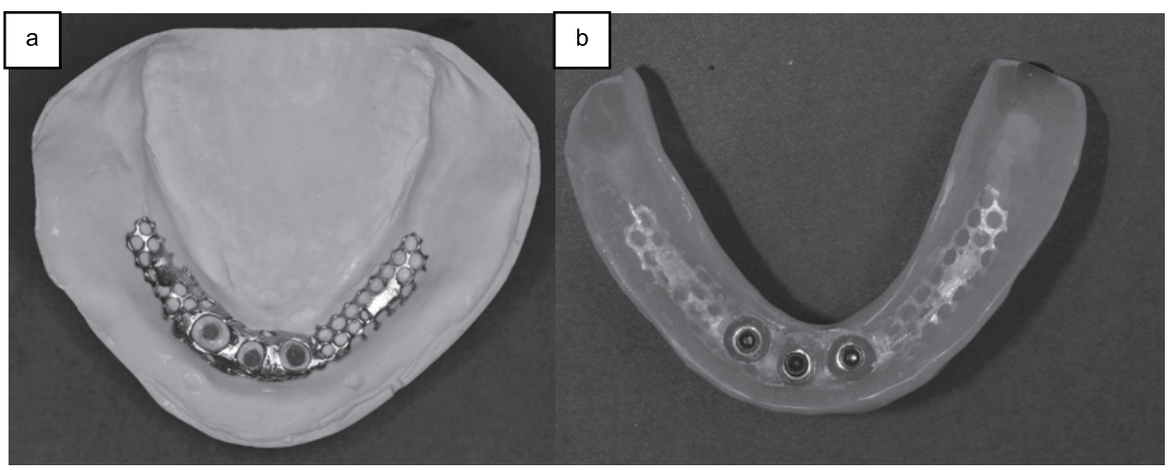


Figure 2: a) Cobalt chrome mesh framework on the study cast with the circular openings provided for the locator attachments. b) Cobalt chrome mesh framework incorporated in the acrylic baseplate of mandibular overdenture.

Chairside pick-up of the metal housing

Access holes were prepared on the intaglio surface of the mandibular denture to accommodate matrix housings. A small- square sized rubber dam was placed around each locator (ball abutments of the mini-implant) to prevent the overflow of hard reline material (Tokuyama® Rebase II, Tokuyama Dental Corporation, Japan) into undercut areas. The material was mixed per the manufacturer's instructions and injected into the access holes using a 5cc syringe. The overdenture was seated intraorally for the direct pick-up procedure. Upon setting, the matrix housings were retained in the denture. The rubber dam was then removed, and additional material was used to correct the voids. The denture was then trimmed and polished.

The retention and stability of the overdentures were assessed clinically during insertion and follow-up appointments using functional evaluation (e.g., resistance to vertical and lateral dislodgement), without applying standardized indices such as the

Kapur or modified Kapur criteria, as the objective of this case series was descriptive rather than quantitative. Bilateral balanced occlusal scheme was established in this case.

Chewing efficiency, phonetics, comfort, and social confidence were evaluated based on patient self-reports during scheduled follow-up visits. This subjective evaluation approach is widely supported in prosthodontic literature as a valid method to capture functional and psychosocial outcomes from the patient's perspective (Fan et al., 2021). Patients in our case series reported improved ability to chew a variety of foods, greater comfort during speech, and enhanced confidence in social interactions—collectively indicating a high level of satisfaction with the treatment.

We also conducted follow-up reviews at 1, 3, 6, and 12 months. Ongoing maintenance includes monitoring for insert wear and potential relining due to bone resorption distant to the implant (Jacobs et al., 1992).

Case 2

A 57-year-old female patient presented to the Prosthodontic Postgraduate Clinic at Universiti Teknologi MARA (UiTM) seeking new dentures. She was wearing a complete acrylic denture and complained of a loose lower denture, limiting her ability to eat anything other than soft foods. While she was generally satisfied with the appearance of her teeth, she was looking for treatment options to improve the stability of her lower denture. Clinical examination revealed an edentulous maxillary arch with a U-shaped, severely resorbed ridge. The mandibular arch was also completely edentulous, exhibiting a knife-edge ridge with significantly reduced height and width (Figure 3a and 4a).



Figure 3: a) OPG radiograph pre-implant placement

Treatment Plan

Detailed examination of the existing prostheses showed Class I occlusion teeth arrangement with a balanced occlusal scheme and an interocclusal rest space of 2 mm. However, the denture also demonstrated inadequate labial and buccal flange extensions, which may have compromised its fit and function. In addition, insufficient upper lip support from the maxillary denture affected the patient's aesthetic. The treatment options were discussed with the patient, and the treatment plan was established. A new maxillary acrylic complete denture and mandibular implant-retained complete overdenture were considered for the treatment.

Treatment Procedure

Implant surgical procedure

Cone beam computed tomography (CBCT) was taken prior to treatment for implant planning on the mandible with the radiographic stent made from a copy of the existing mandibular complete denture. With the aid of the radiographic stent as a surgical guide, two ⌀ 3.3mm x 10 mm implant fixtures (BLT Straumann®, Switzerland) were placed in the canine regions (Figure 4b). Both implants had an insertion torque of 25 Ncm, and a healing abutment was placed. Xenograft bone (200-1000 µm, 0.5cc) was placed at the labial of both implant regions and with 15mm x 20 mm bovine collagen membrane plus (Straumann®, Switzerland) placed. The site of the implant fixture was left to heal within 3 months. Figure 3b showed the position of the 2 implants at the region 33 and 43 after 3 months of healing.

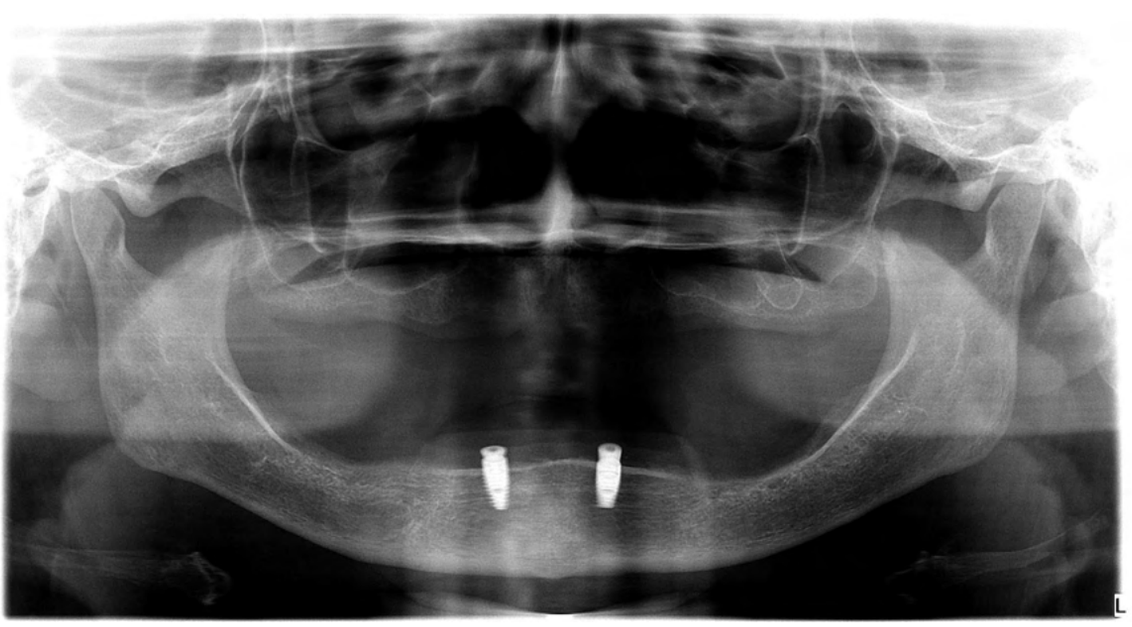


Figure 3: b) Post-implant placement showing 2 implants present at the region 33 and 43

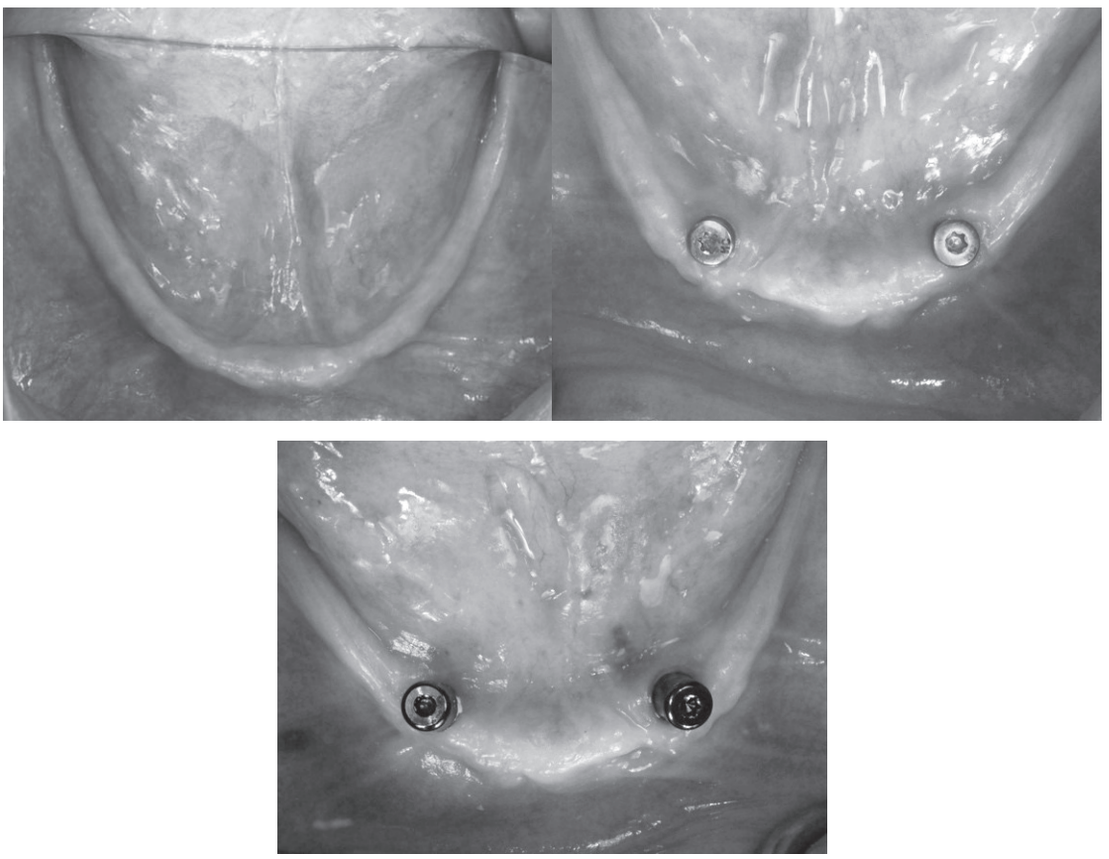


Figure 4: a) Occlusal view of mandible pre-implant placement. b) post-implant placement showing 2 implants with healing abutment present at the region 33 and 43. c) The black Novaloc® attachments (Valoc, Möhlin, Switzerland) at the region 33 and 43.

Attachment placement/ locator dimension

The denture was fabricated following the protocols mentioned in Case 1 without incorporating the cobalt chrome mesh framework in the baseplate. The height of soft tissue following removal of healing abutments was measured using a periodontal probe. The mucosa thickness of region 33 was measured to 3 mm while the mucosa thickness of 43 region measured to 1 mm. The black Novaloc® attachments (Valoc, Möhlin, Switzerland) with NC 3mm gingival height were selected on 33 region while NC 1 mm were selected for 43 region. The Novaloc® attachments (Figure 3c) were placed using the screwdriver with an insertion torque of 35 Ncm. Chairside pickup of the matrix housing was done with reline material (Tokuyama® Rebase II, Tokuyama Dental Corporation, Japan).

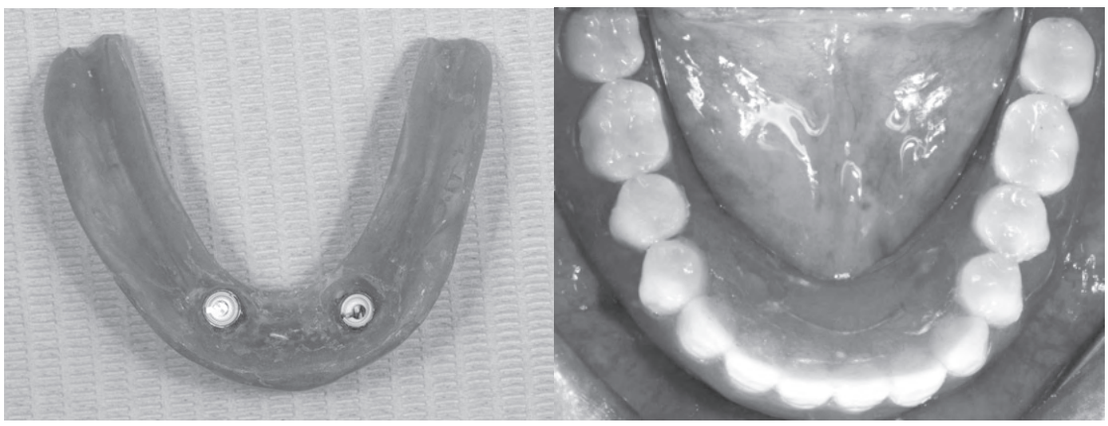


Figure 5: a) The fitting surface of the denture with metal housing in situ. b) Intraoral photo with denture in-situ.

The patient was followed up according to the protocols mentioned in Case 1. Overall, the patient was thrilled with the aesthetic and the improved function of the new denture (Figure 5a and 5b).

DISCUSSIONS

This case series underscores the pivotal role of implant-retained overdentures as a transformative solution for elderly patients with severely resorbed mandibular ridges—a demographic expected to grow substantially as Malaysia approaches its ageing nation status by 2040. The clinical scenarios presented illustrate both the challenges and the innovative strategies available for oral rehabilitation in this vulnerable group.

The National Oral Health Survey of Older Adults (NOHSA) reveals a stark disparity between prosthodontic need and service uptake among Malaysian elderly, with less than one in five utilizing prostheses despite nearly half requiring them.

Socioeconomic and logistical barriers—such as long travel distances, limited transport, and clinic congestion—have been documented in rural parts of Kedah and contribute to reduced access to specialist dental services (Institute for Public Health, 2020; Sulaiman et al., 2018). For example, residents in KEDA settlements report two-hour journeys to public hospitals, extended waiting times, and transportation challenges (Sulaiman et al., 2018). Similar issues have been noted in specialist dental care delivery, where low referral uptake and patient non-attendance further limit the utilization of advanced services (Abu Bakar et al., 2023). These constraints underscore the critical need to improve access to advanced prosthodontic care in Kedah.

The first case, involving mini-implants and recurrent denture fractures, highlights the importance of prosthesis design and material reinforcement. The use of cobalt chrome not only addressed mechanical failures but also improved patient confidence

and function (Alkhodary, 2022). The second case, utilizing standard-diameter Straumann implants with locator attachments, exemplifies the gold standard (Sailer et al., 2022) for stability and retention in atrophic ridges, resulting in marked improvements in chewing efficiency, phonetics, and overall quality of life.

While implant-retained overdentures provide superior function and quality of life compared to conventional dentures (Thomason et al., 2012). Notably, a randomized clinical trial in an academic setting found that mandibular two-implant overdentures incurred direct costs 2.4 times higher than conventional dentures (Takanashi et al., 2004). Moreover, cost-effectiveness analyses highlight that the enhanced outcomes must be weighed against increased financial burden, particularly for elderly patients with limited resources (Zitzmann, Marinello, & Sendi, 2006). However, in the Malaysian Ministry of Health (MOH) context—where conventional dentures are often subsidized—such cost differentials may limit access to implant-retained overdentures, especially when additional maintenance costs (e.g., periodic replacement of attachment inserts) are borne by the patient.

These cases reinforce that treatment must be individualized, considering anatomical limitations, patient expectations, and available resources. The adaptability of implant overdenture protocols—whether through reinforcement techniques or attachment selection—ensures that even the most challenging cases can achieve favourable outcomes.

As Malaysia's population ages, the demand for durable, functional, and patient-centred oral rehabilitation will only intensify. The McGill and York consensus statements advocate for the use of two-implant retained overdentures as the standard of care for edentulous patients. These consensus reports highlight that two-implant overdentures significantly enhance function, comfort, and quality of life compared to conventional dentures. This approach improves stability and retention, improving masticatory performance and patient satisfaction (Thomason et al., 2012). This will contribute significantly to psychosocial well-being, social participation, and nutritional status—key determinants of healthy ageing (Ettinger, 2015; Petersen & Yamamoto, 2005).

CONCLUSION

Implant-retained overdenture is one of the viable treatment options for severely resorbed ridge especially in edentulous mandibular arch which is currently available for patient in Kedah. All clinical situation is unique, hence all the previously discussed parameters have to be studied carefully to fulfill the patient's needs and expectations and to establish a long-term biologic and functional result.

In summary, implant-retained overdentures represent a clinically effective, patient-friendly, and adaptable approach to managing edentulism in the elderly. By embracing such innovations, the Kedah dental community can play a vital role in

advancing oral health equity and supporting Malaysia's journey toward healthy, dignified aging.

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DECLARATIONS

Conflict of Interest

The authors declare that there is no conflict of interest regarding the implant brands, attachment systems, denture materials, or any products mentioned in this case series. No financial or non-financial benefits were received from any manufacturer or supplier.cc

Informed Consent

Written informed consent was obtained from all patients for the publication of their clinical details and accompanying images.

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SERVING LIQUID MEDICATIONS TO CHILDREN: CAN CAREGIVERS MEASURE THE PRESCRIBED DOSE ACCURATELY USING SYRINGE?

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ABSTRACT

Background: Oral liquid medications are frequently prescribed to young children. Yet, dosing accuracy depends on caregivers' ability to use measuring devices correctly. Errors in dosing may result in therapeutic failure or drug toxicity.

Objective: To identify the liquid medication dosing error among caregivers using syringes and factors associated with measurement accuracy

Methods: This single-centre, cross-sectional study recruited caregivers of paediatric patients prescribed with liquid medications. Participants read a text-only medication label and measured the prescribed volume using a syringe provided by the pharmacy. Syrup Simplex BP was used as a substitute for the assessment. Caregivers' demographic data and dosing accuracy were recorded.

Results: Out of 213 subjects, 52.6% (n=112) were able to measure the prescribed dose accurately with no error while 38% (n=81) committed small acceptable dose errors with magnitude ≤10%. Large dose errors with magnitude >10% were made by 9.4% of caregivers (n=20). Large dose errors were more common in caregivers who were non-parents (p=0.029). The size of syringes used during assessment was also significantly associated with large errors (p=0.033). Caregivers using 1ml syringe have 9 times higher risk of making large measurement errors than those using 10ml syringe (OR 9.3, 95%CI (1.66, 51.99), p=0.01).

Conclusion: Approximately one in ten caregivers made significant dosing errors with syringes. Hence, pharmacists play a crucial role in educating caregivers on the proper use of syringes, especially with small syringe size and when the caregiver is non parent.

Keywords: syringes, caregivers, medication errors, paediatrics, patient education

INTRODUCTION

Oral liquid formulations such as solutions, suspensions, and syrups are commonly prescribed for young children due to their ease of administration and the ability to tailor doses to a child's specific needs. The administration of liquid medications to children is a delicate task that demands precision and accuracy to ensure therapeutic efficacy and safety. A variety of devices are available for dosing, including syringes, teaspoons, calibrated spoons, and cups. Among all, oral syringes are often preferred by healthcare professionals due to their potential for greater accuracy (Madlon-Kay & Mosch, 2000).

Globally, medication errors in paediatric care within community settings are a significant concern. Out-of-hospital medication errors among young children are highly prevalent, with approximately one child in the United States receiving the wrong medication or dosage every 8 minutes (Smith et al., 2014). Caregivers play a crucial role in administering these medications, yet they face numerous challenges in ensuring accurate dosing. In fact, dosing errors are among the most common medication errors made by caregivers and represent one of the most preventable categories of adverse drug events in paediatric outpatients (Dahmash, Shariff, Kirby, Terry, & Huynh, 2020; Yin, Mendelsohn, Wolf, Parker, Fierman, et al., 2010). These errors may result from a multitude of factors, including misunderstanding of instructions, difficulties with measurement tools, and distractions during administration. A cross-sectional study conducted in the outpatient pharmacy of a government-funded tertiary hospital in Northern Malaysia revealed that 81.2% of caregivers self-reported some difficulty in reading the medication labels dispensed to their children (Chan, Hassali, Lim, & Saleem, 2015).

Accurate dosing in paediatric medication administration is paramount. Underdosing may result in ineffective treatment and prolonged illness, while overdosing can lead to adverse effects or toxicity, posing serious risks to a child's health. Prior studies estimate that up to 16% of caregivers make dosing errors when using syringes, highlighting the need for improved strategies to enhance dosing accuracy (Yin, Parker, Sanders, Dreyer, Mendelsohn, et al., 2016). While studies have explored dosing errors with various devices, there remains a need for research focusing specifically on caregiver proficiency with syringes in real-world settings, particularly when considering decimal dosages and the influence of caregiver-related factors.

This research aims to investigate the rate of liquid dosing errors among caregivers using oral syringes by determining the magnitude of deviation from the intended dose. By studying the factors influencing the rate of liquid medication dosing errors, this study seeks to provide comprehensive insights into the challenges and potential solutions for ensuring precise medication delivery in paediatric care settings. Ultimately, through this research, we aim to inform the development of targeted

educational interventions to minimize liquid medication dosing errors among caregivers, ensuring that the correct dose is consistently administered to patients at home.

METHODOLOGY

Design and Sampling

An observational cross-sectional study was conducted at Sultan Abdul Halim Hospital from May 2023 to January 2024, following ethical approval from the Medical Research Ethics Committee (MREC), NMRR ID-22-01173-OH7. This design was chosen to provide a snapshot of caregiver dosing accuracy at a single point in time, allowing us to assess the prevalence of dosing errors and identify associated factors.

Sample Size

The required sample size was estimated at 207 using the population proportion formula:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

where *Z* is the standard normal deviate at 95% confidence (1.96), *p* is the estimated prevalence of liquid medication dosing errors with oral syringes among caregivers (16% or 0.16), and *(1–p)* = 0.84. A margin of error (*d*) of 0.05 was applied. Substituting these values yielded a minimum required sample size of 207. This prevalence estimate was based on prior published work by Yin et al. (2016). With a statistical power of 80% and a significance level of 0.05, the calculated sample size was deemed adequate to detect meaningful differences in dosing accuracy.

Participants

Caregivers of children aged 1 month to 7 years who were discharged from paediatric wards or presented to the ambulatory pharmacy with prescriptions for oral liquid medications were recruited via convenience sampling. Convenience sampling was utilized due to the need for timely data collection. However, we acknowledge that this method may introduce selection bias, as the sample may not be fully representative of all caregivers in this hospital. Caregivers with communication barriers (defined as inability to understand or speak Malay), those not involved in administering oral medication at home, or those under 18 years of age were excluded from the study.

Eligible participants were approached either in the paediatric ward upon discharge or in the ambulatory pharmacy during the dispensing process by trained investigators. These investigators comprised of registered pharmacists. They were provided with standardized training on recruitment procedures and data collection techniques. Participants were informed about the study objectives, risks, and benefits, and consent forms were signed before participation. All communication was conducted in the Malay language.

Data Collection

Participants were interviewed to gather information on sociodemographic factors (age, ethnicity, education level, number of children in the household, relationship with the patient, and role as the main caregiver at home), previous experience and counselling on syringe use, and their preferred measuring devices at home.

Participants were then instructed to read the text-only label generated by the e-Hospital Information System (e-HIS) and measure the prescribed dose of liquid medication using an oral syringe provided by the investigator. The e-HIS label included the child's name, medication name, dose (in millilitre) and frequency.

The syringe size provided to participants for the assessment was the one closest to the prescribed dose volume. In this study, Syrup Simplex BP (manufactured by KCK Pharmaceutical Industries Sdn. Bhd.) was used as a surrogate for liquid medications during measurement. Syrup Simplex BP was chosen due to its inert properties, consistent viscosity, and availability. No instructions on syringe use were given prior to assessment.

Dosing accuracy was evaluated by direct observation of the measured volume by a trained investigator. The investigator observed the caregiver's technique, including filling the syringe, checking the volume, and expelling any air bubbles. Dose variation was calculated as a percentage using the formula: (Measured Dose – Prescribed Dose)/ Prescribed Dose $\times$ 100%. Subjects were categorized as making a large dose error if the measured dose deviated by more than ± 10% from the prescribed dose.

Statistical Analysis

Data were analysed using SPSS version 21 (IBM Corp., Armonk, NY). Descriptive statistics (frequency and percentage) were used to describe participant characteristics, dosing error rates, and preferred measuring devices. Pearson's chi-square test, Fisher's exact test and Mann-Whitney test were used to assess factors affecting dosing errors. Statistical significance was set at $p < 0.05$.

RESULTS

General Characteristics of the Study Population

A total of 213 caregivers consented to participate in the study, with 63.4% recruited from the ambulatory pharmacy and 36.6% from the paediatric ward. As shown in Table 1, the majority of participants (181; 85%) were in the 21-40 years age group, reflecting the typical age range of parents and primary caregivers of young children. Most participants were the patient's mother (63.4%), highlighting the central role mothers play in paediatric care. A large proportion (94.4%) identified themselves as the main caregiver at home, indicating their primary responsibility for medication administration. The education level of participants was largely up to secondary school only (63.4%). While most participants (84.5%) reported prior experience using syringes, only 40.8% had received previous education on how to use a syringe properly, suggesting a potential gap in training and counselling.

During the observed dose measurement assessment, 70 caregivers (32.9%) were asked to measure a volume prescribed as a whole number, while the remaining 67.1% needed to measure a dose involving decimal points, reflecting the complexity of real- world dosing scenarios. The frequency of different syringe sizes utilized during the dose measurement assessment is shown in Table 2. The most preferred measuring device among caregivers was the syringe (187; 87.8%), followed by the measuring cup (n=9; 4.2%), reinforcing the importance of focusing on syringe-related skills and knowledge.

Table 1: Sociodemographic Characteristics of the Study Population (N = 213)

Sociodemographic Characteristics	**n (%)**
Caregiver gender	160 (75.1)
Female	53 (24.9)
Male	
Ethnicity	
Malay	200 (93.9)
Chinese	3 (1.4)
Indian	9 (4.2)
Others	1 (0.5)
Caregiver age (years)	33 (9) #
≤ 20	1 (0.5)
21-30	70 (32.9)
31-40	111 (52.1)
>40	31 (14.6)
Number of children	2 (2） #
Relationship with patient	
Mother	152 (71.4)

Father	53 (24.9)
Grandmother	3 (1.4)
Grandfather	1 (0.5)
Others	4 (1.9)
Main caregiver at home	
Yes	201 (94.4)
No	12 (5.6)
Caregiver education level	
Secondary/ Below secondary	135 (63.4)
Tertiary	78 (36.6
First experience in using syringe	
Yes	33 (15.5)
No	180 (84.5)
Any previous education on syringe	
Yes	87 (40.8)
No	126 (59.2)
Patient on any regular oral medication	
Yes	64 (30.0)
No	149 (70.0)

Median (IQR)

Table 2: Location and assessment details of Study Population (N = 213)

Assessment details	**n (%)**
Ward	78 (36.6)
Clinic/ Emergency	135 (63.4)
Syringe volume used during assessment	
1 ml	23 (10.8)
3 ml	51 (23.9)
5 ml	70 (32.9)
10 ml	69 (32.4)
Volume of dose for assessment (Dose prescribed)	
Whole number	70 (32.9)
In decimal value	143 (67.1)

Rate of Dose Measurement Errors by Participant Characteristics and Device

Dose measurements were considered accurate only if the deviation fell within ±10% of the prescribed dose, a threshold consistent with U.S. Pharmacopeia. Of the 213 participants, 112 (52.6%) were able to measure the prescribed dose accurately with no error at all, demonstrating a reasonable level of proficiency in our cohort. Another 81 participants (38%) committed a minimal error within 10% of the prescribed dose, which was also considered acceptable for the purpose of this study. However, 20 caregivers made dosing errors exceeding 10% in magnitude, contributing to an overall dose error rate of 9.4%.

Table 3 shows factors affecting the rate of dose measurement errors by caregivers. Overall, caregivers' age, gender, education level, number of children in the household, previous experience, and education on syringe use did not significantly affect the dose measurement error rate. This suggests that these demographic and experiential factors may not be strong predictors of dosing accuracy in this population. While caregivers tended to make more large errors when asked to measure a dose volume involving decimal places compared to a dose volume using a whole number (10.5% versus 7.1%), this difference was not statistically significant (p = 0.432).

On the other hand, the relationship with the patient and the syringe size used during the observed assessment were found to significantly influence caregivers' dose measurement accuracy. Specifically, large dose errors were more prevalent in caregivers who were not the patient's parents (p = 0.029) or were not the main caregiver at home (p = 0.017). Furthermore, caregivers using a 1 ml syringe had a 9- fold higher risk of committing a large dose measurement error (OR 9.3, 95% CI [1.66, 51.99], p = 0.01), while those using a 3 ml syringe had a 5.3-fold higher risk (OR 5.3, 95% CI [1.06, 26.85], p = 0.036) when compared with their counterparts using a 10 ml syringe. These findings highlight the importance of considering caregiver-patient relationship and syringe size used for dose measurement when designing interventions to improve dosing accuracy.

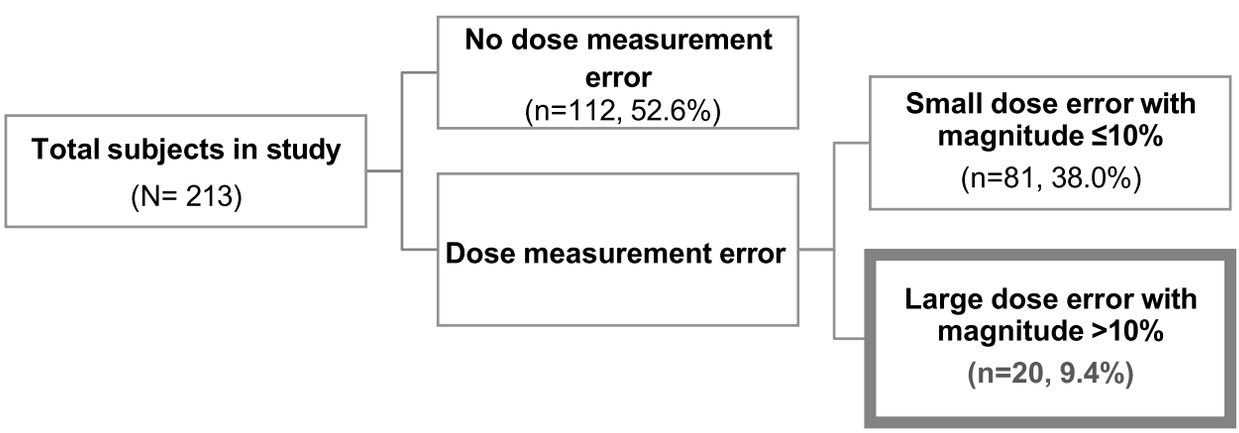


Figure 1: Rate of dose measurement error by caregivers

Table 3: Association between various subjects' characteristics and error in dose measurement: Results of univariate analysis (N= 213)

	No error /minimum error ≤ 10% n (%)	Large error of > 10% deviation n (%)	X^2 stat (*df*)	*p*-value
Caregiver gender				
Female	144 (90.0)	16 (10.0)		0.787 [a]
Male	49 (92.5)	4 (7.5)		
Ethnicity				
Malay	182 (91.0)	18 (9.0)		0.269[a]
Chinese	2 (66.7)	1 (33.3)		
Indian	8 (88.9)	1 (11.1)		
Others	1 (100.0)	0 (-)		
Relationship with patient				
Parent	188 (91.7)	17 (8.3)		0.029[a]
Non parent	5 (62.5)	3 (37.5)		
Main caregiver at home				
Yes	185 (92.0)	16 (8.0)		0.017[a]
No	8 (66.7)	4 (33.3)		
Caregiver education level				
Secondary/ Below secondary	122 (90.4)	13 (9.6)	0.025 (1)	0.874[b]
Tertiary	71 (91.0)	7 (9.0)		
First encounter with oral syringe				
Yes	32 (97.0)	1 (3.0)		0.325[a]
No	161 (89.4)	19 (10.6)		
Any previous education on syringe				
Yes	76 (87.4)	11 (12.6)		
No	117 (92.9)	9 (7.1)	1.83 (1)	0.176[b]
Patient on any regular oral medication				
Yes	135 (90.6)	6 (9.4)	<0.001 (1)	0.996[b]
No	58 (90.6)	14 (9.4)		
Volume of dose for assessment (Dose prescribed)				
Whole number	65 (92.9)	5 (7.1%)	0.619 (1)	0.432[b]
With decimal point	128 (89.5)	15 (10.5%)		
Syringe size used during assessment				
1 ml	18 (78.3)	5 (21.7)		0.026 [a]
3 ml	44 (86.3)	7 (13.7)		
5 ml	64 (91.4)	6 (8.6)		
10 ml	67 (97.1)	2 (2.9)		
Caregiver's age (years)	33.0 (9.0) [c]	35.5 (11.0) [c]		0.213[c]
Number of children in the household	3 (2) [c]	2 (3) [c]		0.873[c]

Note: [a] Fisher's Exact Test [b] Pearson Chi-Square [c] Mann-Whitney test, presented as median (Interquartile range) P<0.05: statistically significant

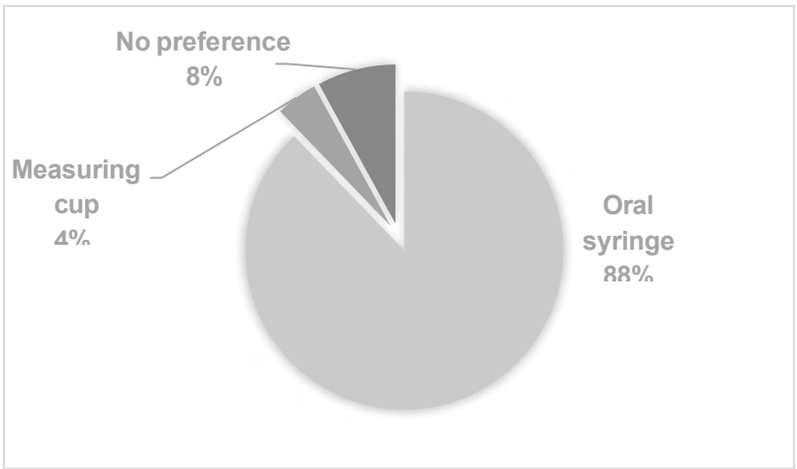


Figure 2: Caregiver's preferred liquid medication measuring device at home (N= 213)

DISCUSSION

Several previous studies have evaluated error rates across a range of measuring devices with varying accuracy levels, such as spoons, measuring cups, droppers, or even household spoons. Our study focused on syringe use because syringes are the FDA-recommended gold standard for liquid medication measurement and are commonly used in our population (Mohd Norizan, Laere, & Sarmo, 2021). This is also in accordance with routine practice in many healthcare institutions in Malaysia, where caregivers are provided with a syringe of appropriate volume alongside each prescription of liquid medication to support accurate administration (Mohd Norizan et al., 2021). In contrast to previous studies that evaluated caregiver dosing accuracy using a fixed volume (e.g., 5 mL), this present study simulated real-world conditions by requiring caregivers to measure the actual dose prescribed for their child. This approach provides a more ecologically valid assessment, as caregivers in routine practice often required to measure complex or decimal-based doses (e.g., 2.5 mL, 0.8 mL), which may increase cognitive load and likelihood of error.

Several studies have reported dose measurement accuracy using different definitions of dosing error. In this study, subjects were categorized as making a large dose error if the measured dose deviated by more than ± 10% from the prescribed dose. This threshold aligns with the U.S. Pharmacopeia standard for acceptable volumetric error in calibrated devices and is consistent with numerous previous studies (Mohd Norizan et al., 2021; Ryu & Lee, 2012; Sobhani, Christopherson, Ambrose, & Corelli, 2008). The rationale for using a 10% deviation is based on clinical significance. Deviations beyond this threshold may lead to subtherapeutic or toxic drug levels, particularly in vulnerable paediatric populations.

Compared to other published studies, the rate of large dose measurement errors (measurement error exceeding 10%) in our study is relatively low. A study by Mohd Norizan et al. (2021) at another district hospital in Malaysia reported error rates of approximately 18.3% and 14.7% when subjects were asked to measure 4.8 ml and 15.0 ml doses of tap water using syringes of their choice. These higher rates may be attributed to sociodemographic differences in the study populations, such as lower education levels (75% with education up to secondary level only). Additionally, their subjects had to select the appropriate syringe size - a task which itself introduces opportunity for error when caregivers failed to do so correctly. In contrast, caregivers in our study were provided with the most appropriate syringe size for the dose measurement assessment, potentially leading to a lower error rate. Supplying the correct syringe size removes one layer of complexity for the caregiver, which likely contributed to improved accuracy in our cohort.

The dose error rate reported in this study (9.4%) is higher than that of an observational study by Joshi and Bavdekar (2019). Joshi and Bavdekar (2019) found that only 3.57% of their subjects made a mild error when measuring volume with a syringe. However, Joshi and Bavdekar only assessed measurement accuracy for a whole volume of 5.0 ml. This difference may explain the higher error rate in our study, where the majority of dosing errors (12 out of 20) occurred with measurement volumes less than 3 ml and in those with prescribed dose of volumes in decimal points (15 out of 20). This suggests that smaller volumes and the presence of decimal points increase the risk of dosing errors, potentially due to the finer gradations on the syringe and the increased cognitive effort required for accurate measurement. Similarly, prior research has also demonstrated that caregivers commonly encounter greater difficulties with decimal-based dosing, especially when using small-volume syringes (Mohd Norizan et al., 2021).

Numerous previous studies have reported that factors such as educational level, caregiver age, gender, and number of children in the household significantly influence caregivers' ability to measure doses accurately (Madlon-Kay & Mosch, 2000; Ryu & Lee, 2012; Ravikiran & Shivarajashankara, 2011). In contrast, none of these factors were significantly associated with caregiver dosing errors in this study. This discrepancy could be due to the relatively homogenous sociodemographic characteristics of our study population or the specific intervention of providing appropriately sized syringes. The only two significant factors we identified—caregiver relationship to the patient and syringe size used for assessment—have not been extensively investigated in other published studies to date. Parents may be more attentive and cautious when administering medication to their own children compared to non-parent caregivers, hence committing fewer dosing errors. This highlights the importance of targeted education for non-parent caregivers, such as grandparents or

other relatives, who may be less familiar with the child's medication regimen or less vigilant in their administration. Additionally, a higher error rate was observed with 1 mL syringes, possibly due to ambiguous design features—such as ".1 mL" markings lacking a leading zero—which may be misinterpreted as "1 mL," particularly among caregivers with limited numeracy.

Health literacy and numeracy play critical roles in safe medication administration (Yin et al., 2009). A pilot study by Chan et al. (2015) in a tertiary hospital in Kedah reported that only 5.8% of caregivers showed adequate health literacy skills, despite the high national literacy rate of 93.1% in Malaysia. Even when caregivers are literate, the ability to understand decimal values and accurately measure small volumes requires numeracy skills that are not always assessed in clinical settings. This is especially relevant in paediatric care, where dosing errors can have significant consequences due to narrow therapeutic margins.

Limitations

This study has several limitations. The use of a convenience sample may limit the generalizability of the findings to other populations. Second, we used Syrup Simplex BP as a surrogate for actual medications, which may not fully replicate the viscosity or other properties of all prescribed liquid medications. Moreover, the observed nature of the dose measurement assessment may have influenced caregiver behaviours. Participants might have been more attentive and careful than they typically would be when measuring doses at home, potentially leading to an underestimation of the true error rate in real-world settings. Although health literacy was not directly assessed, education level was collected as a proxy indicator. However, education level does not fully capture the multifaceted nature of health literacy, which includes the ability to understand and apply health information. In addition, real-world challenges such as caregiver stress, fatigue, and time constraint may further contribute to measurement inaccuracies. Caregivers managing multiple responsibilities or caring for more than one child may face additional challenges in ensuring dosing precision at home. While not directly assessed in this study, such factors could be explored in future research to better understand how real-life circumstances influence caregiver performance.

Implications for Practice

The findings from this study have several important implications for clinical practice. First, healthcare providers should prioritize education for all caregivers, particularly non-parents, on the proper use of oral syringes. This education should include hands-on demonstration and return demonstration to ensure competency. Second, healthcare systems should consider standardizing the labelling of liquid medications

to minimize confusion and reduce the risk of dose measurement errors. This may include using clear and simple written instructions, as well as providing pictorial aids. A pilot study conducted at Sultanah Bahiyah Hospital in Kedah showed that incorporating pictogram-plus-text drug labels to illustrate the correct measurement volume could help to reduce dosing errors by caregivers when administering liquid medications to children (Chan, Aswad, & Ho, 2017). Third, the design of 1 ml syringes should be re-evaluated to minimize the risk of misinterpretation of decimal notations.

CONCLUSION

This study provides insight that approximately 1 in 10 caregivers makes large dose measurement errors with syringes, raising concerns about medication safety in the paediatric population. Non-parental caregivers and the use of smaller syringes (1 ml and 3 ml) were associated with higher error rates. Therefore, pharmacists and other healthcare providers play a crucial role in providing targeted education and support to caregivers, especially those who are not the child's parents and those using small- volume syringes, to ensure accurate doses are administered at home. Standardized labelling with pictorial aids, improved syringe designs, and interventions to address health literacy may further minimize these errors. Future research should focus on developing and evaluating comprehensive strategies to improve medication safety and optimize health outcomes for children receiving liquid medications.

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IMPACT OF PHARMACY INTEGRATED COMMUNITY CARE INTERVENTION PROGRAMME ON GLYCAEMIC CONTROL IN TYPE 2 DIABETES MELLITUS PATIENTS IN 2024: A PRE- AND POST-INTERVENTION ANALYSIS

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ABSTRACT

Introduction: Due to the significant challenge of achieving optimal glycaemic control in patients with type 2 diabetes mellitus, the Pharmacy Integrated Community Care (PICC) programme was established to provide tailored, multidisciplinary education and support in community settings.

Objective: The objective of this study was to determine the changes in HbA1c before and after implementation of the PICC intervention.

Methods: This single-arm pre-post study enrolled 20 adults with HbA1c > 7% identified during clinic consultations who were able to commit to the programme. Participants completed at least 3 of 4 PICC modules, which included community-based talks, interactive games, and quizzes. HbA1c was measured at baseline and six months. Changes were analysed in R software using the Wilcoxon signed-rank test due to data skewness.

Results: Participants had a median age of 62 years; 90% were Malay and 65% were male. Comorbidities included hypertension (80%), hyperlipidaemia (60%), and ischaemic heart disease (30%). Median HbA1c decreased from 8.50% (IQR 1.15) at baseline to 7.80% (IQR 1.70) post-intervention. The sum of positive rank differences exceeded negative ranks, indicating an intervention effect (V = 160.5, p = .038; 95% CI for median change: 0.05-1.30).

Conclusion: The PICC programme was associated with improved glycaemic control. However, these findings were preliminary and hypothesis-generating rather than definitive, given the small sample size and single-arm design, which limit both internal validity and generalisability. Future studies should employ randomised controlled designs with larger, more diverse cohorts to confirm PICC effectiveness and assess long-term outcomes.

Keywords: diabetes mellitus, HbA1c, community pharmacy services, patient education, programme evaluation

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) poses a significant worldwide health concern, resulting from a multifaceted combination of genetic predispositions, environmental influences, and social determinants (Sung and Lee, 2025). Globally, the number of people living with diabetes has surged dramatically, rising from 200 million in 1990 to 830 million in 2022. This increase has been particularly rapid in low- and middle-income countries (World Health Organization, 2024). In Malaysia, diabetes has emerged as a major public health issue, with the National Health and Morbidity Survey (NHMS) 2023 reporting that 15.6% of adults—equivalent to 1 in 6—have diabetes. The prevalence increases with age, yet many remain unaware of their condition; notably, 84% of adults aged 18 to 29 with diabetes do not know they have the disease (Health, 2024). Among the states in Malaysia, Kedah reported the highest prevalence of diabetes mellitus at 24.6% (Husrul Ari H., 2023). Given this high burden, effective glycaemic control becomes essential. Glycated haemoglobin (HbA1c) levels are widely used to monitor this control, as HbA1c offers a more reliable and consistent measure of long-term blood glucose levels compared to fasting plasma glucose (FPG), random blood glucose (RBS), and oral glucose tolerance test (OGTT) (Bekele *et al.*, 2021), establishing it as the preferred marker for detecting and managing T2DM.

Diabetes mellitus represents a significant worldwide health issue, calling for novel strategies to enhance patient care. Traditional uniform treatment methods have proven inadequate in effectively managing the complex and varied aspects of the disease (Sugandh *et al.*, 2023). Integrating pharmacists into community-based interventions has shown great promise in addressing these challenges by improving patient knowledge, self-care practices, medication adherence, and ultimately glycaemic control. For example, a prospective pre- and post-analysis study in Saudi Arabia demonstrated that a pharmacist-led diabetes intervention significantly enhanced patients' disease knowledge, self-management behaviours, medication adherence, and reduced HbA1c levels compared to usual care. These findings highlight the critical role pharmacists can play in personalised diabetes management, supporting the shift towards more collaborative and patient-centred care models

(Khan *et al.*, 2022). Launched in 2020, Malaysia's Pharmacy Integrated Community Care (PICC) programme uniquely incorporates trained civilian Ambassadors of Know Your Medicine (AKYM), who act as essential liaisons within the programme. Group-based interventions (GBIs) like PICC conduct regular sessions on various diabetes management topics, promoting collaboration between facilitators and healthcare professionals. These programs' effectiveness is rooted in the Social Cognitive Theory and Health Belief Model, highlighting the roles of observational learning, social support, self-efficacy, and feedback in managing diabetes. PICC works closely with a multidisciplinary team—including pharmacists, dietitians, nurses, medical officers, and physiotherapists—to deliver holistic, patient-centred care. AKYM ambassadors play a key role in participant recruitment by leveraging community ties, facilitating personalised learning, and boosting motivation and engagement, which strengthens the programme's supportive, community-based approach (Ahmad *et al.*, 2024).

Despite the demonstrated benefits of the PICC programme, its impact has not yet been evaluated in the Kulim district, which represents a significant portion of the population burdened by diabetes. Therefore, this study aims to assess the effectiveness of the PICC intervention in Kulim by evaluating its impact on glycaemic control, specifically measuring changes in HbA1c levels. The findings will provide valuable insights into the programme's applicability and effectiveness in this district, contributing to the broader understanding of pharmacist-led, community-based diabetes management strategies in Malaysia.

METHODS

Study design

This study employed a single-arm pre–post interventional design to evaluate the impact of the PICC programme on glycaemic control.

Study population

The study population comprised 20 patients with type 2 diabetes mellitus (T2DM) and baseline HbA1c levels greater than 7%, recruited from Klinik Kesihatan Taman Selasih, Kulim. Eligible participants were adults diagnosed with T2DM who were able to commit to the programme and attend at least three out of the four scheduled PICC modules.

Study duration

The study was conducted over a period of six months, from June 27, 2024 to October 3, 2024

Sampling method

Participants were selected using purposive sampling

Study variables
Independent variables include age, ethnicity, gender, body mass index (BMI) category, and comorbidities. The dependent variable is the HbA1c changes pre- and post-intervention.

Study tools
The study utilised the PICC activity book as a research tool to facilitate the intervention and data collection.

Intervention
The intervention in the methodology section refers to the Pharmacy Integrated Community Care (PICC) program, which is a structured, pharmacist-led community-based education and support programme for patients with type 2 diabetes mellitus. It consists of four key modules delivered through interactive sessions such as community talks, games, quizzes, and group activities. The modules cover:

- Healthy lifestyle and balanced nutrition
- Diabetes education (disease understanding and self-care)
- Proper use of antidiabetic medications (helps participants recognize and understand their medications, teaches the 'Konsep 5B' framework—covering the right patient, medication, dose, technique, and timing—and encourages knowledge sharing to foster peer support and accountability)
- Education on diabetes-related complications

The PICC session lasted around 2 hours which includes:

- Medication reconciliation: 30 mins
- Recap from previous session (group activities): 15 mins
- Sharing session (brainstorming) among team members and idea clustering: 15mins
- Explanation regarding modules: 20-30 mins
- Assessment of participants understanding: 5 mins

Statistical Analysis
Descriptive statistics was used to summarize the participants' characteristics, including age, ethnicity, gender, BMI category, and presence of comorbidities. For inferential analysis, the Wilcoxon signed-rank test due to skewed data was employed to compare pre- and post-intervention HbA1c levels to determine the significance of any changes

RESULT

Sociodemographic Characteristics of the Participants

The median age of participants was 62 years (IQR 58–69), indicating a generally older adult population (Table 1). A majority were male (65%) and Malay (90%). Over half were overweight (55%), one-quarter obese (25%), and the rest had a normal BMI (20%). Common comorbidities included hypertension (80%), hyperlipidaemia (60%), and ischaemic heart disease (IHD) (30%).

Table 1: Sociodemographic dan clinical characteristic of participants (N=20)

Variables	n (%)
Age (years)[1]	62 (58-69)
Age categories (years)	
30-39	1 (5.0)
40-49	3 (15.0)
50-59	3 (15.0)
60-69	9 (45.0)
70-79	4 (20.0)
Gender	
Female	7 (35.0)
Male	13 (65.0)
Etnicity	
Malay	18 (90.0)
Non-Malay	2 (10.0)
BMI	
Normal	4 (20.0)
Overweight	11 (55.0)
Obese	5 (25.0)
Comorbidities	
Hypertension	16 (80.0)
Hyperlipidemia	12 (60.0)
Ischaemic heart disease (IHD)	6 (30.0)
Anaemia	2 (10.0)
Depression	1 (5.0)
Gout	1 (5.0)
Benign prostatic hyperplasia (BPH)	1 (5.0)

[1] Median (IQR)

Impact of the PICC Intervention on Glycaemic Control

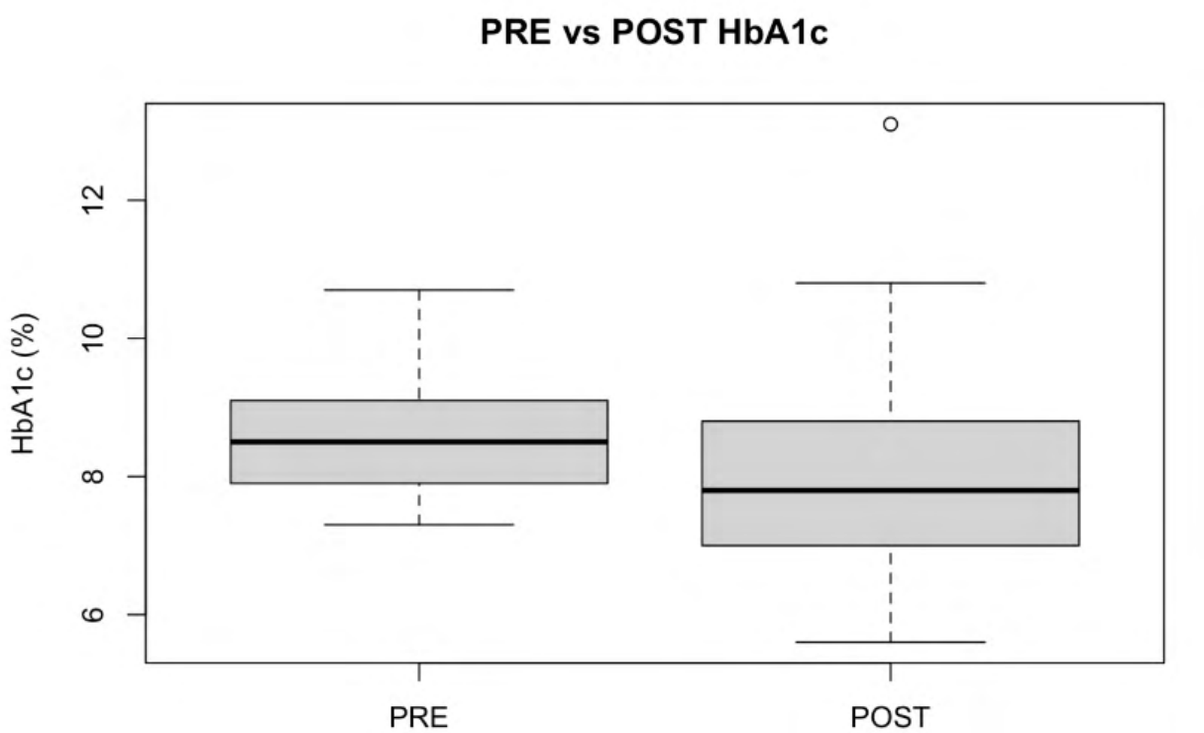


Figure 2: Box plot HbA1c Pre and Post Intervention

Figure 2 shows the box plot of the distribution of HbA1c levels pre and post the PICC intervention. The median HbA1c decreased from 8.50% pre-intervention to 7.80% post-intervention, indicating an overall improvement in glycaemic control among participants. The interquartile range (IQR) appears slightly wider post-intervention, suggesting more variability in HbA1c responses after the intervention. The lower error bar post-intervention extends further downward, indicating some participants achieved markedly better control. The presence of an outlier above the upper error bar post-intervention suggests a few participants had persistently high HbA1c despite the intervention. Overall, the shift in median and distribution supports the conclusion that the PICC program had a favourable impact on reducing HbA1c levels in this population.

Table 1: Comparison of HbA1c Pre and Post Intervention

	Median (IQR)	**T-statistics**	**p-value^a**
Pre	8.50 (1.15)	160.5	0.038
Post	7.80 (1.70		

a Wilcoxon signed-rank test p-value

The median HbA1c decreased from 8.50% (IQR 1.15) to 7.80% (IQR 1.70), with a statistically significant change (V = 160.5, p = 0.038, 95% CI for median change:

0.05–1.30). These results suggest that PICC may effectively improve glycaemic control in this cohort.

DISCUSSION

Impact of the PICC Intervention on Glycaemic Control

The significant reduction in median HbA1c from 8.50% to 7.80% post-intervention highlights the positive impact of the PICC programme on glycaemic control among participants. This finding aligns with evidence from similar pharmacist-led interventions across Malaysia and Asia. For example, a before-and-after study of the PICC programme conducted in an urban Malaysian clinic reported a statistically significant mean HbA1c reduction of 0.5% (from 7.6% to 7.1%) after a 16-week intervention involving community talks, games, quizzes, and home visits by a multidisciplinary team (Abdullah Zawawi *et al.*, 2024). Complementing this, the IMPACT trial in Singapore demonstrated that multidisciplinary care including regular pharmacist follow-ups led to a 0.5% HbA1c reduction over six months in high-risk diabetes patients, compared to no change with usual care. While the IMPACT trial focused on individual clinical visits, the PICC programme emphasised group-based community education (Siaw *et al.*, 2017). Both studies highlight the effectiveness of pharmacist-led collaborative care in improving diabetes outcomes across diverse Asian populations.

This improvement can be attributed to its structured, multifaceted approach using four key modules—healthy lifestyle and nutrition, diabetes education, medication adherence, and complications—delivered through engaging community talks, interactive games, and quizzes. Each module addressed critical components of diabetes self-management. The module on healthy lifestyle and balanced nutrition empowered participants with practical knowledge about dietary choices and physical activity, which are fundamental in controlling blood glucose levels. The effectiveness of this module in the PICC programme is supported by empirical evidence from related studies. For example, research analysing the relationship between lifestyle habits and glycosylated haemoglobin control in patients with Type 2 Diabetes Mellitus demonstrated that patients who maintained more beneficial lifestyle habits had significantly better HbA1c management (Wang *et al.*, 2020). These findings reinforce that equipping patient with practical knowledge about diet and physical activity, as done in the PICC intervention, is fundamental to improving glycaemic control and overall diabetes outcomes.

The diabetes education module in the PICC programme significantly enhanced participants' understanding of the disease process and the importance of ongoing self-care, which is critical for effective diabetes management. This aligns with findings from a prospective quasi-experimental study conducted at King Fahad Armed Forces Hospital in Jeddah, Saudi Arabia, which demonstrated that structured

diabetic education programmes effectively lower HbA1c levels in patients with uncontrolled type 2 diabetes mellitus (Almotairy *et al.*, 2024). The study showed a significant decrease in HbA1c among patients who received the educational intervention compared to controls, confirming the vital role of diabetes self-management education and support in improving glycaemic control. Similar to the PICC intervention, the hospital's programme provided structured knowledge that empowered patients to make informed decisions regarding their treatment and lifestyle, reinforcing the importance of continuous self-care. Both interventions highlight that improving patient understanding through education not only helps reduce HbA1c levels but also supports better health outcomes by promoting adherence to treatment regimens and encouraging proactive management of the disease. These findings underscore the value of integrating diabetes education modules into community-based interventions like PICC to optimise long-term glycaemic control.

The third module of the PICC programme, Proper Use of Antidiabetic Medications, aims to improve glycaemic control through three key objectives. Firstly, by helping participants recognise and understand the purpose of their diabetes medications, the module enhances their awareness of the importance of adherence in controlling blood glucose levels. This relationship is supported by findings from the KAMOGAWA-DM cohort study, which demonstrated that poor understanding of antidiabetic medication is significantly associated with higher HbA1c levels in patients with type 2 diabetes. The study found that patients with a poor understanding of their medication regimen were more likely to have inadequate glycaemic control (HbA1c ≥8%) (Sakai *et al.*, 2019), underscoring the importance of educating patients about their medications. Improving medication knowledge through the PICC module likely reduces this gap, which promotes better adherence and contributes to improved blood glucose management. Secondly, the 'Konsep 5B' provides a practical framework to ensure accurate medication use by emphasising the five rights: the right patient, the right medication, the right dose, the right technique, and the right timing. Furthermore, encouraging participants to share their knowledge fosters peer support and accountability, which further reinforces consistent medication adherence.

Lastly, educating participants on diabetes-related complications plays a crucial role in improving HbA1c levels by increasing their level of awareness on diabetes-related complications and preparing them for self-care, which enhances treatment compliance and supports effective diabetes management (Okoye, 2021). A cross-sectional study conducted among patients with type 2 diabetes in Mexico, which found that inadequate diabetes knowledge—including poor understanding of disease complications—was strongly associated with poor glycaemic control (HbA1c ≥7%). The study used the validated Diabetes Knowledge Questionnaire (DKQ-24), which assesses knowledge of diabetes aetiology, management, and complications, demonstrating that patients with low knowledge had a significantly higher risk of suboptimal glycaemic control. These findings emphasise the importance of

comprehensive diabetes education programmes that include detailed information on complications to enhance patient awareness, encourage proactive self-care, and ultimately improve glycaemic control, consistent with the goals of the PICC programme's complication education module.

Community talks facilitated direct engagement with healthcare professionals, providing personalised clarification and motivation, which is consistent with research highlighting that community-based health education programmes empower individuals through culturally relevant, collaborative interventions that improve health literacy and promote sustained healthy behaviours.(Blessing, 2024). Delivering educational content through quizzes has been shown to significantly enhance understanding and knowledge retention, as highlighted in a recent review on the role of quizzes in medical education (Dengri et al., 2021). This interactive approach encourages active recall and continuous assessment, which are critical for reinforcing learning. In the context of diabetes management, improved patient knowledge through such methods can lead to better self-care practices and medication adherence, ultimately contributing to improved glycaemic control and reductions in HbA1c levels. Thus, incorporating quizzes into diabetes education modules can be an effective strategy to empower patients and support sustained improvements in diabetes outcomes.

This study also has notable strengths and limitations. This study provides important local evidence from Kedah on the effectiveness of the PICC programme in improving glycaemic control, using HbA1c as a consistent indicator of long-term blood glucose levels. However, the small sample size and single-arm study design without a control group limit the ability to definitively attribute the observed improvements to the intervention alone. Therefore, the findings should be considered preliminary and hypothesis-generating rather than definitive, with limited internal validity and generalisability

CONCLUSION

The PICC program demonstrated a significant positive impact on glycaemic control, evidenced by the reduction in median HbA1c from 8.50% to 7.80%, affirming the effectiveness of structured, pharmacist-led, community-based interventions in managing type 2 diabetes. Future studies should employ randomized controlled designs with larger, more diverse cohorts to confirm these preliminary findings and assess the long-term impact of PICC.

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TRENDS IN UNDER-5 MORTALITY IN KULIM DISTRICT FROM 2022-2024: A DATA-DRIVEN APPROACH

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ABSTRACT

Introduction: The under-five mortality rate (U5MR) is a critical indicator of child survival and overall public health. This study aimed to describe the U5MR in Kulim District from 2022 to 2024, focusing on trends, family and child characteristics, and causes of death.

Methods: A descriptive cross-sectional study was conducted using secondary data on under-five mortality cases reported in Kulim District between 2022 and 2024.

Results: A total of 177 under-five deaths were recorded. The perinatal mortality rate (PMR) increased from 8.59 per 1,000 births in 2022 to 14.16 in 2024. U5MR showed a fluctuating pattern: 8.36 (2022), 7.36 (2023), and 10.74 (2024). Most deaths occurred among children of married parents (98%), with 55% having comorbidities. The majority of mothers were housewives (55%) and had adequate antenatal care (98%). Most deaths occurred in neonates aged 0–6 days (44%) and in hospital settings (97%). The leading causes of death were infections (28%) and congenital malformations (26%).

Discussion: Despite national achievements in reducing U5MR, local data from Kulim indicate persistent challenges, particularly rising PMR and fluctuating U5MR. Infections and neonatal causes remain prominent contributors. The findings highlight the importance of targeted maternal and child health strategies, and further analytical studies are needed to explore risk factors.

Keywords: Under-five mortality, perinatal mortality, child health

INTRODUCTION

Under-five mortality (U5M) refers to death of a child before the age of five. Consequently, under-five mortality rate refers to the probability of a child dying between birth and exactly 5 years of age expressed per 1000 live births (Okoroiwu et al., 2024). Death of a liveborn infant can occur in the neonatal period (in the first 28 days of life) or in the post neonatal period (between 28 days and 1 year of age). An infant death is defined as the death of a liveborn baby that occurs before 1 year of age, both neonatal and post-neonatal deaths (ScienceDirect, 2025). Neonatal death has been defined by the World Health Organization (WHO) as “deaths among live births during the first 28 completed days of life” which can be further sub-divided into early neonatal deaths (deaths between 0 and 7 completed days of birth) and late neonatal deaths (deaths after 7 days to 28 completed days of birth) (Pathirana et al., 2016).

Under-5 Mortality Rate (UM5R) serves as an indicator of children's health, overall well-being, and their broader social and economic conditions (Dlamini et al., 2024). Mortality rates indicate the level of children's access to essential health services, including vaccinations, medical care and proper nutrition (Savethechildren, 2025). Established in 2015 by the United Nations General Assembly, the Sustainable Development Goals (SDGs) aim for all nations to reduce the U5MR to no more than 25 deaths per 1,000 live births and the neonatal mortality rate (NMR) to no more than 12 deaths per 1,000 live births by the year 2030 (Sharrow et al., 2022).

In 2023, 4.8 million children younger than five years old died, equating to roughly 13,100 daily deaths in this age group. Infectious diseases—such as pneumonia, diarrhoea, and malaria, along with complications from preterm birth and issues related to childbirth, remain leading causes of death among children under five globally.Between 1990 and 2023, the global under-five mortality rate fell from 94 to 37 deaths per 1,000 live births, marking a 61 percent reduction (UNICEF, 2025). Children in sub-Saharan Africa experienced the highest mortality rates worldwide, with 74 deaths per 1,000 live births—14 times greater than the mortality risk faced by children in Europe and North America (World Health Organization, 2022). Malaysia has met the target for Indicator 3.2.1, the under-five mortality rate, since 1984, recording a rate of 22.8. However, the under-five mortality rate rose slightly in 2021 to 7.4 deaths per 1,000 live births, up from 7.3 per 1,000 live births the year before (Rosidah, 2020, DOSM, 2022). Additionally, research in Kota Kinabalu, Sabah’s preventable U5MR rose from 1.7% in 2015 to 12.5% in 2016 (Dualis, 2018).

The above burden on U5M highlights both progress and ongoing challenges. While Malaysia has successfully met the Sustainable Development Goal targets decades ago, the slight recent increase in U5MR and the rise in preventable deaths in specific regions like Kota Kinabalu underscore the need for continuous vigilance and targeted interventions. The persistence of infectious diseases and complications related to

childbirth as leading causes of death globally points to gaps in healthcare access, quality, and social determinants of health. Despite these national achievements, limited district-level evidence exists to explain local variations in U5MR and to identify context-specific determinants that influence child survival. Addressing this knowledge gap is crucial to ensure resources and interventions are aligned with local needs. Therefore, this study was conducted to examine under-five mortality and its determinants at the district level.

METHODOLOGY

Study Design and Period

A cross-sectional design was employed, using retrospective data covering the period from January 2022 to December 2024.

Study Area

Kulim District, located in the northern state of Kedah, Malaysia, serves as the study area for this research. With a population exceeding 352,200 residents (DOSM, 2024), the district is subdivided into several subdistricts, including Junjung, Karangan, Keladi, Lunas, Mahang, Nagalilit, Sedim, Merbau Pulas, Padang Serai, Padang China, and Sungai Ular.

Operational Definitions

Dependent Variables

Under Five Death
Death from birth to <5 years old (0–1824 days) (WHO, 2024)

Perinatal Mortality Rate
The number of stillbirths (fetuses weighing at least 500g or when birth weight is unavailable, after 22 completed weeks of gestation or with a crown-heel length of 25 cm or more) plus the number of early neonatal deaths, per 1 000 total births (WHO, 2024).

Under-5 Mortality Rate
Deaths of children <5 years per 1,000 live births (WHO, 2024).

Independent Variables

Hospital death
Death occurring in a hospital or in-transit between facilities (WHO, 2024).

Non hospital death
Deaths outside hospital, including brought-in-dead (BID), home, or clinic deaths (WHO, 2024).

Antenatal care attendance
Adequate defined as at least 8 clinic visits during pregnancy, fewer than 8 visits classified as inadequate (WHO, 2024)

Cause of death
The cause of death categorised as infections, congenital malformations, prematurity, prenatal conditions, congenital heart disease, motor vehicle accidents (MVA), or brought-in-dead (BID) cases with undetermined causes.

Data Collection

All recorded U5M from the study period were included. Each death record was selected based on inclusion criteria requiring confirmed age under five years at the time of death, complete demographic details (including age, gender, date of death), and documented cause of death.

Study Tools
A line listing of all under-five deaths in Kulim District from 2022-2024. Variables included:

- Mortality indicators (total deaths, PMR, U5MR)
- Family-related characteristics (marital status, maternal occupation, antenatal care, comorbidities)
- Child-related characteristics (age at death, sex, nationality)
- Place and cause of death

Data Analysis

Descriptive analysis was conducted using Microsoft Excel. Results are presented as frequencies, percentages, and rates per 1,000 live births.

RESULT

Perinatal mortality rate & Under-five mortality rate

From 2022 to 2024, a total of 177 under-five deaths were recorded. The Perinatal Mortality Rate (PMR) in the study area showed an upward trend, increasing from 8.59 per 1,000 live births in 2022 to 14.16 per 1,000 live births in 2024, which is above the target rate of <8.18 per 1,000 live births. Conversely, the Under-Five Mortality Rate (U5MR) showed fluctuating trends over the same period, decreasing from 8.36 per 1,000 live births in 2022 to 7.36 in 2023, indicating some improvement in child survival, before rising again to 10.74 per 1,000 live births in 2024. The U5MR

rates in 2022 and 2024 were above the target of <7.64 per 1,000 live births, while the 2023 rate was below the target, reflecting a temporary achievement of the child mortality goal (WHO, 2024).

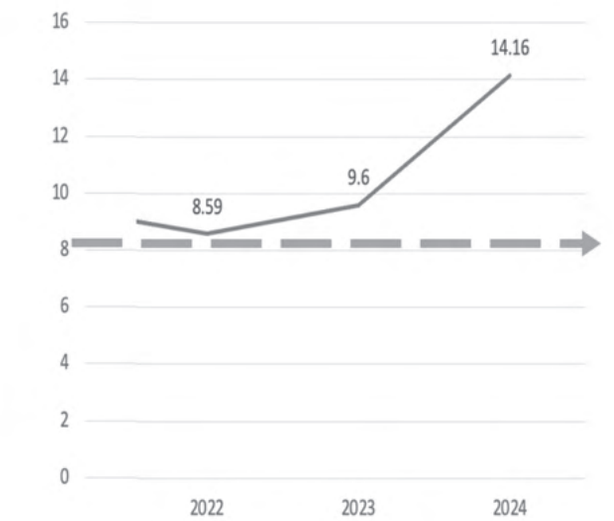


***Figure 1**: The Perinatal Mortality Rate (PMR) in Kulim from 2022-2024*

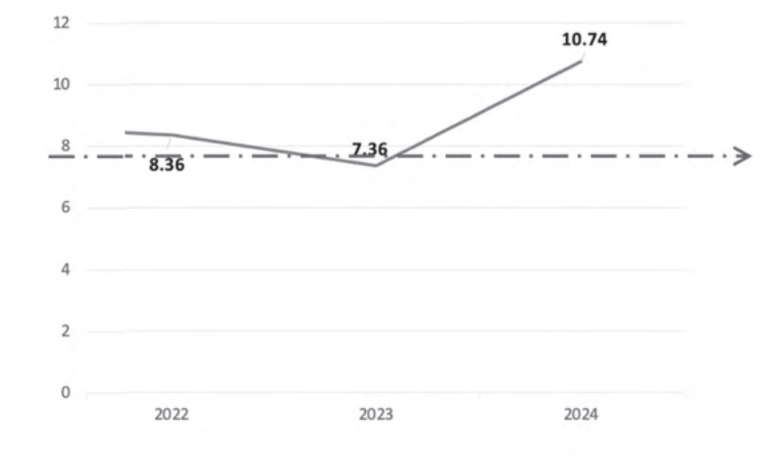


***Figure 2**: Under-five mortality rate (U5MR) in Kulim from 2022-2024*

Family characteristics among under-five deaths in Kulim from 2022-2024

Family-related variables among under-five deaths in Kulim from 2022 to 2024 indicated that majority of deceased children (98%) were born to married parents. More than half (55%) of mothers have documented comorbidities. Most mothers (55%) were housewives, and 98% had attended an adequate number of antenatal care visits (Table 1).

Table 1: The characteristics of family related factors among under-five deaths in Kulim from 2022-2024 (N=179)

Variables	n (%)
Marital Status	
Married	175(98)
Unmarried	4(2)
Comorbid	
Yes	97(55)
No	80(45)
Occupation	
Housewife	98(55)
Private	58(33)
Government	21(12)
Antenatal visit	
Adequate	174(98)
Inadequate	3(2)

Child characteristics among under-five deaths in Kulim from 2022-2024

The child-related characteristics of under-five deaths in Kulim from 2022 to 2024 showed that 51% were male, 48% female, and 1% indeterminate gender (Table 2). The highest proportion of deaths occurred within the first 0–6 days of life (44%), followed by 28 days to less than 1 year (28%), 7–27 days (14%), and 1 year to less than 5 years (13%). Most deaths occurred in hospital settings (97%), with only 3% outside hospitals. Regarding citizenship, the majority of deceased children were Malaysian nationals (94%), while 6% were non-Malaysian.

Table 2: Child characteristics among under-five deaths in Kulim from 2022-2024 (N=177)

Variables	n (%)
Gender	
Male	91(51)
Female	84(48)
Indeterminate	2(1)
Age	
0-6 days	50(44)

7-27 days	16(14)
28 days-<1 years	32(28)
1 year-<5 years	15(13)
Place of Death	
Hospital	172(97)
non-Hospital	5(3)
Citizenship	
Malaysian	167(94)
non-Malaysian	10(6)

Causes of under-five deaths in Kulim from 2022-2024

The leading causes of under-five deaths in Kulim from 2022 to 2024 were infection (28%) and lethal congenital malformations (26%) (Table 3). Other significant causes included prematurity (18%), conditions originating from the prenatal period (13%), congenital heart disease (5%), brought-in-dead cases (4%), and motor vehicle accidents (2%).

Table 3: Causes of under-five deaths in Kulim from 2022-2024 (N=177)

Cause of death	**n (%)**
Lethal Congenital Malformation	24(26)
Infection	26(28)
Condition from Prenatal Period	12(13)
MVA	2(2)
BID	4(4)
Prematurity	17(18)
Congenital Heart Disease	5(5)

DISCUSSION

Perinatal Mortality in Kulim showed a rising trend, increasing significantly from 8.59 per 1,000 live births in 2022 to 14.16 per 1,000 live births in 2024. Compared to Malaysia's national PMR, which showed improvement from 8.2 per 1,000 live births in 2022 to 7.9 per 1,000 live births in 2023 (Ministry of Health Malaysia, 2024). Kulim's PMR was initially similar but became substantially higher by 2024. Perinatal mortality is an important indicator of maternal care and maternal health and nutrition; it also reflects the quality of obstetric and paediatric care available (World Health Organization, 2006). Therefore, the increasing local PMR may suggest deficiencies in maternal nutrition, antenatal care quality, skilled birth attendance, and immediate neonatal care, highlighting areas for urgent public health intervention (UNICEF, 2025).

Compared to the Kota Bharu study (2017–2022), which reported a relatively stable U5MR of approximately 7 per 1,000 live births, the rates observed in the current study, particularly in 2024, are higher (Mohd Khairi Safwan Johar, 2023). Similarly, when compared with the Seremban District study (2018–2021), which analyzed 338 cases and reported a lower proportion of preventable deaths, the current U5MR is notably higher, indicating relatively less stable child survival trends (Siti Aishah Abas, 2024). Although direct comparisons should be interpreted cautiously due to differences in study periods and methodologies, the higher mortality rates observed in this study area may reflect emerging challenges or disparities in healthcare access and quality. These findings underscore the importance of continued monitoring and targeted interventions to better understand and address the factors contributing to under-five and perinatal mortality.

The characteristics of family-related factors

In this study, the vast majority of under-five deaths occurred among children from families where the parents were married, accounting for 98% of cases, while only 2% were observed among children from unmarried parents. This pattern indicates that under-five mortality is not confined to children from single-parent or non-married households, but is also present among those with married parents. These findings are consistent with a multi-country analysis conducted in sub-Saharan Africa, which reported that up to 85.2% of women experiencing under-five child mortality were currently married or in union, with the lowest proportion of married or in-union women still exceeding 60% across the countries studied (Yaya *et al.*, 2018). This suggests that while marital status is an important demographic factor, U5M can affect children across a wide spectrum of family structures.

Previous research has demonstrated that maternal illnesses and poor mental health can adversely affect both maternal and child health outcomes (Mudiyanselage *et al.*, 2024), increasing the risk of morbidity and mortality in children.

This pattern of occupational status is consistent with findings from a multi-country analysis in sub-Saharan Africa, where a substantial proportion of women experiencing under-five child mortality were not engaged in formal employment. In the referenced study, the proportion of mothers not currently working ranged from 31.6% to 72.9% across the countries analyzed, often exceeding those who were employed (Yaya *et al.*, 2018). These similarities highlight that non-working status among mothers as well as low education level commonly observed in populations experiencing higher under-five mortality (Naz *et al.,2021)*.

Finally, the antenatal care visits revealed that most mothers (98%) had adequate antenatal visits, with only a small minority (2%) classified as having inadequate antenatal care. While this high rate of antenatal care utilization is encouraging and reflects the effectiveness of maternal health outreach programs, the persistence of U5MR despite such high coverage suggests that quantity of visits alone may not be sufficient. It points to possible gaps in the quality and comprehensiveness of antenatal services, maternal health conditions that are not fully mitigated by routine care, or factors beyond the health system such as socioeconomic status and neonatal care practices. This highlights the need to not only sustain coverage but also strengthen the quality and scope of antenatal care to ensure better maternal and child outcomes (World Health Organization, 2006).

The characteristics of child-related factors

The distribution of under-five deaths in this study was nearly equal between males (51%) and females (48%), with a small proportion (1%) recorded as indeterminate gender. This pattern is consistent with findings from a study in Afghanistan, which reported that male children accounted for 53.8% of under-five deaths, while females comprised 47% of cases (Pal *et al.*, 2021). The slight predominance of male mortality observed in both settings reflects evidence from global literature, which suggests that male children are often at greater risk of mortality due to their increased biological vulnerability (Janaína Calu *et al.*, 2017).

A substantial proportion of under-five deaths in this study occurred within the neonatal period, particularly in the first week of life (0–6 days), which accounted for 44% of cases. An additional 14% of deaths took place during the late neonatal period (7–27 days). Deaths among post-neonatal infants (28 days to under 1 year) constituted 28%, while 13% occurred in children aged 1 to under 5 years. These findings are consistent with World Health Organization (WHO) estimates, which indicate that nearly half (47%) of all under-five deaths worldwide occur during the neonatal period (the first 28 days of life), with most neonatal deaths (75%) occurring within the first week (World Health Organization, 2024). This highlights the critical importance of interventions targeting the perinatal and immediate postnatal periods to reduce early childhood mortality.

The majority of U5M in this study occurred in hospital settings (97%), with only 3% taking place outside the hospital. This is higher than what was reported in a review on amenable mortality among children under five, which found that approximately 79.4% of deaths occurred in hospital settings (Navarro-Jimenez *et al.*, 2024). Most U5M involved Malaysian citizens (94%), with non-Malaysians accounting for 6% of cases. This may be attributed to the larger proportion of citizens in the population and their greater access to healthcare services compared to non-citizens.

Causes of under-five deaths

The study findings are consistent with global patterns reported by UNICEF, which highlight infectious diseases—such as pneumonia, diarrhoea, and malaria—alongside preterm birth and intrapartum-related complications as major contributors to under-five mortality worldwide (UNICEF, 2025). Similarly, research on under-five mortality causes and prevention has shown that acute respiratory infections, diarrheal diseases, malaria, and birth complications remain the most common causes of death in this age group, particularly in low- and middle-income countries (Tekin, 2021).

CONCLUSION

The U5MR from 2022 to 2024 remains above the target, highlighting persistent challenges in addressing under-five mortality in Kulim. This study provides an overview of under-five deaths, which are primarily characterized by family-related characteristics (including a predominance of married parents, a high proportion of mothers who are housewives, and significant maternal comorbidities), child characteristics (the majority of deaths occurred in the neonatal period, near-equal gender distribution, and the predominance of hospital-based deaths), and underlying causes (mainly infections, congenital malformations, and prematurity). It is recommended that future research employ analytical study designs to investigate the determinants of under-five mortality and enable causal inference to better inform effective intervention strategies.

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