



JURNAL GIZI DAN PANGAN

INDONESIAN JOURNAL OF NUTRITION AND FOOD

Jurnal Gizi dan Pangan

Vol. 19 No. Supp.1, January 2024

Supplementary Issue:

The 1st International Conference on Food,
Nutrition and Health
(ICFNH 2023)

19–20 September 2023



Volume 19, Number Supplement 1, January 2024



9 771978 105189



Published by:



Food and Nutrition Society of Indonesia



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- Publication Fee : IDR 1,500,000 (120 US\$ Full amount)
SWIFT Code: BNINIDJABGR
- Publication Frequency : Three times a year (March, July, and November)
- Subscription Rate : IDR 250,000/year (not including shipping rate and handling)
Bank BNI account number: 0266948576
Account name: Dodik Briawan
- Editorial Address : Secretariat of Jurnal Gizi dan Pangan (Indonesian Journal of Nutrition and Food),
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Jurnal Gizi dan Pangan (Indonesian Journal of Nutrition and Food) is routinely published three times per year since 2006 and received accreditation from Ministry of Research, Technology, and Higher Educational Decree Number 28/E/KPT/2019 in 26 September 2019. This journal focuses on research publications in the fields of nutrition and food encompasses topics related to biochemistry aspect, clinical nutrition, community nutrition, functional food, socio-economic, and regulation in nutrition and food information.

This first supplement issue of the Indonesian Journal of Nutrition and Food features the presentations given at the 1st International Conference on Food, Nutrition and Health that was organized by Centre for Dietetics Studies, Faculty of Health Sciences, Universiti Teknologi MARA which was held virtually on 19–20 September 2023.

These papers were reviewed by the Scientific Committee of ICFNH 2023 before their presentation, but they did not undergo the conventional reviewing system of the Indonesian Journal of Nutrition and Food.

The Indonesian Journal of Nutrition and Food, Bogor, Indonesia

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SCIENTIFIC COMMITTEE MESSAGE FROM 1st ICFNH 2023

The 1st International Conference on Food, Nutrition and Health (ICFNH) 2023 was organized virtually by Centre for Dietetics Studies, Faculty of Health Sciences, Universiti Teknologi MARA. The main objective of this conference is to share the latest information on food, nutrition and health. ICFNH 2023 also serves as an opportunity for researchers, practitioners, students and other interested parties to share their research and ideas in this field. During the ICFNH 2023, a lively discussion were observed among young nutrition and dietetic students and researchers with senior researchers, professors, and thought leaders in the world of food and nutrition.

The organizing committee of the ICFNH 2023 had chosen to focus on "Curating Health through Nutrition: A Shared Responsibilities" as the theme of the conference. The articles presented in this first supplement issue are selected from the 19 oral presentations covering six themes of ICFNH 2023.

The publication of this first issue of ICFNH 2023 supplement is supported by the Indonesian Journal of Nutrition and Food. We do hope this supplement issue can contribute as a source of scientific information in the field of food, nutrition and health for our readers.

On behalf of the 1st ICFNH 2023,

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Royal Free Hospital Nutrition Prioritizing Tools (RFH-NPT): Predictor of Malnutrition Risk among Chronic Liver Disease Patients

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ABSTRACT

This study is aimed to investigate the prevalence of malnutrition using Royal Free Hospital Nutrition Prioritizing Tools (RFH-NPT) and the correlation between malnutrition and RFH-NPT with clinical parameters. A total of 80 cirrhosis liver patients without liver cancer were enrolled in this prospective study. This study was conducted at Selayang hospital, which is the national tertiary referral centre for liver disease in Malaysia. We administered the nutrition screening of RFH-NPT to the patients within 24 hours after admission. The utilization of the RFH-NPT resulted in a higher incidence of nutritional risk, at 73%. The RFH-NPT revealed a higher proportion of Child Pugh C patients at risk for malnutrition (46/50 or 92%, $p=0.002$) and had superior capability in identifying patients with intermediate and high risk for malnutrition (35/61 or 57.3%, $p=0.012$) within the subset of patients with Model for End-Stage Liver Disease (MELD) scores below 15. Hence, we propose that the utilization of the RFH-NPT enhances medical professional's capacity for early-stage prediction of malnutrition risk in patients with cirrhosis predominantly attributed to hepatitis virus infection.

Keywords: cirrhosis, liver disease, Nutrition Risk Screening 2002 (NRS 2002), nutrition screening, Royal Free Hospital Nutrition Prioritizing Tools (RFH NPT)

INTRODUCTION

According to available estimates, a significant proportion ranging from 50% to 90% of individuals diagnosed with cirrhosis in Malaysia exhibit indications of advanced liver disease (Rahman *et al.* 2015). Malnutrition is a significant contributing factor to the exacerbation of liver cirrhosis, a condition that affects a substantial portion of the global population, ranging from 60% to 90% (Wu *et al.* 2020). There is a significant correlation between malnutrition and several adverse health outcomes, including increased mortality rates, heightened incidence of portal hypertension complications, prolonged hospitalization periods, and elevated susceptibility to infections (Tandon *et al.* 2017). The positive impacts of nutritional therapy encompass a reduced likelihood of extended hospital stays, diminished severity of systemic inflammatory response, decreased occurrence of infections, and lower mortality rates among malnourished patients admitted collectively. Despite the absence of large-scale,

well-designed studies on cirrhosis, nutritional therapy has demonstrated success in certain cases. Individuals with malnutrition should be identified as soon as possible to begin nutritional therapy. Therefore, patients will undergo a brief nutritional assessment to determine if they are at risk of malnutrition. Patients at risk should have a thorough nutritional assessment to determine the presence and severity of malnutrition (Reber *et al.* 2019). Due to the lack of a validated rapid nutritional screening tool, the various definitions of malnutrition, and the difficulty in clarifying body composition and laboratory results in volume overload and liver dysfunction (Purnak & Yilmaz 2013), nutrition screening and assessment are rarely performed in patients with liver disease.

The concept of malnutrition lacks a broadly agreed-upon description; however, it can be conceptualized as the state of nutritional instability resulting from insufficient nutrition. Malnutrition is characterized as an adverse nutritional condition that gives rise to detrimental clinical consequences. Given that malnutrition

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(Received 15-08-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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can arise from either a deficiency in essential nutrients or excessive consumption of nutrients, sometimes referred to as overnutrition, it is important to distinguish between the terms 'undernutrition' and 'malnutrition' and avoid using them interchangeably (Cederholm *et al.* 2015).

Individuals suffering from hepatic illnesses face a heightened susceptibility to malnutrition due to the liver's crucial involvement in regulating nutritional status and energy stability. Chronic liver illness may also be accompanied by appetite suppression and decreased absorption of nutrients. Consequently, the etiology of malnutrition in individuals with hepatic diseases is complex and involves multiple factors (Georgiou *et al.* 2019; Skladany *et al.* 2021).

The American Society for Parenteral and Enteral Nutrition (ASPEN) (Reber *et al.* 2019) defines nutritional screening as identifying people at risk or already malnourished. Identifying malnourished hospital patients is critical. A simple and effective dietary risk screening tool is essential. This approach would enable early nutrition assessment and intervention, reducing cirrhosis patient mortality and morbidity (Borhofen *et al.* 2016). This screening aids nutritional assessment and diet therapy development. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends quick and easy screening by community healthcare or admission teams (Lochs *et al.* 2016). An ideal screening instrument has sufficient sensitivity and specificity (Jeejeebhoy *et al.* 2015), can be used by unskilled healthcare personnel, and can be used by patients.

Performing daily system-wide nutritional monitoring for high-risk patient groups is not a common practice. Moreover, the disregard for preventive measures leads to a rise in the economic burden of cirrhosis as a result of malnutrition (Rahman *et al.* 2015). Consequently, individuals who experience malnourishment or are susceptible to it are frequently disregarded until they manifest severe malnutrition or encounter a health issue that poses a threat to their lives. The assessment of nutritional risk factors involves considering the interplay between inflammation and malnutrition, which is influenced by both the individual's nutritional status and the severity of their underlying disease (Heyland *et al.* 2013). According to the European Society for Nutrition and Surgical Outcomes Network (ESPEN),

nutrition risk can be defined as the probability of experiencing either a favorable or unfavorable outcome about a disease or surgical procedure, which is determined by an individual's nutritional and metabolic condition (McClave *et al.* 2016).

Patients with liver cirrhosis face many nutritional issues due to the disease, including Protein-Energy Malnutrition (PEM). This condition is observed in a significant proportion of cases, ranging from 65% to 90%, but it is often not adequately recorded (Palmer *et al.* 2019). Malnutrition poses a significant concern for hospitalized patients across several medical conditions, extending beyond the scope of liver cirrhosis. Identifying malnutrition in individuals with liver disease poses challenges when fluid excesses, such as ascites and edema, are present. Moreover, the presence of ascites-induced intra-abdominal pressure has been linked to symptoms such as nausea, vomiting, and an early sensation of satiety. Hence, it is recommended that the Royal Free Hospital Nutritional Prioritising Tool (RFH-NPT), originally designed as a nutritional screening tool for liver disease (Tandon *et al.* 2017), be employed in evaluating the nutritional status of all individuals diagnosed with liver illness.

This study aims to investigate the prevalence of malnutrition using RFH-NPT and the correlation between malnutrition and RFH-NPT with clinical parameters. The RFH-NPT screening test has been established as the primary and exclusive validated method for identifying malnutrition among this particular demographic. The routine utilization of RFH-NPT as a nutrition screening method in the hepatology department has proven to be an effective means of identifying patients at risk of malnutrition and requiring early nutritional intervention.

METHODS

Design, location, and time

The present investigation is characterized as a cross-sectional study. This study recruited individuals who had been pathologically diagnosed with liver cirrhosis and met the inclusion criteria from Malaysia's national tertiary referral center for liver disease. The estimated sample size for this phase was 80 samples using Raosoft, 2004 formula. After written informed consent was acquired from patients, RFH-

NPT was assessed by nurses within 24 hours after patient admission. The present study was initiated from January 2019 to January 2021. The present investigation employed inclusion criteria that encompassed patients who were 18 years of age or older, individual has been diagnosed with Chronic Liver Disease (CLD) for a minimum of six months, is vigilant, capable of effective communication, and the hospitalization duration must exceed 48 hours. The study implemented several exclusion criteria, including individuals under the age of 18 who were in an acute state, individuals with neurological problems, disorders, or dementia, patients who were admitted to the Intensive Care Unit (ICU) and were in a critical condition, and individuals who declined to participate. This procedure was authorized by the Malaysian Medical Research Ethics Committee (MREC)-NMRR-19-1659-47627, prior to the commencement of recruiting.

Sampling

Royal Free Hospital-Nutritional Prioritizing Tool (RFH-NPT). The RFH-NPT is a developed nutrition screening tool from the United Kingdom (Amodio *et al.* 2013). Its score has been found to have significant associations with various clinical factors, including clinical deterioration, disease severity, the Child-Pugh score, the Model for End-stage Liver Disease (MELD) score, as well as clinical complications such as ascites, hepatorenal syndrome, and episodes of Hepatic Encephalopathy (HE) (Rajab *et al.* 2023). The RFH-NPT steps consist of three primary steps: 1) Individuals presenting with alcoholic hepatitis or undergoing tube feeding are promptly identified as being at a heightened risk, thereby bypassing subsequent evaluation steps. 2) Individuals lacking alcoholic hepatitis and not undergoing tube feeding are subjected to an assessment targeting fluid overload, its potential influence on food consumption, and associated weight reduction. 3) Individuals devoid of fluid overload are subjected to an evaluation of their nutritional status, encompassing parameters such as Body Mass Index (BMI), unintentional weight loss, and daily dietary intake. Patients are categorized into different risk groups based on the scores: low risk (score of 0), moderate risk (score of 1), and high risk (score of 2–7). Furthermore, an increased RFH-NPT score (Wu *et al.* 2020) was associated with improved survival

outcomes. The complete procedure requires less than three minutes and can be executed by individuals without specialized expertise (Wu *et al.* 2020). RFH-NPT has been validated in Malaysia with a moderate specificity of 74% and a high sensitivity of 97% respectively (Borhofen *et al.* 2016). The study concluded that RFH-NPT demonstrates positive and fair agreement between gold standard SGA and RFH-NPT to be used as a routine nutrition screening protocol for identifying patients at risk of malnutrition.

Data collection

The study gathered all individuals' demographic, anthropometric, and clinical data within 48 hours of admission. This data included information on gender, age, weight, height, BMI, lifestyle habits such as alcohol consumption and smoking, diagnosis, Child Pugh Score, and MELD score. Fasting blood samples were obtained within 48 hours of admission using normal laboratory techniques to measure serum albumin and total serum protein levels.

Data analysis

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 26 for Windows. Descriptive statistics were used to assess the baseline parameters. Categorical data are shown as frequencies and percentages and as for numerical data, means with Standard Deviations (SD) are given for normally distributed variables. The continuous variables are described as mean values and standard deviations or medians with ranges. The differences between means were analyzed using independent Student's t-tests. Nominal variables are described as numbers or percentages, and their differences were analyzed with Pearson's χ^2 test, Fisher's exact test, or the McNemar test.

RESULTS AND DISCUSSION

Table 1 shows key patient features. This study included 80 participants with a mean age of 54.0 years and an SD of 8.2 years. Participants were 33–61. The most common liver diseases were hepatitis C (26%), and Non-Alcoholic Liver Disease (NASH) (22%). Thirty individuals (38% of the sample) had Child Pugh class C cirrhosis. Decompensated cirrhosis was found in 68.4% of patients and compensated in 31.6%. Nine percent

Table 1. Patients overall characteristic (n=80) and fundamental clinical indicator

Index	n (%)	Mean**	SD**
Age (years)		54.0	8.2
Sex			
Female	50 (62)		
Male	30 (37)		
BMI (kg/m ²)		21.4	1.31
Dry weight BMI (kg/m ²)		20.4	2.71
Ethnicity			
Malay	40 (50)		
Chinese	21 (26)		
Indian	15 (19)		
Other	4 (5)		
Aetiology of cirrhosis			
Hepatitis C	21 (26)		
Alcohol	15 (19)		
NASH	18 (22)		
Hepatitis C/ETOH	12 (15)		
Others	14 (18)		
Total serum protein (g/L)		79.8	2.65
Albumin (g/L)		35.16	2.41
Child Pugh Score		7.40	0.93
MELD score		6.80	3.02
Cirrhosis			
Compensated		26 (31.6)	
Decompensated		54 (68.4)	
NRS 2002		2.58	0.56
No to low risk	42 (52)		
No to high risk	38 (48)		
RFH-NPT		1.40	0.75
Low risk	30 (37)		
Moderate to high risk	50 (63)		
Hepatic encephalopathy			
Absent	72 (90)		
Present	8 (10)		
Ascitess			
Absent	43 (54)		
Present	37 (46)		

**Mean values and standard deviations; median values and ranges numbers and percentages

BMI: Body Mass Index; MELD: Model for End-stage Liver Disease; NRS: Nutrition Risk Screening; RFH-NPT: Royal Free Hospital Nutrition Prioritizing Tools; SD: Standard Deviation

(8 patients) had hepatic encephalopathy, and 46.5% (37 patients) had ascites.

RFH-NPT showed that 73% (95% CI: 60%–95%) of patients were sensitive to malnutrition. The whole sample had a median BMI of 21.4 kg/m², ranging from 19.8 to 26.41 kg/m². Table 1 shows basic clinical markers in decompensated and non-decompensated cirrhosis patients. There

was no significant gender or age difference between decompensated cirrhosis groups and those without. BMI and blood total protein levels did not differ between compensated and decompensated cirrhosis groups. Decompensated cirrhosis significantly reduced the remaining clinical indices compared to the control group. In the 80 decompensated cirrhosis patients, 10%

Predictor of malnutrition risk using RFH-NPT

(8/80) had hepatic encephalopathy and 37% (46/80) had ascites. Decompensated cirrhosis patients had worse anthropometric measurements and laboratory indicators.

Association of malnutrition risk identified by RFH-NPT with poor clinical parameters

There was no significant difference in the distribution of genders between patients categorized as having a low risk of malnutrition and those classified as having a moderate to high risk, $p=0.08$. There were no significant differences in age distributions between the risk of malnutrition and the RFH-NPT tool, $p=0.06$. This study found that the patients classified as moderate to high risk of malnutrition group indicated by the RFH-NPT exhibited considerably lower levels of total serum protein and albumin.

In Table 2, the RFH-NPT technique found a greater probability of malnutrition in Child Pugh class C patients (46/50 or 92%, $p=0.002$). In the subset of MELD scores below 15, RFH-NPT identified intermediate and high-risk malnutrition patients (35/61 or 57.3%, $p=0.012$). There was no statistically significant difference in malnutrition risk identification among patients with MELD scores greater than 15 using RFH-NPT evaluation techniques. No ascites patients had a low risk of malnutrition according to the Royal Free Hospital-Nutritional Prioritising Tool. The RFH-NPT also detected probable malnutrition in 43 of 72 individuals (60%) without hepatic encephalopathy ($p=0.001$).

The implementation of an effective and straightforward nutrition risk screening method is of paramount significance. The implementation of such a tool will enhance the process of early nutrition assessment and timely intervention, ultimately leading to a reduction in mortality and morbidity rates among patients who have been diagnosed with cirrhosis (Borhofen *et al.* 2016).

Prior research conducted in Europe has indicated that the RFH-NPT exhibits more sensitivity compared to the standard screening tool used, NRS 2002 (Nutritional Risk Screening) when evaluating the likelihood of malnutrition and forecasting disease progression and outcomes in individuals diagnosed with chronic liver disease (Ney *et al.* 2017; Plauth *et al.* 2019). A study conducted in Europe revealed a higher incidence of malnutrition among individuals diagnosed with alcoholic cirrhosis compared to those diagnosed with viral cirrhosis (Georgiou *et al.* 2019). This could be due to alcohol intake in Europe is well recognized as the predominant factor contributing to the development of liver cirrhosis. The RFH-NPT specifically incorporates variables relating to alcohol consumption. Hence, it can be inferred that the utilization of the RFH-NPT leads to a higher estimation of malnutrition risk in cirrhosis patients compared to the application of standard nutrition screening techniques. On the other hand, a significant proportion of liver cirrhosis cases in Asia can be attributed to viral hepatitis, obviating the need for assessing alcohol usage. The RFH-NPT assessments revealed an overall

Table 2. Nutrition risk screening RFH-NPT with different child pugh classes and MELD score

Child pugh class	RFH-NPT		Total	p
	Low risk	Moderate to high risk		
A	19	1	20	1
B	7	3	10	0.055
C	4	46	50	0.002*
Total	30	50	80	
MELD score				
<15	26	35	61	0.012*
≥15	4	15	19	0.065
Total	30	50	80	

*Statistically significant $p<0.05$; A: Child-pugh class A (well-compensated disease) ⁵⁻⁶; B: Child-pugh class B (significant functional compromise) ⁷⁻⁹; C: Child-pugh class C (decompensated disease) ¹⁰⁻¹⁵

MELD: Model for End-stage Liver Disease; RFH-NPT: Royal Free Hospital Nutrition Prioritizing Tools

prevalence of malnutrition of 73% and 48% in patients diagnosed with cirrhosis, respectively. The findings of our study revealed a comparable prevalence of malnutrition, consistent with previous research, which demonstrated rates ranging from 55% to 70% as evaluated using the RFH-NPT and from 31% to 45% as evaluated using the NRS 2002 (Wu *et al.* 2020).

The occurrence of malnutrition is widespread across many types of liver illness, with rates ranging from 20% in individuals with compensated liver disease to over 80% in people experiencing decompensated liver disease (Sharma *et al.* 2017). The findings of this study indicate that the RFH-NPT method revealed a range of malnutrition prevalence rates, with 31.6% observed in patients with compensated cirrhosis and 68.4% observed in patients with decompensated cirrhosis. Similarly, the NRS 2002 method identified malnutrition prevalence rates of 22.4% and 64.2% in patients with compensated and decompensated cirrhosis, respectively. The substantial consensus regarding the occurrence of malnutrition in individuals with compensated cirrhosis provides strong evidence for the reliability of the RFH-NPT.

This study showed that the RFH-NPT method demonstrated a higher efficacy in detecting the danger of malnutrition (46 out of 50 cases, or 92%) among patients diagnosed with Child-Pugh class C condition, hence supporting the aforementioned hypothesis. It is recommended that patients diagnosed with Child-Pugh class B and C disease receive nutritional interventions promptly, even before any clinical indication of malnutrition becomes apparent. Conversely, patients with Child-Pugh class A disease should undergo thorough evaluations to facilitate the timely implementation of necessary support (Mendenhall *et al.* 1995). Hence, the utilization of the RFH-NPT by clinical personnel offers a convenient and expeditious means of identifying patients who may be susceptible to malnutrition, obviating the need to await the evaluation of the Child Pugh class prior to doing a comprehensive nutritional assessment.

The present study is subject to constraints due to its reliance on data obtained only from a single center. Initially, a limited number of participants were included in the assessment of the RFH-NPT's sensitivity and specificity. Consequently, further prospective investigations

are necessary. Nevertheless, the inclusion of anthropometric and biochemical data that indicate various facets of malnutrition has enhanced our capacity to distinguish between these instruments. Furthermore, specific data points were based on subjective evaluations conducted by patients and clinical staff, which introduces the possibility of recall and observer bias.

CONCLUSION

The objective of this study was to evaluate the efficacy of employing the RFH-NPT as a screening tool for identifying nutritional risk in individuals with cirrhosis, primarily caused by hepatitis virus infection, in the context of Malaysia. The RFH-NPT has demonstrated improved capacity in predicting the probability of malnutrition in persons diagnosed with cirrhosis, hence displaying a higher level of prognostic effectiveness. The RFH-NPT has demonstrated a reduced rate of misclassification for individuals in the first stages of cirrhosis who are susceptible to malnutrition. Therefore, the RFH-NPT can serve as a valuable instrument in rapidly identifying persons in need of nutritional therapy, thus reducing the occurrence of complications. Additional investigation is necessary to assess the prognostic effectiveness of the RFH-NPT in larger study populations.

ACKNOWLEDGEMENT

This project was not supported by any sponsor. Many thanks to the medical and nursing staff of the two wards for their cooperation in this project.

DECLARATION OF CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest.

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Dietetics Students' Perceived Facilitators and Barriers to Clinical Training in Malaysia: A Qualitative Theory-Guided Analysis

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ABSTRACT

This study explored barriers and facilitators experienced by Malaysian dietetics graduates during clinical training in local healthcare settings. A qualitative study with phenomenological design was conducted on fifteen purposely selected fresh dietetics graduates, with a mean age of 24.7±0.8 years from seven local universities. Virtual interviews were conducted via the Cisco Webex and were verbatim transcribed and thematically analyzed using NVivo 12 Plus software. Data collection continued until data saturation was reached. Nine Theoretical Domain Frameworks (TDF-derived domains), comprising of 1) knowledge; 2) skills; 3) belief about capabilities; 4) intention; 5) goals; 6) memory, attention, and decision process; 7) environmental context and resources; 8) social influences; and 9) emotions domains, was utilized to develop open-ended questions in the semi-structured questionnaire. Within these domains, frequently associated sub-themes of perceived facilitators were identified: early preparation and comprehension. Pre-clinical classes that involve solving diverse and challenging cases equip students with practical understanding of clinical training. Curriculum-based university clinics offer valuable insights into hospital dietetics practice. Resources availability is crucial for effective Nutrition Care Process (NCP) implementation and aids in evidence-based nutrition counseling. Conversely, the factor that hinders clinical training reported by dietetics graduates is a lack of knowledge and readiness, particularly concerning their perceived knowledge before clinical training. Dissatisfaction also arises from challenges in building rapport, gathering patient information during counseling, and difficulties in assessing dietary recall with patients from diverse cultural backgrounds, affecting their readiness for dietetics practice and therefore, highlighting the need to enhance multicultural knowledge and cultural competency training among dietetics students. The findings from this study may assist in developing strategies to promote impactful experiences and enhance dietetic students' preparedness for clinical practice.

Keywords: barriers, clinical training, dietetics students, facilitators

INTRODUCTION

Dietetics students must undertake clinical placement in hospitals by becoming interns at the end of the degree to enhance their confidence and readiness for professional practice (Ross *et al.* 2017). Clinical training is compulsory in Malaysia's Bachelor of Dietetics (Hons.) program. Dietetics students must undergo clinical attachments in outpatient and inpatient settings, food service, and community. The Clinical Instructors and Local Preceptors will supervise clinical training at various facilities, including Ministry of Health Malaysia Hospitals, Health Clinics, and University Teaching Hospitals.

A study expressed concern regarding producing underprepared graduates, specifically in clinical dietetics, with minimal skills irrelevant to future workforce needs (Morgan *et al.* 2019). According to Hewko *et al.* (2021), there is a need for expanded skills and practice in the dietetics field. Facilitators at the workplace, regular training sessions, allocated time to practice, management support, provision of the electronic health record, and peer support are enablers in implementing good nutrition care to patients during clinical training (Lövestam *et al.* 2020). Another study reported that peer teaching overcomes poor student learning and increases their confidence in clinical practice (Karupaiah *et al.* 2016).

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(Received 16-07-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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Despite its positive impacts in preparing dietetics students for future workforce needs, several studies reported that negative experiences and unwelcoming culture led to emotional stress and anxiety among students, exacerbating the impostor phenomenon of having persistent fear throughout the clinical placement (Gibson *et al.* 2015; Landry *et al.* 2022).

Various studies have been conducted among dietetics students on their experiences, mainly from Australia (Morgan *et al.* 2019; Markwell *et al.* 2021). According to a previous study by Markwell *et al.* (2021), students' intrinsic psychological needs and motivation can be enhanced by autonomy-supportive behaviors from peers and supervisors, which may be advantageous for students on placement. To our knowledge, a published study of Malaysian dietetics students' perceptions of post-clinical placement has yet to be published. Thus, understanding Malaysian dietetics students' perceptions and experiences during clinical training is crucial in identifying potential areas for improvement. This is the first study to identify the facilitators and barriers during clinical training among dietetics students in Malaysia, as strongly recommended by a previous study that dietetics education programs should take graduates' opinions of their training into account and adjusted as necessary (Morgan *et al.* 2019). The findings from this study may assist in developing strategies to promote positive experiences and enhance dietetics students' preparedness for the dietetics practice among Malaysian dietetics students.

METHODS

Design, location, and time

This qualitative study with phenomenological design focused on acquiring participants' perceptions through open-ended and conversational communication. The open-ended questions were regarding the perceived barriers and facilitators encountered during clinical training among fresh graduate dietetics students. This study was conducted online through the Cisco WebEx platform, involving participants across different universities with dietetics programs in West Malaysia from March until July 2023. Ethical approval was granted from the UniSZA Human Research and Ethics Committee (UHREC) on March 9, 2023, UHREC Code: UniSZA/UHREC/2022/472.

Sampling

Purposive sampling was used to select fresh graduate dietetics students who had completed clinical training in 2021 and 2022 to answer the open-ended questionnaires during the online interviews. To ensure a diverse range of perspectives and to enrich the richness of the information gathered, participants were recruited from multiple universities in Malaysia, including 1) Universiti Sultan Zainal Abidin (UniSZA); 2) Universiti Teknologi Mara (UiTM); 3) Universiti Putra Malaysia (UPM); 4) Universiti Kebangsaan Malaysia (UKM); 5) Universiti Sains Malaysia (USM); 6) Universiti Islam Antarabangsa Malaysia (UIAM); and 7) International Medical University (IMU).

Data collection

In-depth interviews were conducted virtually through Cisco Webex platform to capture the diversity of individual experiences and viewpoints while accommodating the availability of participants. The in-depth interview duration varies (Showkat & Parveen 2017), ranging from 60–120 minutes. In-depth interviews for study participants were carried out from March 22 until May 12, 2023, depending on the study participants' time availability.

Semi-structured questionnaire. Semi-structured interviews were conducted in Malay to explore participants' experiences, barriers, and facilitators related to clinical training. The interviews employed pre-determined topics and questions, with additional probing questions added during the interviews as necessary to explore the in-depth perceptions (DeJonckheere & Vaughn 2019). After confirming their eligibility, the interview questions were disseminated to the study participants, allowing them time to reflect on the topics before the interviews. Contents for the semi-structured interview questionnaire were developed based on TDF. The TDF-derived semi-structured questionnaires were developed and were not structured exclusively based on the domains. Instead of clustering questions into each domain that may limit experience exploration, open-ended questions related to the research objective were made to obtain a more comprehensive understanding of dietetics graduates' perspectives on barriers and facilitators during clinical training. A deductive analysis was used as it reported that most previous studies used

TDF-deductive approaches (McGowan 2020). The deductive analysis provides more detailed descriptions of participants' experiences (Haith-Cooper *et al.* 2018).

Recruitment of study participants. Study participants were recruited through disseminated posters once data collection started. Through the recruitment posters, inclusion and exclusion criteria were informed. The inclusion criteria for this study were dietetics graduates who graduated in 2021 and 2022 and completed outpatient and inpatient dietetics training in allocated healthcare facilities. This study excluded participants who could not converse in Malay or English. Study participants were directed to a Google form to complete their consent forms. Any upcoming and essential information for the interview schedule was notified later.

Data analysis

Descriptive statistics on sociodemographic data, including age, graduation year, universities, and frequency of pursuing the current job, were analyzed using IBM SPSS Statistics Version 27—two members, including the interviewer, coded transcripts. Two researchers read transcripts independently, coded the data, and then combined codes into sub-themes and participant quotes. Data collection and analysis were conducted concurrently until thematic saturation was achieved. Thematic saturation is calculated using a base size of 4 interviews and a run length of 2 interviews (Guest *et al.* 2020). Thematic saturation was achieved as the new information threshold reached 0%. All transcribed interviews verbatim were compared to original video recordings to ensure accuracy. Transcripts were thematically analyzed deductively. Two researchers independently read and manually coded the data using NVivo 12 Plus software. The credibility of the arising sub-themes was demonstrated using verbatim participants' quotes. The trustworthiness of the findings was ensured through a rigorous member-checking process with the subjects.

RESULTS AND DISCUSSION

Fifteen dietetics graduates, consisting of 14 females and one male, with a mean age of 24.7±0.8 years, participated in this study. Participants were recruited from Universiti

Sultan Zainal Abidin (UniSZA) (n=6, 40.0%), Universiti Teknologi MARA (UiTM) (n=3, 20.0%), Universiti Putra Malaysia (UPM) (n=1, 6.7%), Universiti Kebangsaan Malaysia (UKM) (n=2, 13.2%), International Medical University (IMU) (n=1, 6.7%), Universiti Islam Antarabangsa Malaysia (UIAM) (n=1, 6.7%), and Universiti Sains Malaysia (USM) (n=1, 6.7%). A total of fifteen consents were received from each of the universities. The number of participants who participated in this study varied from each university. All participants were eligible for this study and proceeded to interviews.

Participants enrolled in this study mainly graduated in 2022 (n=13, 86.7%), and only two (13.3%) graduated in 2021. The participants were predominantly practicing dietitians specializing in various dietetics fields. Among them, five participants (33.3%) were clinical dietitians, four (26.7%) worked as retail dietitians in pharmacies, two (13.3%) were food service dietitians, one (6.7%) was a community dietitian, and one (6.7%) worked as a corporate dietitian. Additionally, one participant (6.7%) worked in public relations in science, and another (6.7%) pursued a Master of Science degree in Nutrition.

Perceived facilitators reported by dietetics graduates throughout the interviews are categorized into seven Theoretical Domain Frameworks (TDF): knowledge, skills, intentions, environmental contexts and resources, social influences, emotions, memory, attention, and decision process, followed by domain belief about capabilities and goals. The overview of the sub-themes for perceived facilitators is shown in Figure 1.

Perceived facilitators

The most frequent perceived facilitator reported by dietetics graduates is early preparation and understanding. Dietetics graduates reported having pre-clinical classes in solving common and complex cases aids them in having an idea of what clinical training would be. According to P09_Female, *"Before we go for clinical attachment, my university organized one short class and provided us with many cases. We have different cases to be solved every week. The cases varied and had different difficulties such as ICU or burn patient case..."* A previous study reported that pre-clinical training effectively prepares dietetics students for clinical placement as they

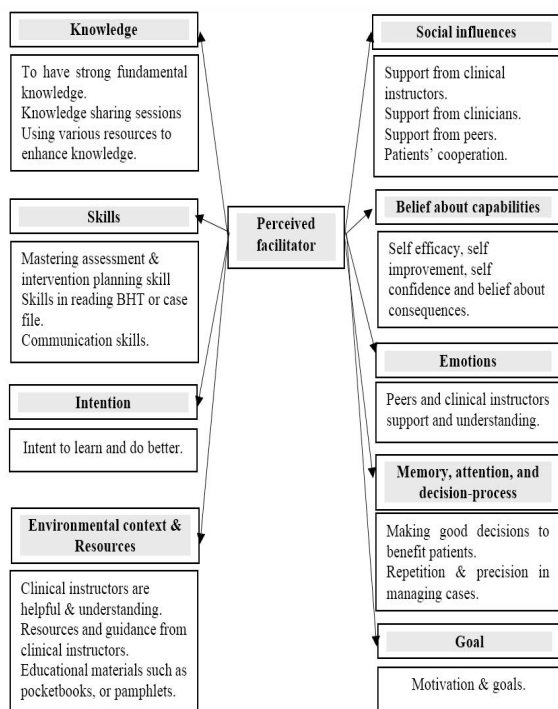


Figure 1. Overview of the sub-themes for perceived facilitators

can apply theoretical concepts to clinical training (Kellet *et al.* 2018). In addition, curriculum-based university clinics also enabled third-year dietetics students to gain early insight into hospital dietetics practice (Swanepoel *et al.* 2016). A previous study also reported that dietetics students valued 'real' learning experiences as they developed awareness of dietitians' roles and appreciated the profession's reality (Morgan *et al.* 2019).

Early preparation regarding resources used during clinical training aids them in nutrition counseling. This coincides with another facilitator in which preparation and availability of educational resources such as handbooks, pocketbooks, or pamphlets help them give nutritional care according to evidence-based practices. A previous study reported that evidence-based dietetics practice combined utilizing evidence-based guidelines, the dietitian's expertise and judgment, and patients' unique circumstances (Hand *et al.* 2021). Resource scarcity hinders successful Nutrition Care Process (NCP) implementations and affects patient nutrition care (Porter *et al.* 2015). As said by P07 Female, "Plates and cups must be brought together. My bag is heavy because I

prepare and bring along books and files. One of the files consists of MNT books. At the same time, another file contains pamphlets for counseling, such as diabetes pamphlets. It is used as our reference during the counseling." Sub-themes and supporting quotes are summarized in Table 1.

Perceived barriers reported by dietetics graduates throughout the interviews are categorized into seven Theoretical Domain Frameworks (TDF): knowledge, skills, belief about capabilities, social influences, emotions, environmental contexts, resources, memory, attention, and decision process. The overview of the sub-themes for perceived barriers is shown in Figure 2.

Lack of knowledge and readiness is the most frequent barrier identified in the interviews, representing dietetics students' perceived knowledge before clinical training. This study found that dietetics graduates complained of needing to be more prepared and satisfied with their knowledge before clinical training as knowledge gaps hindered dietetics students' progress in clinical placements (Gibson *et al.* 2015). Since the participants graduated from the dietetics batch in 2021 and 2022, they have been severely affected by the COVID-19 pandemic. This pandemic has negatively impacted dietetics students' education quality and made them learn less than usual (Coakley & Gonzales-Pacheco 2022). Unpreparedness before clinical training reported by dietetics graduates during their clinical training includes a lack of multicultural counseling skills for patients with various cultural backgrounds and an inability to build rapport and extract patient information during counseling in an outpatient setting.

Dietetics graduates reported having intense counseling experiences with patients from different cultural backgrounds. They encountered difficulty assessing dietary recall due to limited knowledge of the ingredients. "I got Chinese, Indian patients. So, regarding their foods, it was difficult to assess because we did not know how to estimate the calories correctly as we were unfamiliar with the food eaten. And we didn't know the ingredients used. Hence, taking their diet recall is somehow challenging." (P06_Female). A previous study on Canadian dietetics students reported that students show low multicultural knowledge that hinders their cultural competence (Hack *et al.* 2015). This

Perceived barriers and facilitators to clinical training

Table 1. Arising sub-themes of perceived facilitators and supporting quotes

Domains	Sub-themes of perceived facilitators	Supporting quotes
Knowledge	To have strong fundamental knowledge	“But basic knowledge must be strong. With strong basic knowledge, CIs will easily understand when you talk, and discussing with friends becomes easy.” (P03_Female)
	Knowledge-sharing sessions	“So, we all decided to sit together with six friends. We all will be sharing information. For example, when another group performed measurements. So, when they returned home, they taught us how to do the measurement. And then, we also share our cases with them.” (P10_Female)
	Using various resources to enhance knowledge	“So, we had a one-week rotation, one week for clinical, and another alternate week for simulations. I think CIs helped a lot. Sometimes, the simulations were conducted one-to-one, but sometimes in groups. So, that means we treat the simulations like real-case situations. We pretend to be a patient and dietitian whereby CIs will observe.” (P05_Female)
Skills	Mastering assessment and intervention planning skills	“Initially, we acknowledged our intervention was inadequate even though we got plenty of times but did not know what to do. However, as time passes, we know how to shorten the counseling sessions. We know how to save time.” (P02_Female)
	Skills development in reading bed head tickets (BHT) or case file	“When we flipped through the BHT, we knew what to search for. For diabetic patients, we looked for glucose monitoring. Sometimes, nurses did not update the glucose reading in the system. So, the data can only be obtained in BHT as the nurse reported it manually.” (P05_Female)
	Communication skills	“You cannot use jargon terms learned during classes. Patients will not be able to understand well, so you must adapt to that. And then, you have to know the correct counseling flow because we only learn basic counseling skills in classes. So, we must know the appropriate techniques for the counseling sessions.” (P10_Female)
	Early preparation and understanding	“Plates and cups must be brought together. My bag is heavy because I prepare and bring along books and files. One of the files consists of MNT books. At the same time, another file contains pamphlets for counseling, such as diabetes pamphlets. It is used as our reference during the counseling.” (P07_Female)
Belief about capabilities	Self-efficacy	“We must think critically during clinical training because we need to be able to connect different theories to achieve better outcomes. We need to be able to think critically.” (P09_Female)
	Self-confidence	“I think I’m good at coping with stress. Even though I felt nervous meeting patients and did not know what to do, and I expressed my confidence so that the patients would trust me.” (P12_Female)
	Self-improvement	“Every challenge I faced is what shaped me now. I became confident that I could face challenges and speak English fluently. I have work now, and I communicate in English with my client from Singapore fluently.” (P04_Female)
	Belief about consequences	“It’s great because I was exposed to making decisions during the clinical training. Thus when I work alone, I can execute decisions myself if correct” (P04_Female)

Continue from Table 1

Domains	Sub-themes of perceived facilitators	Supporting quotes
Intention	Intent to learn and do better	“There is a lot to learn in terms of simplifying sentences, in terms of knowledge on how to make sure patients understand what we try to say. And we will not stutter.” (P13_Female)
Goals	Motivation and doing better	“As a student, we need to move forward. We should have the initiative to learn. That means it will be hard to catch up if we act passive during clinical training.” (P15_Female)
Emotions	Peers and clinical instructors support and understanding	“I and my colleagues separated into different clinical groups. So sometimes, we gather at night and finish our thesis together. Hence, at the same time, we stay up and have a heart-to-heart session together.” (P15_Female)
Environmental Context and Resources	Clinical instructors are helpful and understanding	“The knowledgeable and experienced CIs showed a lot of things. Besides sharing knowledge, they also provide support and guidance. So, I think helpful CIs are important in clinical training.” (P12_Female)
	Resources and guidance from clinical instructors	“CIs provide us with notes to read before entering clinical training. For example, biochemical data and oral nutrition supplements should be memorized.” (P09_Female)
	Educational materials such as handbooks, pocketbooks, or pamphlets	“References such as Kidney Disease Outcomes Quality Initiative (KDOQI) and Kidney Disease: Improving Global Outcomes (KDIGO). One more thing: you must read more from Clinical Practice Guidelines (CPG) because there are a lot of versions for diseases. Next, you need to refer a lot to seniors.” (P10_Female)
Social influences	Support from clinical instructors	“Our CIs are so motherly, very supportive, and acknowledged that we were from Covid batch. They understand that we lacked a lot in terms of counseling skills and knowledge.” (P14_Female)
	Support from clinicians	“Dietitians in the hospitals taught us wholeheartedly. We felt relieved as dietitians showed their sincerity to teach us even though we were nervous in the first place.” (P07_Female)
	Support from peers	“Clinical training is tiring, but it's fun if you have supportive group mates that help you by encouraging you” (P10_Female)
	Cooperation from patients	“For the first time, I was so happy to consult an elderly person that was cooperative and very kind during the counseling. Maybe she knew that I was a student at that time.” (P04_Female)
Memory, attention, and decision-process	Making good decisions to benefit patients	“The general knowledge you have, you should be able to apply to patients' conditions. Besides, you need to know what to prioritize. The main problem should be prioritized and followed by other problems.” (P07_Female)
	Repetition and precision in managing cases	“I took almost an hour in the early training phase because I did not know what to do, but I got help from CIs since that was my first time. Day by day, I have shown improvement as I have become familiar, and I can make decisions quickly. I did not need a long time to think of what to do.” (P05_Female)

showed that dietetics students were unprepared even though dietitians have been proven to be culturally competent to enhance nutrition care across all populations (Jager *et al.* 2020). A previous study also emphasized dietetics students should be involved and participate in cultural

competency training to tackle a growing diverse community (McCabe *et al.* 2020).

They also expressed dissatisfaction with building rapport and extracting patient information during counseling due to the lack of preparedness before the clinical placement. P07_

Perceived barriers and facilitators to clinical training

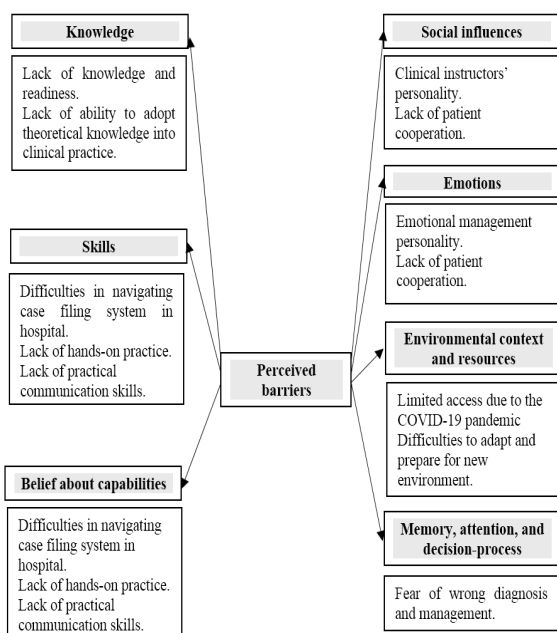


Figure 2. Overview of the sub-themes for perceived barriers

Female said, "So, uh, the experiences, it's like we were ready, everything is already prepared in my mind, but the outcomes make us feel like it was not enough, there was a feeling of something

important that was left out that made us feel incomplete. We were dissatisfied as the process was not completed." Dietetics graduates also frequently mentioned that the active participation of actual patients may enhance the preparation for clinical training regarding communication skills due to reproductive actions on repetition of performing counseling patients. A previous study also supported that Patient Centered Care (PCC) established communications between the professional and the patients (Olsson *et al.* 2013). This training has been proven relevant in improving the self-efficacy of healthcare professionals in terms of their communication skills through the participant-centred care process (Mata *et al.* 2021). In addition, a previous study also highlighted the importance of communication skills influencing perfect patient satisfaction scores in nutrition counseling (Knight *et al.* 2020). Lack of preparation in knowledge and skills in the early stages of clinical training impedes their ability to communicate effectively with patients, thus influencing their readiness for dietetics practice (Teng & Najlan 2019). Sub-themes and supporting quotes are summarized in Table 2.

Table 2. Arising sub-themes of perceived barriers and supporting quotes

Domains	Sub-themes of perceived facilitators	Supporting quotes
Knowledge	Lack of knowledge and readiness	"So, uh, the experiences, it's like we were ready, everything is prepared in mind, but what came out makes us feel like it was not enough, there was a feeling of something important that was left out made us feel incomplete. We were dissatisfied as the process was not completed." (P07_Female)
	Lack of ability to adopt theoretical knowledge into clinical practice	"We immediately went for clinical, especially since we had to learn the theories online during the pandemic. So, all the case studies and discussions were conducted online. Thus, we were lost in the early clinical training days because we did not know how to apply." (P14_Female)
Skills	Difficulties in navigating the case filing system in the hospital	"We didn't know what BHT is, bed head tickets, and what dietitians' care notes (DCN). We only know about MNT and NCP processes. I mean the system they are using in the hospital. It's different from my mindset, so the university also didn't teach us about the complete details of the system used in the hospital." (P11_Male)
	Lack of hands-on practice	"We couldn't attend wards, so we did it virtually with clinical instructors. It was like a role-play simulation with the clinical instructors. The experiences were okay, but we had to do it ourselves during clinical training, so it was different because we did not have real experiences." (P02_Female)
	Lack of practical communication skills	"When you meet patients, they will be like 'what is diet recall?', then you must educate them in layman's terms. That is the biggest problem." (P10_Female)

Continue from Table 2

Domains	Sub-themes of perceived facilitators	Supporting quotes
Belief about capabilities	Students perceived self-incompetency	"I am not satisfied with myself. In terms of preparation during phase 1, it was inorganized. If I had to rate myself out of ten, it would be four out of ten because I'm unprepared." (P03_Female)
	Guilty of not performing up to the expected standard	"We worried that everything we said was wrong, and what is more concerning us if patients did not understand what we were trying to say." (P01_Female)
Emotions	Emotional management	"Honestly, it was tiring mentally and physically because you had to attend clinical from eight to five in the evening. Whether you went to health clinics, hospitals, or just simulation, you still had to clerk cases. You couldn't even do other things or even relax. If you didn't attend clinical in the hospital, you still get cases from clinical instructors." (P05_Female)
	Mental and physical exhaustion	"We were indeed tired, like mentally exhausted. We had to complete all AD-IME and all the reports because you had to submit them by Monday. It means you had to submit it all on Sunday." (P10_Female)
Environmental context and resources	Limited access due to the COVID-19 pandemic	"I think the experiences were unfair due to the pandemic. So, the exposure of the clinical experiences we got was lesser than other cohorts." (P11_Male)
	Difficulties in adapting and preparing for new environments	"It was stressful to adapt to the hospital environment, but over time, it got better by days." (P08_Female)
Social influences	Clinical instructors' personality	"To be honest, I once cried in front of the CI. I cried because I got mad at myself every day. There was one time; I cried because I couldn't hold it back." (P04_Female)
	Lack of patient cooperation	"It was difficult to counsel patients as they only listened to themselves. They did not listen to our advice. Sometimes, patients had to meet us several times, even for simple advice like eating." (P09_Female)
Memory, attention, and decision-process	Fear of wrong diagnosis and management	"I became nervous every time I was given cases. It is because of being fearful. I was afraid I misdiagnosed the patients, gave inaccurate intervention, or misunderstood the case, especially during inpatient training." (P05_Female)

CONCLUSION

In conclusion, this qualitative study provides a detailed exploration of dietetics graduates' perspectives on perceived barriers and facilitators throughout their clinical training journey in local healthcare settings in Malaysia. The most recurring perceived barrier among dietetics graduates is a need for more knowledge and readiness for clinical training. Lacking knowledge and being unprepared for clinical training contributed to low self-esteem and confidence in providing nutritional care for patients. However, the most frequently perceived facilitator reported by the dietetics graduate is early preparation and understanding in nutrition counseling. These findings may help develop a more practical and effective

dietetics curriculum to enhance dietetics students' competency throughout their bachelor's degree and preparedness for the dietetics workforce in the future.

A wide range of perspectives was identified that enabled a more profound exploration of dietetics graduates' perceived facilitators and barriers during clinical training in Malaysia with a minimum of one hour through in-depth interviews and semi-structured questionnaires. Data from this study has reached data saturation; hence, these findings may help develop a more practical and effective dietetics curriculum for educators to enhance dietetics students' early preparation for clinical training. However, there are several limitations in conducting this study. Due to the lengthy data collection method interview, the recruitment of participants took

longer than planned, dragging data analysis and thematic analysis. Besides that, the researcher has lower literacy regarding thematic analysis. Hence, qualitative experts were referred. In addition, there were some disruptions in the internet connection during the interview. Still, to ensure all details and questions were asked, the researcher repeated the questions and asked participants to re-answer the questions.

The recommendation for future research is to conduct an in-depth exploration using a qualitative approach among Clinical Instructors (CIs) to study their perceptions and experiences in supervising dietetics students in identifying potential clinical training areas or students that need improvement.

ACKNOWLEDGEMENT

We want to extend my deepest gratitude and acknowledge all the participants who generously dedicated their time and insights by sharing their experiences throughout clinical training. Their contributions have added depth and meaning and fulfill the objective of this study. This research was supported by Universiti Sultan Zainal Abidin under the Scholarship of Teaching and Learning (SoTL) UniSZA 2022 (UniSZA/SoTL/2022/01).

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Nutritional Status and Factors Affecting Food Intake among Hospitalized Patients in Hospital Ampang

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ABSTRACT

The study aims to measure the current nutritional status and factors contributing to food consumption during hospitalization at Hospital Ampang. This is a cross-sectional study of 206 patients consisting of 104 males and 102 females respectively between 18 to 70 years of age. Data obtained from Factors Influencing Dietary Intake of Hospitalized Patients Questionnaire and Nutritional Risk Screening (NRS 2002). We used standardized methods to measure weight, height. Body weight categories were defined based on Body Mass Index (BMI). The BMI of participants was $26.08 \pm 4.56 \text{ kgm}^{-2}$ and 52.0% (107) of participants had low risk of malnutrition and at risk of malnutrition. 85.4% admitted that the food tasted different. To conclude, patients' low consumption of food during hospitalization should be enhanced. Thus, it is essential to implement effective strategies and interventions to increase dietary intake among hospitalized patients to fulfill their nutritional requirements and encourage quick recovery.

Keywords: food intake, hospitalized patients, malnutrition, nutritional status

INTRODUCTION

Hospital food service is of the utmost importance in food provision to more than 75% of hospital patients (Andersson *et al.* 2013). Food consumption during hospitalization is determined by the quality of food and beverages which might have an impact on patients' recovery (Norshariza *et al.* 2019; Osman *et al.* 2022). Additionally, it is the responsibility of a hospital's food and nutrition service to provide adequate diets to patients and the meal provided must supply sufficient nutrients that can maintain or restore nutritional status during acute or chronic disease state (Gomes *et al.* 2020). However, barriers experienced by patients due to current illness can affect their food intake during hospitalization such as difficulty in swallowing and chewing and psychosocial factors include food beliefs and stress (Norshariza *et al.* 2019). Other factors also suggested by Kontogianni *et al.* (2020) can be

classified into modifiable (food smell and taste) and less modifiable factors (decreased appetite). Food consumption of less than or equal to 50% is considered as low and it was found that 31% of patients consume low food intake during hospitalization (Allard *et al.* 2015).

The occurrence of reduced food intake over time can lead to inadequate energy, protein, and essential nutrients that could eventually lead to malnutrition (Bellanti *et al.* 2022). The World Health Organization (WHO) defined malnutrition as insufficient dietary intake to meet the nutrient requirement set by the health organization which can be classified into undernutrition and overnutrition (WHO 2019). Disease-Related Malnutrition (DRM) has significantly increased globally among hospitalized patients by 20 to 50% (Correia *et al.* 2017; Hiesmayr *et al.* 2019). Malnutrition was also prevalent in Malaysia with 35.4% of geriatric patients diagnosed with malnutrition aligning with the global

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(Received 10-08-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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prevalence (Sahran *et al.* 2016). An increment of malnutrition prevalence has been recorded among geriatric patients at 61.7% using Subjective Global Assessment (SGA) as the nutritional assessment tool (Abd Aziz *et al.* 2018). Negative consequences associated with malnutrition include high mortality rates, increased hospital stays, and lower discharge rates (Osman *et al.* 2022). The nutritional status of patients is assessed using Nutritional Risk Screening (NRS 2002) by recommendations made by European Society for Clinical Nutrition and Metabolism (ESPEN) for hospitalized patients (Kondrup *et al.* 2003). Malnutrition is more prevalent in elderly patients, however, there still needs to be more data on adult patients which will be the aim of this study and identifying factors affecting patients' food intake during hospitalization.

METHODS

Design, location, and time

The present study performed a cross-sectional research design among patients admitted to the adult medical wards. This study was conducted in Hospital Ampang, located in Selangor, Malaysia, covering a time frame from December 2022 to July 2023.

The ethics and data collection approval was obtained from the Ministry of Health, Malaysia (NMRR-22-01126-SKH (IIR)) on 10 February 2023.

Sampling

A method of random selection used to determine eligible respondents from the hospital admission list, and 104 males and 102 females participated in the study after receiving prior consent from the patients themselves.

Participants were provided with a structured online questionnaire to determine the factors that influence the dietary intake of hospitalized patients. The questionnaire consisted of three sections: socio-demographic questions, nutrition-related questions, and inquiries regarding the factors that impact patients' food consumption. In addition, the questionnaire includes inquiries about the quality of hospital meals that involve appearance, smell perception, taste experience, tactile sensation, serving size, hygiene standards, temperature, and availability. Regarding anthropometry measurement, weight

and height were measured using standardized methods, and body weight categories were defined based on Body Mass Index (BMI). The BMI of the participants calculated using a formula weight in kilograms divided by height in meters squared kgm^{-2} . A one-day 24-hour diet recall performed to estimate the total energy intake and macronutrients consumed by the patients. Then, NRS-2002 was used to identify patients' risk of malnutrition by considering some dynamic parameters including recent weight loss, current BMI, recent food intake, and disease severity (Reber *et al.* 2019).

Data collection

Following receiving a daily hospital admission list, patients were chosen for inclusion in the study by a random selection process that adhered to the predetermined criteria for inclusion and exclusion. To be eligible for participation in the study, patients were required to have been admitted to the hospital for at least one night and should not have been admitted to a pediatric, psychiatric, acute care, or post-natal unit (Tah *et al.* 2020). In addition, individuals who were in a critical condition, characterized by an inability to take food orally, reliance on mechanical ventilation for breathing, adherence to a prescribed diet, receiving nutrition by parenteral or enteral means, or undergoing fasting in anticipation of a surgical procedure or diagnostic test, will be immediately dismissed. Before initiating the research, individuals will be approached within the selected ward and provided with an explanation regarding the study's objectives. After getting consent from the participant, researchers will measure their anthropometry measurement, perform a 24-hour diet recall and distribute an online questionnaire regarding Factors Affecting Food Intake among Hospitalized Patients. Apart from that, from the one day 24-hour diet recall, the total calorie intake and macronutrient composition were analyzed using the Nutritionist Pro Software. Regarding the differences in energy requirements among individuals, the energy requirements of the participants were estimated using the Schofield equations from 1985 (ref). The determination of Basal Metabolic Rate (BMR) takes into account factors such as gender, age, weight, and height, which then multiplied by the individual's Physical Activity Levels (PAL). In addition, the

Recommended Nutrient Consumption (RNI) 2017 was used as a reference point in determining the required daily energy consumption, protein, and fiber requirements for all study participants.

Data analysis

Descriptive analysis including means, percentages, and frequencies was applied to organize, describe, and summarize the data regarding socio-demographic factors, anthropometric measurements, and factors influencing food intake. Furthermore, a Pearson correlation analysis was performed on a sample of individuals admitted to the hospital to ascertain whether any relationships exist between the NRS score and the patients' energy intake, BMI, and Length of Stay (LOS).

RESULTS AND DISCUSSION

Socio-demographic

By referring to inclusion and exclusion criteria, two hundred and six participants were recruited among Malay ethnicity and from medical wards. 104 (50.5%) of the participants were male with an average age of 42.13±13.91 and females were 39.51±13.89 years old. The average length of stay was 2.83±1.96 days with 49% being diagnosed with type 2 diabetes.

Nutritional status

Malnutrition is assessed based on patients' current nutritional status, malnutrition risk score, and dietary intake. The mean BMI of male patients is higher compared to female patients. However, there is no statistically significant mean difference between BMI ($p=0.24$). Based on Table 1, the highest BMI category recorded was overweight, 44.2% and 30.1% of patients were obese. Recorded data had shown a higher prevalence of overweight and obese (74.2%) compared to research conducted by National Health and Morbidity Survey (NHMS) in 2019 where 50.1% of the Malaysian population were obese and overweight. Previous studies conducted in Selangor have recorded a higher prevalence of obesity among the female population which contradicts with our findings, where 34% of male patients were obese while only 28% of female patients were obese (Mohd-Sidik *et al.* 2021).

The overall dietary intake of patients is exceeding 75% of the nutrient requirement which is a good sign of adequate nutrients during hospitalization. However, male and female patients are low in fiber intake with a mean of 7.01±8.63 g and 5.58±3.64 g from a total of 20 g per day (Table 2). Apart from that, the mean difference of fiber intake between female and male patients is not statistically significant

Table 1. Anthropometric and NRS-2002 score data of the hospitalized patient

Variables	Male (n=104) (Mean±SD)	Female (n=102) (Mean±SD)	Total (n=206) (Mean±SD)	<i>p</i>	%
Height (m)	1.68±0.05	1.58±0.07	1.63±0.08		
Weight (kg)	75.11±13.09	63.99±12.71	69.60±14.03		
BMI (kgm ⁻²)	26.45±4.49	25.70±4.62	26.08±4.56	0.24 ^a	
BMI category					
Underweight (<18.5 kgm ⁻²)	1	1	2		0
Normal (18.5–22.9 kgm ⁻²)	19	32	51		24.8
Overweight (23.0–27.4 kgm ⁻²)	50	41	91		44.2
Obese Class I (27.5–32.4 kgm ⁻²)	27	17	44		21.4
Obese Class II (32.5–37.4 kgm ⁻²)	5	9	14		6.8
Obese Class III (≥37.5 kgm ⁻²)	2	2	4		1.9
Malnutrition risk, NRS-2002 score					
No risk (0)	44	55	99		48.1
Low risk (1–2)	58	47	105		51.0
At risk (3–4)	2	0	2		1.0

^aIndependent t-test, the significant difference at $p<0.05$: BMI: Body Mass Index; NRS: Nutritional Risk Screening

Table 2. Dietary intake of the patient during hospitalization

Variables	Male Mean± SD	Female Mean±SD	<i>p</i>	Male (n)	Female (n)	%
Energy	1,441.25±381.93	1,151.41±169.39				
25%				1	0	0.5
50%				9	1	4.9
75%				44	64	52.4
100%				50	37	42.2
Protein	54.68±23.13	41.07±11.87				
25%				2	0	1.0
50%				7	8	7.3
75%				23	39	30.1
100%				72	55	61.7
Fibre	7.01±8.63	5.58±3.64	0.125 ^a			
25%				33	54	42.2
50%				62	37	48.1
75%				8	9	8.3
100%				1	2	1.5
Carbohydrate	202.37±166.43	173.0±31.5				
Fat	52.83±21.51	33.04±11.39				

^aIndependent t-test, the significant difference at $p < 0.05$

($p = 0.125$; 95% CI: -0.40, 3.25). Different findings were discovered by Fernstrand *et al.* in 2017 as there is a statistically significant difference of mean fiber intake between female and male indicating 12.5 g and 10.9 g, respectively. This study showed that male patients tend to consume more fiber from cereal and grain whereas female patients consume higher fiber sources from fruit.

Malnutrition is considered by the World Health Organization (WHO) as the significant threat to public health worldwide, affecting 20 to 60% of hospitalized patients. Malnutrition risk screening among patients in Hospital Ampang revealed that almost half of the patients were not experiencing malnourishment however 52% were low and at risk of malnutrition, which align with WHO findings. A statistically significant association exists between malnutrition risk score and weight status ($p < 0.05$). This contradicts Zhang *et al.*'s findings in 2022 among Covid-19 patients, as the malnutrition risk category was among patients with lower BMI.

Malnutrition risk score had shown an association with energy intake and Length of Stay LOS (Table 3). There is a statistically significant, inverse, and fair association between

malnutrition risk score and the energy intake of patients. Patients at risk tend to have decreased food intake due to numerous reasons including decreased appetite, nausea or vomiting, feeling tired and not feeling hungry (Kontogianni *et al.* 2020). Yalçın *et al.* (2018) discovered the same findings, where energy intake and nutrient consumption were lower among patients who were at risk of malnutrition compared to well-nourished patients. Next, the malnutrition risk score has poor correlation with length of stay. Few previous studies have found that more extended hospital stays are significant among patients diagnosed with malnutrition with a mean

Table 3. Association between malnutrition risk score with weight status, energy intake, and length of stay

Variables	BMI	Energy intake	LOS
NRS score	0.259 ^a	-0.425 ^a	0.178 ^a
	(<0.001) ^b	(<0.001) ^b	(0.017) ^b

BMI Body Mass Index; LOS: Length of Stay

NRS: Nutritional Risk Screening

Factors affecting food intake among hospitalized patients

of 12.6 days (Corkins *et al.* 2014). Furthermore, malnourished general patients had longer LOS, and prolonged treatment duration with a higher risk of morbidity. Besides, malnutrition has been an independent factor for longer LOS (Yalçın *et al.* 2018).

Factors affecting food intake among hospitalized patients

Five categories of factors affecting adequate food intake including organizational issues, quality and satisfaction with food, effects of illness on food intake, choice, and eating difficulties.

The finding shows that satisfaction with food was the common reason influencing patients' dietary intake during admission (Table 4). 85.4% agreed that the taste of the food provided by the hospital tasted differently and 41.7% did not like the taste of the food respectively. Meanwhile, 82% complained that food could have been more appealing. A therapeutic diet to suit patients'

health conditions might have some modifications in terms of taste, texture and appearance which potentially increases the probability of inadequate energy intake among patients (Williams & Walton 2011). Along the same lines as the recent findings, Kontogianni *et al.* 2020 noted in their study that 13.6% of patients dislike the food taste which may be altered by individual factors such as underlying health issues, medicine, or even age itself.

Regarding the aspect of the organization, 2.4% of respondents expressed dissatisfaction with their inability to select their preferred food options. Furthermore, 6.3% of participants felt that the hospital environment was not appealing and it was noted that a majority of 99.5% disagreed with the statement that they had missed meals as a result of hospital procedures. In contrast, a study conducted by Kontogianni *et al.* (2020) found that around 7% of patients who missed a portion of their meals reported doing so due to needing a medical checkup or surgical procedure. Generally,

Table 4. Factors affecting food intake among hospitalized patients

Factors	Frequency (n)		
	Agree	Disagree	Not applicable
Organizational			
Missed meals (hospital procedure)	0 (0.0)	205 (99.5)	1 (0.5)
Eating environment was not appealing	13 (6.3)	192 (93.2)	1 (0.5)
Not able to choose food	5 (2.4)	200 (97.10)	1 (0.5)
Satisfaction with food			
Food taste different	176 (85.4)	29 (14.1)	1 (0.5)
I do not like the taste of the food	86 (41.7)	119 (57.8)	1 (0.5)
Food is not appealing to me	169 (82.0)	36 (17.5)	1 (0.5)
Effect of illness on food intake			
Do not have usual appetite	143 (69.4)	62 (30.1)	1 (0.5)
I normally eat less than what was served	49 (23.8)	155 (75.2)	2 (1.0)
I feel nausea and vomiting	12 (5.8)	193 (93.7)	1 (0.5)
Choices			
I do not like the food offered	164 (79.6)	42 (20.4)	
Not hungry at that time	6 (2.9)	199 (96.6)	1 (0.5)
I do not enjoy eating alone	0 (0.0)	206 (100.0)	
Eating difficulties			
I feel pain	3 (1.5)	202 (98.1)	1 (0.5)
Chewing/swallow problem	7 (3.4)	198 (96.1)	1 (0.5)
Uncomfortable eating position	-	205 (99.5)	1 (0.5)

hospital environments were considered as “not conducive to eating,” which might significantly influence patients' appetite and food consumption (Osman *et al.* 2022). To enhance the overall food consumption of patients, various interventions have been demonstrated to be successful, including protected mealtimes, enhancing the mealtime environment, and providing mealtime support (Osman *et al.* 2022).

The decrease in appetite and the resulting decrease in food consumption were caused by administering medications and treatment. Patients reported various symptoms including nausea, gastrointestinal pain, reflux, stomatitis, diarrhea, and constipation (Hope *et al.* 2017). This conclusion aligned with the findings that 69.4% of individuals did not have their usual appetite. A total of 23.8% of individuals consumed a quantity of food that was lower than the amount provided, while 5.8% reported experiencing symptoms of nausea and vomiting. It was supported by a study conducted by Aminuddin *et al.* (2018), which found that only 11% of patients consumed the whole meal that was provided to them. Therefore, it may be determined that, on average, 35% of the food served to patients at various hospitals was wasted.

Moreover, the reality of a limited selection of food options was associated with a decline in overall food consumption, as seen by the agreement of 79.6% of respondents who expressed dissatisfaction with the food offered by the hospital. This finding aligns with a study conducted by Aminuddin *et al.* (2018), whereby it was observed that patients expressed dissatisfaction with the quality of food due to a limited range of options available on the menu because there is no menu distribution provided by the Malaysian public hospitals. In terms of eating difficulties, only 1.5% complained that feeling pain affect their dietary intake, 3.4% had swallowing problems and none had issues with eating position upon admission. Thus, this finding indicated that eating difficulties were not the main reason for reducing food intake during admission.

CONCLUSION

In conclusion, there was a significant rate of low risk, and no risk of malnutrition on admission was discovered, with just 1% of patients at risk

of malnutrition. Moreover, this study revealed a positive correlation between elevated BMI and LOS with a greater probability of malnutrition. Meanwhile, it was discovered that a decrease in calorie intake was associated with a higher risk of malnutrition. This study has provided valuable insight into factors affecting food intake among hospitalized patients. Satisfaction with food provided by the hospital was the primary obstacle to adequate food consumption and eating difficulties were not the main factor of inadequate food intake among hospitalized patients.

Based on the findings of this study, some recommendations could be made to inform future interventions in Factors Affecting Food Intake Among Hospitalized Patients. While this study only provided data on Malay patients, this limitation should be considered for future studies to have diverse participants by including other races so that the study results can be generalized when it comes to intervention. Other than that, by identifying the factors that influence food intake among hospitalized patients, future studies need to focus on developing efficient interventions to enhance the quality of food service within hospital settings. This will help to improve patients' dietary intake so that they get a sufficient amount of food during their hospitalization.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the Ministry of Health, Malaysia for the approval to conduct this study and GPK Grant [600-RMC/GPK 5/3 (244/2020)] from Universiti Teknologi MARA for funding. Special thanks to the staff of Hospital Ampang for their assistance in facilitating data collection, the participants for their willingness to join, and all those who contributed directly or indirectly through their participation in this study.

DECLARATION OF CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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Family Support and Dietary Adherence in Individuals with Type 2 Diabetes Mellitus in Banten, Indonesia

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ABSTRACT

The aim of this study was to determine the correlation between family support and dietary compliance in diabetes patients. This observational, cross-sectional study was conducted among 92 Type 2 Diabetes Mellitus (T2DM) patients age 20–70 years in Citangkil Public Health Center, Cilegon, Banten, Indonesia. Data were collected using self-administered questionnaire to measure the dietary adherence and family support. Data was analyzed using Fisher Exact Test. Among 92 respondents that participated in the study, 84 (91.30%) reported having good family support, while 8 (8.70%) reported having inadequate family support. Family support associated with dietary adherence in individuals with T2DM ($p < 0.05$) in the Citangkil I Public Health Center area, Cilegon I, Banten, Indonesia. Good family support is expected to increase dietary adherence in T2DM patients.

Keywords: diabetes, dietary adherence, family support

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a group of metabolic diseases defined by hyperglycemia signs and symptoms caused by abnormalities in the production or action of insulin or both (PERKENI 2021). Diabetes Mellitus is a non-communicable disease with a high prevalence worldwide, and the prevalence rate will continue to rise globally. According to the International Diabetes Federation (IDF), the global prevalence of Diabetes Mellitus in the 20–79 age range was 8.3% in 2019. Meanwhile, Bangun *et al.* (2020) state that the prevalence of Diabetes Mellitus in Indonesia has increased by 6.9% (MoH RI 2013) to 8.5% (MoH RI 2018) and results (Dinkes Provinsi Banten 2020) Banten province in 2018 the prevalence of individuals with Diabetes Mellitus in the City of Cilegon in residents aged 15 and over the target 2021 prevalence of T2DM is 2.6%, or 8,726 people.

T2DM must be closely monitored for blood sugar levels to remain stable (Ilmah & Rochmah 2015). The implementation of a specific dietary regimen is an integral component of diabetes management strategies, aimed at mitigating the risk of complications. Effective adherence to the prescribed dietary plan is contingent upon factors

such as familial support, healthcare provider involvement, and pertinent knowledge factors (Anggi & Rahayu 2020). Dietary adherence entails minimizing fatty foods, soft drinks, sweets, and carbohydrates and increasing fiber, fruit, and vegetable consumption.

Individuals with Diabetes Mellitus recognize the significance of dieting, but many are inevitably disobedient to their diet, intentionally or accidentally. Several factors, including internal and external factors, can influence dietary adherence in individuals with Diabetes Mellitus. Internal factors of dietary adherence can be affected by education, knowledge, beliefs, and personal traits. In contrast, external aspects of a person's dietary adherence are influenced by the environment, family support, and interactions between health professionals and patients with Diabetes Mellitus (Bangun *et al.* 2020). Individuals with T2DM can receive support from their families through assistance with nursing issues, adherence to dietary recommendations, and encouragement to continue following a healthy diet to maintain and enhance their quality of life. Family intervention may improve patients' perceptions of social support, self-efficacy, diabetes knowledge, and self-care (Mphasha *et al.* 2022; Baig *et al.* 2016). Family support had a

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(Received 24-07-2023; Revised 22-09-2023; Accepted 23-11-2023; Published 31-01-2024)

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correlation with dietary adherence in individuals with Diabetes Mellitus (Azmiardi *et al.* 2021; Aklima *et al.* 2012).

The incidence of T2DM at the Citangkil I Health Center was the highest in the city of Cilegon, Banten, Indonesia, and family support correlated with dietary adherence in individuals with T2DM. Given these problems, this study aims to determine the correlation of family support to diet adherence in patients with T2DM in the Citangkil I Public Health Center area, Cilegon City, Banten, Indonesia.

METHODS

Design, location, and time

This is an observational study with a cross-sectional study design, which aims to determine the correlation between family support and dietary adherence in individuals with T2DM. Cross-sectional design was used because it enables measurement of prevalence for all aspects under examination and allows researchers to acquire information about multiple age groups in a short amount of time and at a low cost. This study was conducted from June 2021 to September 2022 at Citangkil I Health Center, Cilegon City, Banten, Indonesia.

Sampling

The sampling technique used in this research was consecutive sampling. The population of this study was T2DM patients who lived in the Citangkil I Public Health Center area, Cilegon City, totaling 727 individuals with T2DM, and the sample size of this study was 92 respondents (determined using the Lemeshow formula, which was added 10% to avoid sample dropping out). The inclusion criteria of the subjects were patients diagnosed with Type 2 Diabetes Mellitus, have family members, age more than 18 years old, and are literate. The exclusion criteria of subjects are T2DM patients who is mute and deaf.

Data collection

Data were collected using self administered questionnaires to measure the dietary adherence and family support. The questionnaire used in this study refers to questionnaires that have been used in previous study (Sulanjari 2018). The questionnaires have been tested for validity and reliability with the results of the validity test of

the family support questionnaire ($r=0.704-0.914$) and the diet adherence questionnaire ($r=0.949-0.983$) for the reliability value of the family support questionnaire ($\alpha=0.957$) and on the diet adherence questionnaire ($\alpha=0.957$).

The instruments used for data collection in this study were the dietary adherence and family support questionnaires. Questionnaire I contains the level of family support for individuals with T2DM and consists of 16 questions with a Likert scale category of favorable questions. Positive questions scored Always=4, Often=3, Rarely=2, Never=1 and one negative/unfavorable questions scored Always=1, Often=2, Rarely=3, Never=4. Questionnaire II contains dietary adherence in individuals with Diabetes Mellitus, including 19 questions with a Likert scale category of positive questions. Positive questions scored Always=4, Often=3, Rarely=2, Never=1 and on negative questions scored Always=1, Often=2, Rarely=3, Never=4.

Data analysis

Subject characteristics such as age, gender, occupation, level of education, and length of suffering from T2DM were described in percentage (proportion). Bivariate analysis uses Fisher's exact statistical test because it does not meet the requirements of using the chi-square test. This research has received approval from the Research Ethics Commission of 'Aisyiyah Yogyakarta University and has fulfilled ethical principles with No: 2252/KEP-UNISA/VII/2022.

RESULTS AND DISCUSSION

Based on Table 1, of the 92 respondents, it was found that the average age of respondents in the middle adult category (40–60 years) was 59.78% of respondents. More than half of the respondents got good family support (91.30%) and good adherence to their diet (91.30%) (Table 1).

Based on Table 2, it was found that 17 respondents (88%) of 82 respondents had good family support and adhered to their diet. Meanwhile, some respondents had poor family support and dietary adherence (5%) (Table 2). The statistical test showed a correlation between family support and dietary adherence in individuals with T2DM in the Citangkil I Public Health Center Area, Banten, Indonesia ($p<0.05$, $p=0.0001$).

Family support and dietary adherence in diabetes mellitus

Table 1. Characteristics of respondents

Variable	f	%
Age		
Adult (20–40 years old)	6	6.52%
Middle age (40–60 years old)	55	59.78%
Late adult (>60 years old)	31	33.70%
Education level		
Elementary	11	11.96%
Junior High School	13	14.13%
Senior High School	43	46.74%
Academy/College	23	25%
No school	2	2.17%
Sex		
Male	48	52.17%
Female	44	47.83%
Work		
Private area	11	18.48%
Entrepreneur	13	30.43%
Civil servant	43	11.96%
Unemployment	23	39.13%
Length of time with diabetes		
1–3 Years	28	30.43%
4–6 Years	25	27.17%
>6 Years	39	42.39%
Family support		
Good	84	91.30%
Poor	8	8.70%
Dietary adherence		
Good	84	91.30%
Poor	8	8.70%

Table 2. The Correlation between family support and dietary adherence

Family support	Dietary adherence				Total		<i>p</i>
	Good		Poor		n	%	
	n	%	n	%			
Good	81	88	3	3	84	91	0.001*
Poor	3	3	5	5	8	9	
Total	84	91	8	9	92	100	

Families can help patients with T2DM adhere to their diets by regularly monitoring their health and informing them of the objectives, advantages, and side effects of their diet. Families can also offer informational support by giving patients with T2DM information obtained from health professionals, most of which is provided by walking alongside them. Family and friends' social support offers patients useful assistance and can lessen the strains of dealing with illness (Miller & DiMatteo 2013). Family support increases the dietary adherence of patients with T2DM (Susanti & Sulistyarini 2013). When the families of adults with T2DM2 participated in culturally appropriate family-based interventions, it helped families better understand the needs of the individuals with T2DM2, and it encouraged family behaviors that made it possible for the adults with T2DM2 to live healthy lives (Busebaia *et al.* 2023). There may be a connection between the increased risk of diabetes and non-communicable illnesses in a partner and family due to comparable dietary habits, lifestyles, and micro- and macro-environments. Family and spouse support is crucial for overcoming unfavorable behaviors and optimizing behaviors in diabetes management, studies have repeatedly demonstrated (Gupta *et al.* 2019).

Family support is related to dietary adherence because the more substantial the family support for individuals with T2DM, the higher their dietary adherence. Family support is significant to motivate patients to create an environment that avoids the stress caused by the treatment (Anjani & Gayatri 2018; Kencana *et al.* 2022). Family social support protects against stress triggers and creates a comfortable environment to maintain blood sugar control (Miller & DiMatteo

2013). Emotional support can involve expression, empathy, and concern for someone to make them feel better, feel they have regained their confidence, and feel belonging and love in times of stress. Communication and interaction between family members are necessary to understand the situation of family members. This dimension is obtained by measuring the patient's perception of family support through understanding and affection from other family members.

Family support consists of 4 dimensions, namely emotional support, information support, instrumental support, and appreciation support. So, with the fulfillment of these 4 dimensions, respondents with good family support tend to be more obedient in carrying out the T2DM diet. The results of research on emotional support for most of the respondents always answered that the family encouraged them to maintain their health. The family also advised respondents regarding T2DM. Still, in some respondents, it was also found that there were families who allowed respondents to eat or drink even though they violated dietary rules, did not help meet the needs of respondents, and did not supervise the implementation of eating rules that must be followed by sufferers of T2DM as evidenced by the respondent's answers to the family support questionnaire at point 11 which is about freedom to choose food and drink, blood sugar levels.

Based on the results, most of the families served and assisted the respondents when needed, and most of the families escorted or accompanied the respondents for treatment at health facilities. Most of the respondents' families always bought or provided them with food according to the recommended dietary guidelines for people with Diabetes Mellitus. Nevertheless, other

respondents discovered that many families rarely made an effort to hear the stories and criticisms that people with Diabetes Mellitus wished to share. A recent study about Dietary adherence to T2DM patients at the Depok II Health Center in Sleman Yogyakarta shows that the majority of respondents adhere to their diet as evidenced by the last level of education in the elderly who have been exposed to the characteristics of the respondents showed that most of the elderly had high school education so that the elderly were easier to receive information (Go'o *et al.* 2020).

Dietary adherence is a behavior recommended by nurses, doctors, and other health workers that must be adhered to by individuals with Diabetes Mellitus. Dietary adherence in individuals with Diabetes Mellitus, namely in the form of eating patterns and the accuracy of eating T2DM patients. The diet T2DM patients must pay attention to the amount of food, type of food, and meal schedule to control their blood glucose levels. Food management is the key to managing Diabetes Mellitus, which at first glance seems easy, but it is difficult to control one's appetite. Complying with a series of diets is a big challenge for T2DM patients so that complications do not occur. T2DM patients frequently have poor diet adherence because they do not comprehend, put into practice, and retain the necessary antecedents, including motivation, comprehension, health beliefs, self-efficacy, practical goals, and social support (Al-Salmi *et al.* 2022). Rural residents with diabetes had a 3.75 times higher risk of dietary non-adherence than those who lived in urban regions (Tirfie *et al.* 2020).

Low-income family support will result in the health of individuals with Diabetes Mellitus being disrupted and vice versa (Baghikar *et al.* 2019). If the family support is good, individuals with Diabetes Mellitus will feel motivated to adhere to the diet. There are four main pillars in the management of Diabetes Mellitus, namely education (health education), medical therapy, nutrition (diet), physical exercise, and pharmacological intervention. Therapeutic nutrition or diet is a significant component of successful diabetes management as a result of diet, controlling blood sugar levels within normal limits, body weight within the normal range, and preventing the severity of complications (Djamiluddin *et al.* 2020). Diabetes Mellitus

therapy and care require quite a long time, so it usually causes boredom, especially in elderly patients. In addition to paying attention to physical problems, individuals with Diabetes Mellitus also need to pay attention to psychological factors in solving Diabetes Mellitus problems, the role and participation of family members in medication, diet, physical exercise, and positive lung time filling. Family support is a form of an active role in the successful management of Diabetes Mellitus. Enrolling in culturally relevant family-based interventions helped increase understanding of the requirements of adults with T2DM2 and encouraged family behaviors that made those needs possible (Busebaia *et al.* 2023).

The obstacle often encountered when handling the Diabetes Mellitus diet is the patient's boredom with going on a diet, which is very important to achieve successful treatment. Implementation of the Diabetes Mellitus diet has a close correlation with family support. Support can be interpreted as belonging or believing someone actively participates in daily activities. The feeling of being connected to other people in their environment creates strength and helps to reduce feelings of isolation. Most patients with Diabetes Mellitus had strong family support and maintained their diet (Hariyono *et al.* 2022).

Based on the findings of this study, respondents paid attention to the type of food they consumed, such as using sugar substitutes if they wanted to consume sweet foods and drinks. Some respondents preferred replacing rice with tubers, consuming fruit daily as recommended, and reducing salt intake and saturated fat. However, it was found that some respondents still needed to be more compliant with the types of diets and recommended foods, such as still consuming sweet foods and drinks without special sugar, often consuming foods high in sugar, high in salt, and high in fat. In the meal schedule, most individuals with T2DM have not paid attention to their meal schedule because they often skip meals. The feeding schedule is disciplined to help the pancreas secrete insulin regularly, and according to the amount of food the respondent eats. The amount of food consumed by individuals with T2DM has not been considered the amount consumed based on body weight, height, type of activity, and age, so the standard calories consumed by individuals with T2DM are not known with certainty.

In providing health services, it is better to increase the involvement of families of T2DM patients in realizing their dietary adherence to control their blood sugar levels. The goal of the program for supporting dietary self-management is to help T2DM patients make better food choices and to give them the self-assurance they need to make the adjustments. A self-management support program cannot be successful without a collaborative correlation with each patient and their family. Collaboration between patients, their families, and their medical experts can improve how T2DM patients manage their condition (Aklima *et al.* 2012). Individuals with T2DM are expected to follow a diet based on recommendations from doctors, nurses, and other health workers. For families and communities to provide more support and motivation to Diabetes Mellitus patients to always comply with their diet by providing direction and motivation to avoid complications through emotional, informational, appreciation, and instrumental support. Effectiveness of a type 2 diabetes patient intervention on food and medication adherence based on the Health Action Process Approach (HAPA) approach and support from family and friends (Ranjbaran *et al.* 2022). For future researchers, it is hoped that this research can add to the knowledge and insight of researchers in developing knowledge about the correlation of family support to dietary adherence in individuals with Diabetes Mellitus and as additional reference material and references, and further researchers can examine other confounding factors.

Family support and dietary compliance are related to the working environment of the Citangkil I Public Health Center in Cilegon City. The most significant way to provide healthcare is to involve type 2 Diabetes Mellitus patients' families more in attaining diet compliance to control their blood sugar levels.

CONCLUSION

The aim of this study was to determine the correlation between family support and dietary adherence in diabetes patients. Family support is associated to dietary compliance in diabetes patients. Subject who received good family support tend to have good dietary adherence. Qualitative research to study the influence of family support on dietary adherence is good to

carry out for more in-depth and comprehensive scientific study.

ACKNOWLEDGEMENT

The author would like to express gratitude to all respondents who were involved in this research and provided their cooperation throughout the data collection process as well as to the University which has supported the publication of this research.

DECLARATION OF CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest concerning this articles research, authorship, and publication.

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Effects of Time-Restricted Eating on Cardiometabolic and Cardiovascular Health: Study Protocol (TRES)

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ABSTRACT

This study aims to assess the safety, feasibility, and effectiveness of 10-hr Time-Restricted Eating (TRE) compared to ad libitum eating on anthropometric measurements, cardiometabolic and cardiovascular health in patients with Acute Coronary Syndrome (ACS). The Time-Restricted Eating Study (TRES) is a single-centre, pragmatic, prospective, randomised controlled trial that will include 48 patients with ACS. Participants will be randomised in a 1:1 ratio to the intervention group where eating duration is restricted to 10 hours per day or control group with no limitation of eating duration imposed. Testing is scheduled at baseline and after four weeks of intervention. The primary outcome is change in body weight after four weeks of intervention. Secondary outcomes include changes in body composition, glycaemic and lipid profiles, inflammatory markers, oxidative stress, endothelial function, arterial stiffness, blood pressure, heart rate, safety, and feasibility of TRE on patients with ACS. The study was approved by the UiTM Research Ethics Committee. Findings will be disseminated through manuscripts, reports, and presentations. Findings on the feasibility and effectiveness of TRE in patients with ACS may broaden the body of evidence for implementing TRE as a dietary intervention to prevent secondary cardiovascular diseases.

Keywords: chrononutrition, cardiovascular diseases, intermittent fasting obesity, time-restricted eating

INTRODUCTION

Coronary Artery Disease (CAD) is a subset of Cardiovascular Diseases (CVD), an umbrella of disorders related to the heart and blood vessels. Coronary artery disease is often characterised by the presence of atherosclerosis in coronary arteries. It is the leading cause of death and Disability-Adjusted Life years (DALYs) loss worldwide. The most recent data from the Global Burden of Disease (GBD) Study 2019 shows a gradual increase in the number of incidences, prevalence, mortality and DALYs related to CAD globally (Global Burden of Disease Collaborative Network 2021). Researchers and health care professionals have explored multiple diet-related

strategies to improve weight, cardiometabolic health and prevention of CVD through caloric and macronutrient restriction, consumption of specific food or nutrients, adherence to selected dietary patterns as well as fasting. Continuous Calorie Energy Restriction (CER) is frequently used to manage the body weight of individuals excess weight (Rynders *et al.* 2019). However, adherence to this dietary strategy is challenging due to the daunting task of reducing caloric intake daily (Golbidi *et al.* 2017). Chrononutrition-based dietary interventions like time-restricted eating have gained popularity as a sustainable CVD prevention strategy (Katsi *et al.* 2022). Prolonged nocturnal fasting by limiting food intake to daylight hours is a simple, feasible, and

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(Received 16-07-2023; Revised 22-09-2023; Accepted 11-11-2023 Published 31-01-2024)

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potentially effective disease prevention strategy (Patterson & Sears 2017).

Literature suggests that Time-Restricted Eating (TRE) may be a promising alternative to weight loss and metabolic health for people who can safely tolerate fasting intervals for a certain period of the day. Studies in the preclinical setting demonstrate that TRE mitigated metabolic diseases caused by various obesogenic diets, with benefits proportional to fasting duration (Chaix *et al.* 2014; Zaman *et al.* 2023). In addition, TRE stabilised and reversed the progression of pre-existing obesity, type II diabetes, hepatic steatosis and hypercholesterolemia of mice in the study. These benefits, which may or may not be related to weight loss, frequently result in metabolic benefits. However, human data on TRE and metabolic health are limited and restricted to healthy, normal weight, overweight, or obese adults and diabetes mellitus with varying results (Manoogian *et al.* 2022). To date there is no available data on the safety and effectiveness of TRE on patients with CAD. Individuals with a history of CVD have a significantly increased risk of recurrent CVD or death (Lin *et al.* 2017). Monitoring and managing risk factors are crucial for preventing the recurrence of cardiovascular disease. We designed Time-Restricted Eating Study (TRES) to assess the safety, feasibility, and effectiveness of adopting 10-hr Time-Restricted Eating (TRE) compared to ad libitum eating on anthropometric measurements, cardiometabolic and cardiovascular health in patients with ACS.

METHODS

Study design

TRES employs investigator-led, pragmatic, single-centre, parallel, randomised, single-blinded clinical trial to assess the safety, feasibility, and effectiveness of 10-hr TRE compared to ad libitum eating on anthropometric measurements, cardiometabolic and cardiovascular health in patients with ACS. The study will be conducted at the Cardiology Department, Al-Sultan Abdullah Hospital, Selangor. The duration for the RCT is five weeks. The trial comprised of a one-week baseline period followed by four weeks of intervention phase. Participants will be randomised to either TRE or control group (ad libitum eating) and expected to follow their assigned eating duration during the four-week intervention period. The

duration of the intervention is set to four weeks with the consideration that improvement in cardiometabolic health can already become evident within two to four weeks after IF-related interventions (De Cabo & Mattson 2019). After completing four weeks of intervention, all participants will return to the study site for an end-of-study visit for assessments. Recruitment of participants for this interventional study is expected to take place for 12 months or until the sample size is achieved.

Sample size

The sample size was calculated to detect the difference in the reduction of body weight of 1.0 kg in four weeks between subjects undergoing TRE compared to ad-libitum timing of eating. The formula was calculated using the formula for statistical superiority (Zhong 2009). The value 1.0 kg for δ will be used as the difference in weight that would be considered as clinically significant reduction of the parameter for four weeks of weight reduction intervention. Meanwhile, a value of 0.97 for s was taken from a previous study assessing TRE's effect on overweight patients with metabolic syndrome (Wilkinson *et al.* 2020). Sample size calculation yielded 20 samples needed for each group. Thus, the sample size required for both arms will be 40. With the consideration of approximately 20% lost to follow-up from the previously mentioned study, a total of 48 patients will be needed to be enrolled in the study to detect a significant difference in weight loss in this RCT.

Participants and eligibility

Eligible participants will be approached and invited to participate in this study. A thorough explanation of the study will be relayed along with the patient information sheet. Written and verbal informed consent will be requested from eligible patients prior to study enrolment. Clinically stable patients with ACS will be screened by investigators based on the inclusion and exclusion criteria of this study:

Inclusion criteria. 1) Adult, 18–65 years old; 2) Had history of acute coronary syndrome (ACS); 3) Clinically stable; 4) Overweight, Body Mass Index (BMI) ≥ 25 kg/m²; 5) Self-reported eating window of at least 12 h per day.

Exclusion criteria. 1) Severe obesity, BMI ≥ 40 kg/m²; 2) Unstable weight in the past three

months (gain or lose more than 4 kg of weight); 3) Unstable cardiovascular, renal, cardiac, liver, lung, adrenal, or nervous system disease that may compromise study validity; 4) Any medications or supplements known to affect sleep, circadian rhythms, or metabolism (exception: caffeine); 5) Pregnant or lactating women; 6) Perform overnight shift work more than one day/week on average; 7) Regularly fasted for more than 15 hours/day or having completed twelve 24-hr fasts within the past three months); 8) Active use of tobacco or illicit drug or history of treatment for alcohol abuse; 9) Type I diabetes or diabetic, treated with insulin; 10) Use of anti-obesity drugs or other drugs affecting body weight; 11) Currently enrolled in weight loss or management programmes, including surgical intervention; 12) Severe kidney failure Glomerular Filtration Rate (GFR) <30 mL/min); 13) Eating disorder or current diagnosis of uncontrolled psychiatric illness, which may impair study involvement; 14) Malignancy undergoing active treatment; 15) Had gastrointestinal surgery or impaired nutrient absorption; 16) Travelled more than two time zones away two months prior to enrolling in the trial or will travel more than two time zones away during the study period; 17) Concurrent participation in other interventional studies.

Randomisation procedure and treatment allocation

Participants will be randomly assigned to a 1:1 ratio to follow a time-restricted eating regime (consuming all meals within a 10 hours window) or to maintain their regular feeding pattern (ad libitum eating) throughout the study period, four weeks. Block randomisation of ten will be generated by statistician using an online random number generator: www.randomization.com to ensure an equal number of participants in both arms. The randomisation list will be concealed

using individual, sequentially numbered, opaque, sealed envelopes, which will only be opened once a participant is enrolled to assign them to interventions. Healthcare providers and outcome assessors will not be informed of their nutrition intervention allocation. Blinding will also be done prior to laboratory assessment and statistical analysis through renumbering of samples for analysis and labelling intervention groups with non-identifying terms (Group A and B).

Study intervention

After randomisation, participants will be briefed on dietary instructions for the assigned eating duration (Figure 1). Participants in the TRE group will be asked to restrict eating to 10 hours and to be allowed to decide on the starting time of the eating period latest by 09:00 am. Participants in TRE group are required to maintain the same 10-h feeding window each day. For example, participants who begin eating at 08:30 h will be required to finish their last meal of the day by 18:30 h daily and to fast until 08:30 h of the next day. Participants will be advised to consume their main meals at constant intervals (i.e lunch at 1–2 pm). Additionally, TRE group participants will be asked to limit dietary intake to water and caloric-free beverages such as sugar-free black coffee and tea during the fasting period. Meanwhile, participants in the control group will be required to maintain their habitual period of eating throughout the intervention period. Caloric restriction will not be implemented during the intervention period, participants will be allowed ad libitum dietary intake while complying with the assigned eating period. Ten-hour TRE is adopted as the duration of TRE intervention as it is deemed more sustainable compared to shorter TRE duration. It is a safer practice as it is expected that a subpopulation of the study population may be diabetic.



Figure 1. Eating and fasting duration during intervention

All participants in both groups will receive nutrition education regarding a heart-healthy diet through individualised counselling sessions. Heart-healthy diet consists of a dietary pattern rich in plant foods like cereals, fruits, vegetables, legumes, tree nuts, and seeds. Foods from plant origin should be eaten in large amounts and often as plants provide important nutrients, fibre, and protective substances that help with overall health, feeling full, and keeping a balanced diet. Emphasis will be given to healthy sources of protein from plants and regular consumption of fish. The diet promotes intakes of minimally processed foods, liquid plants oil and low consumption salt and added sugar. The primary intention of nutrition education is to improve the overall quality of the diet through better food selection. Additionally, participants will be advised to maintain their level of physical activity throughout the entire trial.

Study outcomes

Primary outcome. The primary outcome is a mean change in body weight (kg) from baseline to the end of four weeks of intervention.

Secondary outcomes. Secondary outcomes include a range of cardiometabolic, and cardiovascular health markers potentially associated with TRE. Secondary outcomes of interest include changes between pre- and post- 10 hr-TRE intervention for four weeks on body composition, glycaemic and lipid profiles, inflammatory markers, oxidative stress, endothelial function, arterial stiffness, blood pressure, and heart rate. Additionally, the safety and feasibility of TRE will be assessed in this study.

Study procedures

This study will be performed on identical test days for all assessments required for this study. Upon consent, patients will be provided with a Diet log (consisting of food diary and subjective appetite) and information on recording the log. Participants will be scheduled for baseline assessment the following week. They are advised to follow their habitual eating pattern, sleep, and exercise during the one-week baseline period. During the first visit (pre-intervention encounter), nutrition education regarding heart-healthy diet will be given, relevant information from participants (characteristics, medical history,

and medications) will be gathered, baseline assessments will be conducted, and completed log will be collected. Intervention will begin at week 1, after baseline assessments are completed. Weekly follow-up will be conducted at week 2, 3, 4, and post-intervention will be conducted on termination visit at week 5. Summary of study activities are outlined in Table 1.

Pre-intervention measures. Baseline assessment includes anthropometric measurements, vital signs, flow-mediated dilation, brachial-ankle pulse wave velocity and blood sampling. Participants will be instructed to consume their last meal by 8:00 pm for an overnight fast and to avoid alcohol consumption or strenuous activities 24 hours prior to assessment day. Fasting blood samples will be collected by trained staff using standard institution procedures from all participants. Additionally, participants will answer questionnaires related to physical activity and sleep quality and complete a Diet log consisting of a food diary, eating time log and subjective appetite.

Intervention assignment and follow-up. Random assignment to interventions will be conducted after a 1-week baseline period at first visit. Follow-up telephone calls will be done weekly (week 2, 3, 4) for intervention monitoring, where medications, food timing and adverse events will be reviewed. Additionally, a weekly consultation during follow-up visits will take place to discuss any nutrition-related queries, with the objective to improve and maintain compliance with the intervention.

Post-intervention measures. Termination visits will be conducted four weeks post-intervention (week 5). All parameters assessed at baseline will be repeated during the termination visit.

Withdrawal of participants from a study procedure

Participants are free to withdraw from the study or procedures voluntarily at any point of the study for any reason without penalty to their continuing medical care. Additionally, participants must be withdrawn from the study by the principal investigator in consultation with the study physician for the following reasons: grade 4 clinical adverse events (requiring hospitalisation) considered causally related to TRE, pregnancy, compliance failure, poor logging or adherence to

Table 1. SPIRIT schedule of enrolment, interventions, and assessment

Timepoint	Study period (4 weeks)					Termination
	Enrolment	Baseline & allocation	Post-allocation			
	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5
Enrolment						
Eligibility screen	x					
Informed consent	x					
Allocation		x				
Interventions						
TRE 10 hr		x	x	x	x	
Ad libitum eating		x	x	x	x	
Assessments						
Demographics	x					
Clinical data	x					
Medication review	x	x	x	x	x	x
Blood pressure		x				x
Blood samples		x				x
Anthropometric measurements		x				x
Flow-mediated dilation		x				x
Brachial-ankle pulse wave velocity		x				
Food diary	x					x
Physical activity		x				x
Sleep quality		x				x
Subjective appetite	x					x
Food timing log			x	x	x	x
Adverse events			x	x	x	x

TRE: Time-Restricted Eating

the intervention, lost to follow-up, medication/s adjustment. Data collected prior to withdrawal will be used for analysis to maintain the reliability of the study. Participants who discontinue the study early will be asked to return to the study site at week 5 for end-visit assessments.

Data collection

Data collection for intervention monitoring and outcomes of study data will be gathered

during pre- and post-intervention assessments and in free-living settings.

Sociodemographic and clinical data.

One-off sociodemographic data will be collected after informed consent is obtained. Data includes age, ethnicity, marital status, education level, residential district, occupation, working hours, household income, household size and number of children. clinical data will include current cad diagnosis, prior history of cvd, other chronic non-

cardiovascular comorbidities, and medications. Concomitant medication use will be recorded at baseline and continued during the intervention.

Anthropometric measurements.

Anthropometric measurements including weight, height, body composition and waist circumference will be conducted at pre- and post-intervention.

Resting heart rate and blood pressure.

Resting heart rate (beats per minute) and blood pressure (mmHg) will be measured twice in an interval of three minutes, using a calibrated digital blood pressure monitor (OMRON HEM-907, Japan) by trained nurses. Measurement will be taken in a sitting position, on the right arm with an appropriate cuff size. Measurement will be taken after a minimum of 10 min rest. Hypertension is measured by having a systolic blood pressure of 140 mmHg or more or a diastolic blood pressure of 90 mmHg or more (MoH 2017). Resting heart rate ranges from 60 to 100 beats per minute, which is considered normal for adults.

Flow-mediated dilatation. Flow-mediated dilatation measurements will be conducted at pre- and post-intervention following an overnight fast based on the protocol specified in the literature (Corretti *et al.* 2002). Participants will lay in the recumbent position for 15 minutes in a quiet, temperature-controlled room prior to the measurements. Measurements of the right brachial artery in the longitudinal plane, approximately 2 to 4 cm above the antecubital fossa, will be performed by a single trained, blinded operator, using 5–13 MHz linear array transducer (Epiq CVX, Philips, Eindhoven, the Netherlands) operating in high-resolution B-mode. The brachial artery diameter will be measured in end-diastole from a single 2-dimensional frame. After three baseline measurements, forearm ischemia (reactive hyperemia) will be induced by inflating sphygmomanometer cuff applied to the right forearm 2 cm below the olecranon process to 50 mmHg greater than the systolic blood pressure for 5 min. As the cuff is deflated, the shear stress created will induce dilation, representing the spontaneous endothelial function. Readings will be taken at pre compression (baseline), 30 s prior to cuff release, and then every 30 s after cuff release for 2 min. FMD percentage will be calculated as $(\text{maximum diameter} - \text{baseline diameter}) / \text{baseline diameter} \times 100$.

Brachial-ankle pulse wave velocity.

The measurement of brachial-ankle pulse wave

velocity (baPWV) is a non-invasive technique used to assess systemic arterial stiffness by the analysis of waveforms in the brachial and tibial arteries. In the supine posture, following a brief period of rest, the SphygmoCor XCEL device (AtCor Medical) will be utilized to measure the arterial waveforms and blood pressure at both the brachial and ankle sites. The brachia and ankles will be affixed with cuffs, and a plethysmography sensor coupled to the cuffs will be used to simultaneously record pulse volume waveforms at the four extremities. Data will be collected for a duration of 10 seconds while applying a compression force of 50 mmHg. Continuous measures of blood pressure will be conducted using a typical cuff-oscillometric approach at the right arm and ankle. Subsequently, measurements will be taken at the left arm and ankle. The calculation of baPWV involves determining the time gap between the wave fronts of the brachial and ankle artery waveforms, as well as the path length from the brachia to the ankle, which is derived from the individual's body height.

Food diary. Participants will be asked to record each individual food and beverage consumed over a 24-h period (12:00 am and 11:59 pm) in a food diary for two weekdays and one weekend at baseline and at the end of the intervention. Participants are to record mealtime, food items and portion size taken on the selected days. All supplement intakes, including vitamins and minerals in the form of tablets, capsules, powder, or liquid, that might have added to the total number of calories and other nutrients will also be recorded. The food diary will be reviewed and coded by a trained dietitian using the Nutritionist Pro™ Diet Analysis software (Axxya Systems, Stafford, TX, USA) to quantify participants' average nutrient intake. Malaysian Food Composition Database (MyFCD) and the U.S. Department of Agriculture (USDA) Foods database will be used to supplement information on food items.

Questionnaires. Participants will answer the self-reported questionnaires for sleep quality (Pittsburgh Sleep Quality Index), physical activity (International Physical Activity Questionnaire), and perceived appetite (Visual analog scale) at pre- and post-intervention.

Blood test. Venous blood samples will be collected into blood tubes at pre- and post-intervention in the morning via a catheter in an

antecubital vein, following eight hours of fasting. A total of 15 mL of blood samples will be taken from subjects using a hypodermic needle and syringe by phlebotomist/certified personnel (staff nurse/doctor). Analyses include assessment of circulating levels of glucose, insulin, lipids, inflammatory markers, oxidative stress, complete blood count and future analysis, gene expression.

Intervention monitoring

Intervention monitoring will include reporting adherence to intervention and adverse events. Feasibility will be measured by the rate of participants' withdrawal from the study due to adverse effects or inability to comply with the TRE.

Adherence to intervention. Adherence to intervention will be appraised by asking participants to complete a daily meal timing log in real-time or before bedtime. Subjects will be asked to report feeding duration by imputing the time of first meal consumption and the end time of last their last meal. Compliance with the feeding duration is assumed when participants consume their meal within the identified duration with a permissible 30-minute deviation.

Safety and feasibility. The indicator for the safety of TRE used in this study will be based on the report of adverse events and complete blood count. Participants will be asked to report any adverse events weekly throughout the study period. Participants will be formally informed of the possible adverse events and serious adverse events that might occur upon participating in this intervention study. Adverse Events (AE) related to TRE include vomiting, fatigue, dizziness, headache, nausea, constipation, diarrhoea and irritability. Meanwhile, Serious Adverse Event (SAE) is considered as defined by Malaysian Guideline for Good Clinical Practice, 4th Edition, as any untoward medical occurrence that at any dose, including death, life-threatening events requiring inpatient hospitalisation or prolongation of existing hospitalisation and results in persistent or significant disability/incapacity. Participants with AE or SAE will be given appropriate care under medical supervision until the symptoms resolve or the participant's condition becomes stable.

Data management

Paper-based Case Report Forms (CRFs) will be used to record study data. CRF will be

used for each participant should be filled out by study staff as soon as assessments are carried out. The CRF will be double-checked for potential errors or missing data prior to patients leaving the study sites. All study data, including informed consent, screening assessments, physical examinations, questionnaires, and laboratory results, will be kept confidential and filed in the study office. Data entry will be completed and stored in the primary investigator's password-protected computer. Another investigator will verify data entry to ensure consistency in data collected. CRF and other study documents will be identified based on study ID. A master list consisting of study ID and identifier will be stored in the primary investigator's password-protected computer. Data monitoring committee has not been appointed for the trial because the perceived risk of damage is low.

Data analysis

All data analyses will be carried out using statistical software package SPSS software version 26 (SPSS Inc., Chicago, IL, USA). The normality of the distribution will be tested using Shapiro-Wilk for data set less than 50. Data will be presented as means (standard deviation) or medians (Interquartile range) as indicated based on its normality. All tests will be two-tailed, and p-value of <0.05 was taken to be considered statistically significant. Chi-square test (for categorical variables) and independent t-test (for continuous variables) will be used to examine differences in baseline between groups. Analysis of Covariance (ANCOVA) will be used to compare changes in study outcomes at post-intervention. Baseline data, dietary intake and physical activity, will be treated as covariates (Wan 2021). The analysis will be performed primarily based on intention-to-treat. Missing data will be imputed according to the last observation carried forward. In addition, a per-protocol analysis including only patients with no missing observations of the variable of interest will be performed. The findings of the trial will be disseminated through communication in appropriate journals and at scientific conferences.

ETHICS AND DISSEMINATION

This study will be conducted in accordance with the Declaration of Helsinki.

Written approval of the study was obtained from Universiti Teknologi MARA Ethics Committee, reference no.: REC/02/2023 (ST/MR/46). This study is registered in a clinical trial registry, ClinicalTrials.gov, identifier no.: NCT06007950. Written informed consent will be acquired prior to enrolment into the study. This protocol is prepared based on Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) 2013 (Chan *et al.* 2013). Reporting of this trial will be based on all Consolidated Standards of Reporting Trials (CONSORT) 2010.

DISCUSSION

Time-restricted eating is the chosen intermittent fasting regime in this trial due to the perceived better sustainability advantage compared to caloric restriction. Implementation of TRE aligns daily food consumption with circadian rhythm without overt attempt to reduce caloric intake. TRE research suggests that extending the duration of the daily fast to more than 12 hours may yield additional cardiometabolic benefits (Regmi & Heilbronn 2020). The proposed mechanism of actions of TRE includes the promotion of ketogenesis, attenuation of oxidative stress and alignment with circadian rhythm (Poggiogalle *et al.* 2018; De Cabo & Mattson 2019; Azemi *et al.* 2022). TRES is the first randomised clinical trial in Malaysia to explicitly assess the effectiveness of TRE on anthropometrics, cardiometabolic health, and cardiovascular health in patients with heart disease. The design of the study is predicated on previous research on the metabolic effects of TRE interventions conducted on various populations of metabolically healthy or altered participants. Exploration of the effects of TRE on vascular health, such as endothelial function and arterial stiffness, is limited but essential for preventing additional vascular impairment (Alinezhad-Namaghi *et al.* 2023).

Current TRE studies in humans typically limit eating duration to four to 12 hours during waking hours to induce fasting effects (Christensen & Kirkham 2021). This study adopts 10 hours TRE for patients with ACS after several considerations. First, as prior human study in this specific population is not available, experimenting with gradual restriction of eating duration is reasonable, taking into account the

metabolic vulnerability of patients with Acute Coronary Syndrome (ACS). Annual Report of the ACS Registry 2018–2019 for Malaysians reported 93.5% of people with ACS had at least one of the common cardiovascular risk factors, with 44.2% of these patients had diabetes, 61.9% had hypertension, 36.7% had dyslipidaemia (Ahmad 2022). Secondly, study on patients with metabolic syndrome revealed mild TRE, such as limiting eating duration to ten hours, reduced adiposity and improved blood pressure, blood glucose, and blood cholesterol levels (Wilkinson *et al.* 2020). Thirdly, ten hours of TRE is assumed to be more sustainable for long-term implementation, which can be achieved by scheduling dinner earlier. Consequently, we postulate that 10-hour TRE may be advantageous for patients with ACS.

Change in body weight is identified as the primary outcome of this RCT for multiple reasons. First, excess weight is a common attribute of patients with CAD, where data from 10,507 CAD patients participating in the EUROASPIRE IV and V studies show that 80% of patients with CAD are overweight or obese. The study showed that most patients with obesity (86%) remained obese, and 14% of overweight patients had become obese at study visits (≥ 6 and < 24 months post-hospitalisation) (De Bacquer *et al.* 2022). Secondly, an umbrella review of systematic review revealed that obesity is associated with mortality with a pooled odd ratio of 2.18, (1.10–4.34) (Harrison *et al.* 2021). Third, the sixth joint task force of the European Society of Cardiology and other societies strongly recommends weight loss in individuals with overweight and obesity to prevent cardiovascular disease prevention. Weight loss improves blood pressure levels, reduces the risk of type 2 diabetes and, therefore, reduces the risk of recurrent cardiovascular events. Fourth, body weight is easy to measure with high precision and available in most clinical studies enabling direct comparison across studies with similar interventions.

This study is expected to confirm the safety and feasibility of mild TRE in patients with ACS. Evaluation of the effectiveness of 10-h TRE offers alternative dietary intervention for secondary prevention of CVD. Additionally, based on the findings of this study, future works with a more stringent TRE regime can be challenged on patients with ACS considering TRE effects are

duration-dependent. Therefore, it is necessary to investigate whether TRE is advantageous for individuals with more adverse metabolic profiles, such as CAD.

CONCLUSION

The protocol of the TRES clinical trial was designed to determine the safety, feasibility and effectiveness of TRE on anthropometrics, cardiometabolic and cardiovascular health in patients with ACS. Data from this study may contribute to the development of a simple, safe and sustainable dietary intervention to prevent secondary cardiovascular diseases. We anticipate that our study will serve as foundations to confirm our findings in future larger studies or studies with shorter duration in this vulnerable population.

ACKNOWLEDGEMENT

This work is supported by Universiti Teknologi MARA and Kementerian Pengajian Tinggi Malaysia (FRGS/1/2021/SKK06/UITM/03/3).

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Nutrition Management for Acute Stroke with Right-Sided Hemiparesis: A Case Study

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ABSTRACT

This case study aims to report on the nutrition management of acute stroke with right-sided hemiparesis using an approach of early enteral feeding intervention to prevent malnutrition. Mr. R, a 77-year-old Malay man was admitted to the hospital due to an acute stroke with right hemiparesis with underlying disease of Atrial Fibrillation (AF), hypertension, type 2 Diabetes Mellitus (DM), Chronic Kidney Disease (CKD) stage 3b, and significant Peripheral Artery Disease (PAD). His BMI was 24kg/m² with a weight of 67kg and height of 1.67m, and he was presented with abnormal blood results. All his vital signs were normal, and he appeared lethargic. The patient was on bolus Nasogastric (NG) feeding via Ryle's tube with polymeric formula. Inadequate enteral nutrition infusion related to infusion volume not yet reached, as evidenced by a 47% energy and 60% protein adequacy feeding history. The polymeric formula was changed to a diabetic-specific formula for better blood sugar control, and feeding was given according to the patient's needs. Mr. R required at least 70% of 1,675 kcal of energy and 53.6 g of protein (0.8 g/kg body weight) to prevent malnutrition. The patient was still on Ryle's tube feeding and already achieved the targeted energy and protein requirements. Before being discharged, the patient was allowed orally, and a sample menu was given as guidance to avoid weight loss and muscle wasting during long-term recovery. This case highlights the importance of early enteral feeding support in stroke recovery and the need to prioritize meeting nutritional needs in stroke patient care. Mr. R showed improvement in health and nutrition and concluded that early and focused enteral nutrition support can lead to improved results and better quality of life for stroke survivors.

Keywords: dysphagia, enteral nutrition, malnutrition, post-stroke nutrition, stroke

INTRODUCTION

Dysphagia is the patient's medical condition with swallowing difficulties (WHO 2019). Most patients with stroke commonly have a dysphagia problem, which usually leads to malnutrition if not appropriately addressed (Hien *et al.* 2022). In stroke patients, it may increase the risk of pulmonary complications and mortality (Grossmann *et al.* 2021). One of the ways to prevent malnutrition for patients with stroke and dysphagia is through early initiation of enteral nutrition (EN) (Sabbouh & Torbey 2018). Patients treated with EN within 72 hours of admission in the stroke unit have better nutrition test results at 21 days than those receiving family-managed food. Early EN improves neurological performance,

aiding the recovery of neurological functions (Zheng *et al.* 2015). Early EN aims to meet the nutritional needs of patients who cannot eat or tolerate regular oral intake due to various medical conditions such as stroke, surgery, or trauma. By initiating EN early, healthcare providers aim to prevent malnutrition, preserve lean body mass, improve immune function, reduce the risk of infections, and promote better patient outcomes (Koontalay *et al.* 2021). Challenges in early EN are encountered in clinical settings, particularly among critically ill patients. One primary challenge lies in gastrointestinal tolerance, as some individuals may experience difficulties such as abdominal distension, diarrhea, or vomiting when initiating EN early, necessitating careful monitoring and adjustments. Furthermore, there

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(Received 11-08-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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is a risk of aspiration, particularly in patients with compromised swallowing abilities, which requires a delicate balance to ensure safe EN delivery (Wischmeyer 2021).

Pathophysiology

A stroke, also known as a Cerebrovascular Accident (CVA), is a medical condition that occurs when blood flow to the brain is suddenly disrupted, leading to brain cell damage or death. This disruption can happen due to a blockage of a blood vessel, classified as ischemic stroke, or the rupture of a blood vessel, causing bleeding into the brain and is classified as hemorrhagic stroke (Kuriakose & Xiao 2020). When a stroke occurs, the affected part of the brain is deprived of oxygen and nutrients, resulting in various neurological deficits depending on the location and extent of the brain injury. These deficits may include weakness or paralysis on one side of the body (hemiparesis), speech difficulties (aphasia), vision problems, coordination issues, and other cognitive or sensory impairments (Musuka *et al.* 2015). Risk factors for stroke include non-modifiable factors such as age, race, and ethnicity, and modifiable factors such as a smoking habit, lack of physical activity, and medical conditions such as hypertension, Atrial Fibrillation (AF), diabetes, and cardiovascular disease. Stroke treatment is highly individualized, and the specific approach may vary based on the patient's age, overall health, time since symptom onset, and other factors. Early recognition of stroke symptoms and seeking immediate medical attention can improve the chances of successful treatment and recovery. Stroke can have significant nutrition implications in terms of prevention and post-stroke care. Primarily, dietary choices are a key factor in stroke prevention. A diet high in saturated fats, trans fats, and sodium, and low in fruits, vegetables, and whole grains can elevate stroke risk, emphasizing the importance of promoting a diet rich in healthier options. The Dietary Approaches to Stop Hypertension (DASH) diet was recommended by promoting the consumption of fruits, vegetables, and low-fat dairy products while advocating for reduced intake of saturated fat, overall fat, and cholesterol. It encouraged the inclusion of whole grains, poultry, fish, and nuts while discouraging the consumption of red meat, sweets, and sugar-containing beverages (Spence 2018). Alcohol

consumption, substance abuse, and smoking have varying impacts on stroke risk, depending on the type of stroke. For ischemic stroke, research suggests a J-shaped relationship with alcohol consumption. Light to moderate drinking, defined as up to 2 drinks daily for men and up to one drink daily for women, appears to provide some protection against stroke. In contrast, heavy alcohol consumption is linked to a heightened risk of ischemic stroke (Boehme *et al.* 2017). Nutritional deficiencies are a common concern for individuals who have experienced a stroke, often resulting in malnutrition, which is linked to reduced daily functioning and quality of life (Lee & Chiu 2021). Various stroke-related factors, such as dysphagia, limited upper limb mobility, visuospatial difficulties, increased catabolism, gastrointestinal issues, and depression, can contribute to malnutrition (Shiraishi *et al.* 2018). There is a close association between sarcopenia and inadequate dietary intake. Malnutrition or a lack of essential calories and nutrients can lead to muscle decline and potentially worsen post-stroke sarcopenia (Scherbakov *et al.* 2013). Therefore, assessing the nutritional status early and, if necessary, implementing nutritional interventions to enhance outcomes for individuals with sarcopenia following a stroke is crucial.

Patient profile

Mr. R, a 77-year-old Malay Man, government pensioner, used to work as a plan designer. He is married and blessed with six children. Before admission, the patient could do basic Activities of Daily Living (ADL) independently. His primary carer is his sixth daughter and grandson. He has underlying disease of Atrial Fibrillation (AF), hypertension, type 2 Diabetes Mellitus (DM), Chronic Kidney Disease (CKD) stage 3b, and significant Peripheral Artery Disease (PAD). The patient was admitted to the medical ward via the emergency unit due to sudden numbness in the face and arm and slurred speech. He was diagnosed with acute stroke with right-sided hemiparesis due to thromboembolic, uncontrolled DM, and Acute Kidney Injury (AKI) on CKD. He currently receives medications for treating his medical condition, which are T. Atorvastatin 40 mg ON, S/C Actrapid 6u PRN, T. Glyprin 100 mg OD, T. Omeprazole 20 mg OD, T. Bisoprolol 10 mg OD, and T. Metformin HCL XR 2 g OD. The patient was referred to a dietitian

on his third day of admission for nutrition optimization of enteral feeding.

NUTRITION ASSESSMENT

Anthropometry data

The patient's weight is 67 kg with a height of 1.67m, and the calculated Body Mass Index (BMI) is 24 kg/m², categorized as normal BMI for older adults (Winter *et al.* 2014). According to the patient's daughter, the patient does not show any recent signs of weight loss, as the patient was well before admission to the ward.

Biomedical data, medical tests, and procedures

Based on Table 1, his biochemical profile shows an elevated level of urea (13.1 mmol/L) and creatinine (123 µmol/L) due to his condition of AKI on CKD and high level of blood sugar (13.8 mmol/L) as the patient diagnosed with uncontrolled DM and a low level of red blood cell (3.9x10¹²/L) and hemoglobin (11.8 g/

dL) in blood. Besides, the patient has a normal reading of lipid profile and a slightly high level of c-reactive protein (5.6 mg/dL).

Nutrition-focused physical findings

All his vital signs are normal, and his Glasgow Coma Scale (GCS) score of 11/15 describes the patient as alert and conscious with incomprehensible sounds.

Food nutrition-related history

A Ryle's tube was inserted for nasogastric feeding initiation due to dysphagia and the patient received EN through bolus nasogastric tube feeding. The feeding was initiated by the ward nurse, and he currently receives a standard polymeric formula with a dilution of 3 scoops in 150 mL water, given every four hours and six times feeding daily providing 787 kcal, 32.4 g protein, 102.6 g carbohydrate, and 25.2 g fat. Based on Table 2, his energy intake is inadequate, and he only received 47% of his energy requirements.

Table 1. Mr. R's nutrition assessment data during the first dietitian visit on day 3 of admission

Nutrition assessment	Criteria	Normal range	Result	Interpretation
Anthropometry	BMI	18.5–24.9 kg/m ²	24 kg/m ²	Normal
Biochemical data, medical tests, and procedures	Urea	2.78–8.07 mmol/L	13.1	Above normal range
	Sodium	135–145 mmol/L	137	Normal
	Creatinine	44–80 µmol/L	123	Above normal range
	eGFR	>60 mg/mmol	48.0	Below normal range
	Red blood cell	4.5–5.5 x 10 ¹² /L	3.9	Below normal range
	Hemoglobin	12.0–15.0 g/dL	11.8	Below normal range
	Fasting blood sugar	4.0–6.0 mmol/L	8.3	Above normal range
	Random blood sugar	4.0–7.8 mmol/L	13.8	Above normal range
	Total cholesterol	<5.2 mmol/L	4.1	Normal
	Triglyceride	<1.7 mmol/L	1.3	Normal
	LDL cholesterol	<3.0 mmol/L	2.2	Normal
	HDL cholesterol	≥1.3 mmol/L	1.3	Normal
	C-Reactive protein	<5 mg/dL	5.6	Above normal range
	Nutrition-focused physical findings	Blood pressure	<140/90 mmHg	119/79 mmHg
Pulse rate		60–100 bpm	79 bpm	Normal
Temperature		<37.5°C	36.3°C	Normal
GCS		E4V6M5	E4V2M5	Alert and conscious with incomprehensible sound

BMI: Body Mass Index; eGFR: Estimated Glomerular Filtration Rate; GCS: Glasgow Coma Scale
HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein

All macronutrients are also inadequate, achieving 60% of protein requirements, 47% of carbohydrate requirements, and 39% of fat requirements.

NUTRITION DIAGNOSIS

Inadequate enteral nutrition infusion related to infusion volume not yet reached, as evidenced by feeding history, which only received 47% of energy and 60% of protein requirements, 0.5 g/kg body weight.

NUTRITION INTERVENTION

The short-term goal for Mr. R is to provide adequate energy and protein to prevent malnutrition by achieving at least 70% of the requirements (Arsava *et al.* 2018) and controlling the patient's blood sugar profile. His energy requirement is 1,675 kcal per day, which is calculated by multiplying with a factor of 25 kcal per kg body weight based on nutrition requirements for elderly stroke patients (Yuan *et al.* 2019), and his protein requirement is 53.6 g per day which is calculated by 0.8 grams per kg body weight. Protein was not given too high due to his condition of AKI on CKD (Ikizler *et al.* 2020). To achieve the goal, the standard polymeric formula was changed to a diabetic-specific formula for better blood sugar control, and feeding was prescribed with 4.5 scoops in 200 mL water, given every four hours with six times daily feedings. This feeding regime provides 1,231 kcal per day and 54 g per day of protein, indicating 74% and 100% of his energy and protein requirements, respectively. He was only able to achieve 74% of the energy requirements due to the restriction of protein because of his kidney condition which is considered adequate as the patient's goal is to achieve at least 70% of the calculated energy requirement.

NUTRITION MONITORING & EVALUATION

The patient was monitored by assessing his biochemical data changes and nutrition-focused physical findings, including vital signs as mentioned in Table 3. There were no changes in BMI during the follow-up visit, seven days after the first visit by the dietitian. The renal profile shows improvements with decreasing trend of urea and creatinine levels with readings of 10.4 mmol/L and 95 µmol/L respectively, but sodium levels dropped to below range with readings of 132 mmol/L. Red blood cell values show improvement even though not yet reached the normal range with a value of $4.2 \times 10^{12}/L$, and hemoglobin level shows improvement and achieved the normal range with a value of 12.5 g/dL. Both fasting blood sugar and random blood sugar showed improvement and achieved normal range values with readings of 5.9 mmol/L and 7.0 mmol/L respectively. All his vital signs were maintained in the normal range but with a slight drop in GCS to 9/15, indicating decreased alertness with incomprehensible sounds.

Food-nutrition-related history shows the patient tolerates enteral feeding because there is no gastric residual volume, diarrhea, vomiting, or gastrointestinal bleeding. Based on Table 4, the patient achieved the target goal of energy with at least 70% of the requirement, 1,231 kcal as prescribed. For macronutrients, the patient was able to achieve 100% protein requirement with 54 g/day and 0.8 g/kg body weight. Carbohydrates only reached 64% of the calculated requirement, 140.4 g/day out of the goal due to the use of a diabetic-specific formula with lower carbohydrate content. Fat can meet over 70% of the daily requirement with 45.9g/day, which is 71% of the requirement.

Table 2. Comparison of current intake and requirement for Mr. R's food nutrition-related history during the first dietitian visit on day 3 of admission

Nutrition assessment	Criteria	Current intake	Requirement	Interpretation
Food nutrition-related history	Energy	787 kcal	1,675 kcal	Inadequate intake
	Protein	32.4 g	53.6 g	Inadequate protein
	Carbohydrate	102.6 g	217.8 g	Inadequate carbohydrate
	Fat	25.2 g	65.1 g	Inadequate fat

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Table 3. A comparison of the nutrition assessment data of Mr. R during the first visit (day 3) and follow-up visit (day 10) by the dietitian

Nutrition assessment	Criteria	Normal range	First visit (Day 3)	Follow-up visit (Day 10)	Interpretation
Anthropometry	BMI	18.5–24.9 kg/m ²	24 kg/m ²	24 kg/m ²	No changes
Biochemical data, medical tests, and procedures	Urea	2.78–8.07 mmol/L	13.1	10.4	Decreased
	Sodium	135–145 mmol/L	137	132	Decreased
	Creatinine	44–80 µmol/L	123	95	Decreased
	eGFR	>60 mg/mmol	48.0	66	Increased
	Red blood cell	4.5–5.5 x 10 ¹² /L	3.9	4.2	Increased
	Hemoglobin	12.0–15.0 g/dL	11.8	12.5	Increased
	Fasting blood sugar	4.0–6.0 mmol/L	8.3	5.9	Decreased
	Random blood sugar	4.0–7.8 mmol/L	13.8	7.0	Decreased
	Total cholesterol	<5.2 mmol/L	4.1	No data	Normal
	Triglyceride	<1.7 mmol/L	1.3	No data	Normal
	LDL cholesterol	<3.0 mmol/L	2.2	No data	Normal
	HDL cholesterol	≥1.3 mmol/L	1.3	No data	Normal
	C-Reactive protein	<5 mg/dL	5.6	4.0	Decreased
	Nutrition-focused physical findings	Blood pressure	<140/90 mmHg	119/79 mmHg	121/80 mmHg
GCS		E4V6M5	E4V2M5	E2V2M5	Decreased alertness with incomprehensible sound

BMI: Body Mass Index; eGFR: Estimated Glomerular Filtration Rate; GCS: Glasgow Coma Scale
HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein

Table 4. A comparison of the food-nutrition-related history of Mr. R during the first visit (day 3) and follow-up visit (day 10) by the dietitian

Nutrition assessment	Criteria	Requirement	Intake first visit (Day 3)	Intake follow-up visit (Day 10)	Interpretation
Food nutrition-related history	Energy	1,675 kcal	787 kcal	1,231 kcal	74% (Achieved goal >70%)
	Protein	53.6 g	32.4 g	54 g	100% (Achieved goal)
	Carbohydrate	217.8 g	102.6 g	140.4 g	65% (Inadequate carbohydrate)
	Fat	65.1 g	25.2 g	45.9 g	71% (Achieved >70%)

The patient was allowed discharge after 11 days of admission. Before discharge, the patient was reviewed by the speech-language therapist to assess his swallowing ability. Based on the assessment, the patient could tolerate mixed porridge and thin liquid consistency; thus,

Ryle's tube was removed. The patient was given a discharge plan which included a 1,600 kcal menu with mixed porridge and thin liquid consistency suitable for his diabetic and post-stroke condition. A sample of the menu is provided in Table 5.

Table 5. Sample menu of 1,600 kcal with mixed porridge and thin liquid consistency

Meals	Food	Portion
Breakfast 6.00–8.00 am	Mixed vegetables and tofu porridge	2 cups
	- Brown rice porridge	2 cups
	- Mixed vegetables	½ cup
	- Firm tofu, diced	½ cup
	- Oil	2 teaspoons
	Tea 'o' without sugar	1 cup
Morning tea 10.00 am	Papaya and chia seed porridge	1 cup
	- Papaya, diced	½ cup
	- Chia seeds	2 tablespoons
	- Skimmed/low-fat milk	2 tablespoons / ½ glass (60 mL)
Lunch 1.00–2.00 pm	Chicken and spinach porridge	2 cups
	- Rice porridge	2 cups
	- Chicken breast, diced	1 medium size (120 g)
	- Spinach	1 cup
	- Oil	2 teaspoons
	Plain water	1 glass
Afternoon tea 4.00 pm	Rolled oat porridge with mixed nuts	1 cup
	- Rolled oat	3 tablespoons
	- Mixed nuts, chopped	2 tablespoons
	- Skimmed/low-fat milk	2 tablespoons / ½ glass (60 mL)
Dinner 7.00–8.00 pm	Fish and asparagus porridge	2 cups
	- Rice porridge	2 cups
	- Fish fillet	1 fillet (120 g)
	- Asparagus, chopped	½ cup
	- Oil	2 teaspoons
	Plain water	1 glass
Supper 10.00 pm	Greek yogurt	½ cup
	+ mixed berries	½ cup

DISCUSSION

The comparison of first and follow-up visits shows an improvement in biochemical data analysis, vital signs, and food-nutrition-related history. Positive improvement in red blood cell value and hemoglobin level might indicate the patient received adequate energy and protein. Blood sugar profile also showed an

improvement because of changing to a diabetic-specific formula. Food-nutrition-related history shows the patient achieving the target goal with at least 70% of the nutrient requirement. This patient received 74% of the energy requirements and 100% of the protein requirements on day 3, after 72 hours of admission after being seen by a dietitian for the first visit. There is a limitation for achieving 100% of the intended calories due to

the restriction of protein because of the patient's underlying disease of CKD. For adequate enteral feeding, it is recommended to administer at least 70% of the intended calorie and protein amounts within the initial 48 to 72 hours of admission (Arsava *et al.* 2018). EN support is a valuable approach to meeting the nutritional needs of individuals with dysphagia after an acute stroke (Ojo & Brooke 2016). The European Society of Intensive Care Medicine (ESICM) advocates for the utilization of early EN to improve results and decrease mortality rates in critically ill patients, even those who have experienced ischemic and hemorrhagic strokes (Reintam Blaser *et al.* 2017).

This case study of Mr. R provides several critical learning points. It emphasizes the importance of assessing a patient's nutritional status through measures such as BMI, biochemical profiles, and food-nutrition-related history. Mr. R's normal BMI and the absence of recent weight loss suggested that his nutritional issues were primarily linked to his medical condition rather than chronic malnutrition. Mr. R's specific medical conditions, including uncontrolled diabetes and acute kidney injury on chronic kidney disease, necessitated adjustments in his enteral feeding regime. Switching to a diabetic-specific formula helped in better blood sugar control while considering his kidney function by giving protein of 0.8 g/kg body weight. The importance of setting short-term goals tailored to the patient's overall health objectives is another key learning point. In this case, the short-term goal was to provide adequate energy and protein to prevent malnutrition while controlling blood sugar levels. Achieving at least 70% of calculated energy requirements was considered sufficient, considering the constraints imposed by the patient's kidney condition. Continuous monitoring of the patient's progress, both biochemically and through physical findings, was crucial. The improvements seen in Mr. R's renal profile, red blood cell values, hemoglobin levels, and blood sugar levels demonstrated the effectiveness of the nutritional interventions. However, it's essential to remain vigilant for any changes in vital signs, as a drop in the Glasgow Coma Scale (GCS) indicated decreased alertness in this case. In future cases like this one, it's important to optimize the patient's nutritional intake, closely monitor their biochemical markers, and adjust the nutrition plan as needed to achieve optimal outcomes.

Additionally, effective communication among the healthcare team and promptly addressing any changes in the patient's condition will be essential for providing comprehensive care.

CONCLUSION

Mr. R's health and nutrition have improved since the first assessment. He has made progress in his condition, showing positive outcomes in blood tests, vital signs, and dietary patterns. The patient was able to receive more than 70% of the essential nutrients required and his blood sugar improved. Mr. R's case highlights the significance of tailored nutritional interventions in stroke survivors' recovery. Early and focused enteral nutrition support can lead to improved results and a better quality of life during the critical phase of stroke rehabilitation.

CONSENT

Verbal consent has been obtained from the patient.

ACKNOWLEDGEMENT

We would like to express my gratitude to Hospital Al-Sultan Abdullah for providing me with the opportunity to handle this case. This study was funded by Universiti Teknologi MARA, 600-RMC/KEPU 5/3 (006/2023).

DECLARATION OF CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest concerning the preparation and publication of this article.

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Nutrition Management for Acute Stroke with Right-Sided Hemiparesis: A Case Study

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ABSTRACT

This case study aims to report on the nutrition management of acute stroke with right-sided hemiparesis using an approach of early enteral feeding intervention to prevent malnutrition. Mr. R, a 77-year-old Malay man was admitted to the hospital due to an acute stroke with right hemiparesis with underlying disease of Atrial Fibrillation (AF), hypertension, type 2 Diabetes Mellitus (DM), Chronic Kidney Disease (CKD) stage 3b, and significant Peripheral Artery Disease (PAD). His BMI was 24kg/m² with a weight of 67kg and height of 1.67m, and he was presented with abnormal blood results. All his vital signs were normal, and he appeared lethargic. The patient was on bolus Nasogastric (NG) feeding via Ryle's tube with polymeric formula. Inadequate enteral nutrition infusion related to infusion volume not yet reached, as evidenced by a 47% energy and 60% protein adequacy feeding history. The polymeric formula was changed to a diabetic-specific formula for better blood sugar control, and feeding was given according to the patient's needs. Mr. R required at least 70% of 1,675 kcal of energy and 53.6 g of protein (0.8 g/kg body weight) to prevent malnutrition. The patient was still on Ryle's tube feeding and already achieved the targeted energy and protein requirements. Before being discharged, the patient was allowed orally, and a sample menu was given as guidance to avoid weight loss and muscle wasting during long-term recovery. This case highlights the importance of early enteral feeding support in stroke recovery and the need to prioritize meeting nutritional needs in stroke patient care. Mr. R showed improvement in health and nutrition and concluded that early and focused enteral nutrition support can lead to improved results and better quality of life for stroke survivors.

Keywords: dysphagia, enteral nutrition, malnutrition, post-stroke nutrition, stroke

INTRODUCTION

Dysphagia is the patient's medical condition with swallowing difficulties (WHO 2019). Most patients with stroke commonly have a dysphagia problem, which usually leads to malnutrition if not appropriately addressed (Hien *et al.* 2022). In stroke patients, it may increase the risk of pulmonary complications and mortality (Grossmann *et al.* 2021). One of the ways to prevent malnutrition for patients with stroke and dysphagia is through early initiation of enteral nutrition (EN) (Sabbouh & Torbey 2018). Patients treated with EN within 72 hours of admission in the stroke unit have better nutrition test results at 21 days than those receiving family-managed food. Early EN improves neurological performance,

aiding the recovery of neurological functions (Zheng *et al.* 2015). Early EN aims to meet the nutritional needs of patients who cannot eat or tolerate regular oral intake due to various medical conditions such as stroke, surgery, or trauma. By initiating EN early, healthcare providers aim to prevent malnutrition, preserve lean body mass, improve immune function, reduce the risk of infections, and promote better patient outcomes (Koontalay *et al.* 2021). Challenges in early EN are encountered in clinical settings, particularly among critically ill patients. One primary challenge lies in gastrointestinal tolerance, as some individuals may experience difficulties such as abdominal distension, diarrhea, or vomiting when initiating EN early, necessitating careful monitoring and adjustments. Furthermore, there

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(Received 11-08-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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is a risk of aspiration, particularly in patients with compromised swallowing abilities, which requires a delicate balance to ensure safe EN delivery (Wischmeyer 2021).

Pathophysiology

A stroke, also known as a Cerebrovascular Accident (CVA), is a medical condition that occurs when blood flow to the brain is suddenly disrupted, leading to brain cell damage or death. This disruption can happen due to a blockage of a blood vessel, classified as ischemic stroke, or the rupture of a blood vessel, causing bleeding into the brain and is classified as hemorrhagic stroke (Kuriakose & Xiao 2020). When a stroke occurs, the affected part of the brain is deprived of oxygen and nutrients, resulting in various neurological deficits depending on the location and extent of the brain injury. These deficits may include weakness or paralysis on one side of the body (hemiparesis), speech difficulties (aphasia), vision problems, coordination issues, and other cognitive or sensory impairments (Musuka *et al.* 2015). Risk factors for stroke include non-modifiable factors such as age, race, and ethnicity, and modifiable factors such as a smoking habit, lack of physical activity, and medical conditions such as hypertension, Atrial Fibrillation (AF), diabetes, and cardiovascular disease. Stroke treatment is highly individualized, and the specific approach may vary based on the patient's age, overall health, time since symptom onset, and other factors. Early recognition of stroke symptoms and seeking immediate medical attention can improve the chances of successful treatment and recovery. Stroke can have significant nutrition implications in terms of prevention and post-stroke care. Primarily, dietary choices are a key factor in stroke prevention. A diet high in saturated fats, trans fats, and sodium, and low in fruits, vegetables, and whole grains can elevate stroke risk, emphasizing the importance of promoting a diet rich in healthier options. The Dietary Approaches to Stop Hypertension (DASH) diet was recommended by promoting the consumption of fruits, vegetables, and low-fat dairy products while advocating for reduced intake of saturated fat, overall fat, and cholesterol. It encouraged the inclusion of whole grains, poultry, fish, and nuts while discouraging the consumption of red meat, sweets, and sugar-containing beverages (Spence 2018). Alcohol

consumption, substance abuse, and smoking have varying impacts on stroke risk, depending on the type of stroke. For ischemic stroke, research suggests a J-shaped relationship with alcohol consumption. Light to moderate drinking, defined as up to 2 drinks daily for men and up to one drink daily for women, appears to provide some protection against stroke. In contrast, heavy alcohol consumption is linked to a heightened risk of ischemic stroke (Boehme *et al.* 2017). Nutritional deficiencies are a common concern for individuals who have experienced a stroke, often resulting in malnutrition, which is linked to reduced daily functioning and quality of life (Lee & Chiu 2021). Various stroke-related factors, such as dysphagia, limited upper limb mobility, visuospatial difficulties, increased catabolism, gastrointestinal issues, and depression, can contribute to malnutrition (Shiraishi *et al.* 2018). There is a close association between sarcopenia and inadequate dietary intake. Malnutrition or a lack of essential calories and nutrients can lead to muscle decline and potentially worsen post-stroke sarcopenia (Scherbakov *et al.* 2013). Therefore, assessing the nutritional status early and, if necessary, implementing nutritional interventions to enhance outcomes for individuals with sarcopenia following a stroke is crucial.

Patient profile

Mr. R, a 77-year-old Malay Man, government pensioner, used to work as a plan designer. He is married and blessed with six children. Before admission, the patient could do basic Activities of Daily Living (ADL) independently. His primary carer is his sixth daughter and grandson. He has underlying disease of Atrial Fibrillation (AF), hypertension, type 2 Diabetes Mellitus (DM), Chronic Kidney Disease (CKD) stage 3b, and significant Peripheral Artery Disease (PAD). The patient was admitted to the medical ward via the emergency unit due to sudden numbness in the face and arm and slurred speech. He was diagnosed with acute stroke with right-sided hemiparesis due to thromboembolic, uncontrolled DM, and Acute Kidney Injury (AKI) on CKD. He currently receives medications for treating his medical condition, which are T. Atorvastatin 40 mg ON, S/C Actrapid 6u PRN, T. Glyprin 100 mg OD, T. Omeprazole 20 mg OD, T. Bisoprolol 10 mg OD, and T. Metformin HCL XR 2 g OD. The patient was referred to a dietitian

on his third day of admission for nutrition optimization of enteral feeding.

NUTRITION ASSESSMENT

Anthropometry data

The patient's weight is 67 kg with a height of 1.67m, and the calculated Body Mass Index (BMI) is 24 kg/m², categorized as normal BMI for older adults (Winter *et al.* 2014). According to the patient's daughter, the patient does not show any recent signs of weight loss, as the patient was well before admission to the ward.

Biomedical data, medical tests, and procedures

Based on Table 1, his biochemical profile shows an elevated level of urea (13.1 mmol/L) and creatinine (123 µmol/L) due to his condition of AKI on CKD and high level of blood sugar (13.8 mmol/L) as the patient diagnosed with uncontrolled DM and a low level of red blood cell (3.9x10¹²/L) and hemoglobin (11.8 g/

dL) in blood. Besides, the patient has a normal reading of lipid profile and a slightly high level of c-reactive protein (5.6 mg/dL).

Nutrition-focused physical findings

All his vital signs are normal, and his Glasgow Coma Scale (GCS) score of 11/15 describes the patient as alert and conscious with incomprehensible sounds.

Food nutrition-related history

A Ryle's tube was inserted for nasogastric feeding initiation due to dysphagia and the patient received EN through bolus nasogastric tube feeding. The feeding was initiated by the ward nurse, and he currently receives a standard polymeric formula with a dilution of 3 scoops in 150 mL water, given every four hours and six times feeding daily providing 787 kcal, 32.4 g protein, 102.6 g carbohydrate, and 25.2 g fat. Based on Table 2, his energy intake is inadequate, and he only received 47% of his energy requirements.

Table 1. Mr. R's nutrition assessment data during the first dietitian visit on day 3 of admission

Nutrition assessment	Criteria	Normal range	Result	Interpretation
Anthropometry	BMI	18.5–24.9 kg/m ²	24 kg/m ²	Normal
Biochemical data, medical tests, and procedures	Urea	2.78–8.07 mmol/L	13.1	Above normal range
	Sodium	135–145 mmol/L	137	Normal
	Creatinine	44–80 µmol/L	123	Above normal range
	eGFR	>60 mg/mmol	48.0	Below normal range
	Red blood cell	4.5–5.5 x 10 ¹² /L	3.9	Below normal range
	Hemoglobin	12.0–15.0 g/dL	11.8	Below normal range
	Fasting blood sugar	4.0–6.0 mmol/L	8.3	Above normal range
	Random blood sugar	4.0–7.8 mmol/L	13.8	Above normal range
	Total cholesterol	<5.2 mmol/L	4.1	Normal
	Triglyceride	<1.7 mmol/L	1.3	Normal
	LDL cholesterol	<3.0 mmol/L	2.2	Normal
	HDL cholesterol	≥1.3 mmol/L	1.3	Normal
	C-Reactive protein	<5 mg/dL	5.6	Above normal range
Nutrition-focused physical findings	Blood pressure	<140/90 mmHg	119/79 mmHg	Normal
	Pulse rate	60–100 bpm	79 bpm	Normal
	Temperature	<37.5°C	36.3°C	Normal
	GCS	E4V6M5	E4V2M5	Alert and conscious with incomprehensible sound

BMI: Body Mass Index; eGFR: Estimated Glomerular Filtration Rate; GCS: Glasgow Coma Scale
HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein

All macronutrients are also inadequate, achieving 60% of protein requirements, 47% of carbohydrate requirements, and 39% of fat requirements.

NUTRITION DIAGNOSIS

Inadequate enteral nutrition infusion related to infusion volume not yet reached, as evidenced by feeding history, which only received 47% of energy and 60% of protein requirements, 0.5 g/kg body weight.

NUTRITION INTERVENTION

The short-term goal for Mr. R is to provide adequate energy and protein to prevent malnutrition by achieving at least 70% of the requirements (Arsava *et al.* 2018) and controlling the patient's blood sugar profile. His energy requirement is 1,675 kcal per day, which is calculated by multiplying with a factor of 25 kcal per kg body weight based on nutrition requirements for elderly stroke patients (Yuan *et al.* 2019), and his protein requirement is 53.6 g per day which is calculated by 0.8 grams per kg body weight. Protein was not given too high due to his condition of AKI on CKD (Ikizler *et al.* 2020). To achieve the goal, the standard polymeric formula was changed to a diabetic-specific formula for better blood sugar control, and feeding was prescribed with 4.5 scoops in 200 mL water, given every four hours with six times daily feedings. This feeding regime provides 1,231 kcal per day and 54 g per day of protein, indicating 74% and 100% of his energy and protein requirements, respectively. He was only able to achieve 74% of the energy requirements due to the restriction of protein because of his kidney condition which is considered adequate as the patient's goal is to achieve at least 70% of the calculated energy requirement.

NUTRITION MONITORING & EVALUATION

The patient was monitored by assessing his biochemical data changes and nutrition-focused physical findings, including vital signs as mentioned in Table 3. There were no changes in BMI during the follow-up visit, seven days after the first visit by the dietitian. The renal profile shows improvements with decreasing trend of urea and creatinine levels with readings of 10.4 mmol/L and 95 μ mol/L respectively, but sodium levels dropped to below range with readings of 132 mmol/L. Red blood cell values show improvement even though not yet reached the normal range with a value of $4.2 \times 10^{12}/L$, and hemoglobin level shows improvement and achieved the normal range with a value of 12.5 g/dL. Both fasting blood sugar and random blood sugar showed improvement and achieved normal range values with readings of 5.9 mmol/L and 7.0 mmol/L respectively. All his vital signs were maintained in the normal range but with a slight drop in GCS to 9/15, indicating decreased alertness with incomprehensible sounds.

Food-nutrition-related history shows the patient tolerates enteral feeding because there is no gastric residual volume, diarrhea, vomiting, or gastrointestinal bleeding. Based on Table 4, the patient achieved the target goal of energy with at least 70% of the requirement, 1,231 kcal as prescribed. For macronutrients, the patient was able to achieve 100% protein requirement with 54 g/day and 0.8 g/kg body weight. Carbohydrates only reached 64% of the calculated requirement, 140.4 g/day out of the goal due to the use of a diabetic-specific formula with lower carbohydrate content. Fat can meet over 70% of the daily requirement with 45.9g/day, which is 71% of the requirement.

Table 2. Comparison of current intake and requirement for Mr. R's food nutrition-related history during the first dietitian visit on day 3 of admission

Nutrition assessment	Criteria	Current intake	Requirement	Interpretation
Food nutrition-related history	Energy	787 kcal	1,675 kcal	Inadequate intake
	Protein	32.4 g	53.6 g	Inadequate protein
	Carbohydrate	102.6 g	217.8 g	Inadequate carbohydrate
	Fat	25.2 g	65.1 g	Inadequate fat

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Table 3. A comparison of the nutrition assessment data of Mr. R during the first visit (day 3) and follow-up visit (day 10) by the dietitian

Nutrition assessment	Criteria	Normal range	First visit (Day 3)	Follow-up visit (Day 10)	Interpretation
Anthropometry	BMI	18.5–24.9 kg/m ²	24 kg/m ²	24 kg/m ²	No changes
Biochemical data, medical tests, and procedures	Urea	2.78–8.07 mmol/L	13.1	10.4	Decreased
	Sodium	135–145 mmol/L	137	132	Decreased
	Creatinine	44–80 µmol/L	123	95	Decreased
	eGFR	>60 mg/mmol	48.0	66	Increased
	Red blood cell	4.5–5.5 x 10 ¹² /L	3.9	4.2	Increased
	Hemoglobin	12.0–15.0 g/dL	11.8	12.5	Increased
	Fasting blood sugar	4.0–6.0 mmol/L	8.3	5.9	Decreased
	Random blood sugar	4.0–7.8 mmol/L	13.8	7.0	Decreased
	Total cholesterol	<5.2 mmol/L	4.1	No data	Normal
	Triglyceride	<1.7 mmol/L	1.3	No data	Normal
	LDL cholesterol	<3.0 mmol/L	2.2	No data	Normal
	HDL cholesterol	≥1.3 mmol/L	1.3	No data	Normal
	C-Reactive protein	<5 mg/dL	5.6	4.0	Decreased
	Nutrition-focused physical findings	Blood pressure	<140/90 mmHg	119/79 mmHg	121/80 mmHg
GCS		E4V6M5	E4V2M5	E2V2M5	Decreased alertness with incomprehensible sound

BMI: Body Mass Index; eGFR: Estimated Glomerular Filtration Rate; GCS: Glasgow Coma Scale
HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein

Table 4. A comparison of the food-nutrition-related history of Mr. R during the first visit (day 3) and follow-up visit (day 10) by the dietitian

Nutrition assessment	Criteria	Requirement	Intake first visit (Day 3)	Intake follow-up visit (Day 10)	Interpretation
Food nutrition-related history	Energy	1,675 kcal	787 kcal	1,231 kcal	74% (Achieved goal >70%)
	Protein	53.6 g	32.4 g	54 g	100% (Achieved goal)
	Carbohydrate	217.8 g	102.6 g	140.4 g	65% (Inadequate carbohydrate)
	Fat	65.1 g	25.2 g	45.9 g	71% (Achieved >70%)

The patient was allowed discharge after 11 days of admission. Before discharge, the patient was reviewed by the speech-language therapist to assess his swallowing ability. Based on the assessment, the patient could tolerate mixed porridge and thin liquid consistency; thus,

Ryle's tube was removed. The patient was given a discharge plan which included a 1,600 kcal menu with mixed porridge and thin liquid consistency suitable for his diabetic and post-stroke condition. A sample of the menu is provided in Table 5.

Table 5. Sample menu of 1,600 kcal with mixed porridge and thin liquid consistency

Meals	Food	Portion
Breakfast 6.00–8.00 am	Mixed vegetables and tofu porridge	2 cups
	- Brown rice porridge	2 cups
	- Mixed vegetables	½ cup
	- Firm tofu, diced	½ cup
	- Oil	2 teaspoons
	Tea 'o' without sugar	1 cup
Morning tea 10.00 am	Papaya and chia seed porridge	1 cup
	- Papaya, diced	½ cup
	- Chia seeds	2 tablespoons
	- Skimmed/low-fat milk	2 tablespoons / ½ glass (60 mL)
Lunch 1.00–2.00 pm	Chicken and spinach porridge	2 cups
	- Rice porridge	2 cups
	- Chicken breast, diced	1 medium size (120 g)
	- Spinach	1 cup
	- Oil	2 teaspoons
	Plain water	1 glass
Afternoon tea 4.00 pm	Rolled oat porridge with mixed nuts	1 cup
	- Rolled oat	3 tablespoons
	- Mixed nuts, chopped	2 tablespoons
	- Skimmed/low-fat milk	2 tablespoons / ½ glass (60 mL)
Dinner 7.00–8.00 pm	Fish and asparagus porridge	2 cups
	- Rice porridge	2 cups
	- Fish fillet	1 fillet (120 g)
	- Asparagus, chopped	½ cup
	- Oil	2 teaspoons
	Plain water	1 glass
Supper 10.00 pm	Greek yogurt	½ cup
	+ mixed berries	½ cup

DISCUSSION

The comparison of first and follow-up visits shows an improvement in biochemical data analysis, vital signs, and food-nutrition-related history. Positive improvement in red blood cell value and hemoglobin level might indicate the patient received adequate energy and protein. Blood sugar profile also showed an

improvement because of changing to a diabetic-specific formula. Food-nutrition-related history shows the patient achieving the target goal with at least 70% of the nutrient requirement. This patient received 74% of the energy requirements and 100% of the protein requirements on day 3, after 72 hours of admission after being seen by a dietitian for the first visit. There is a limitation for achieving 100% of the intended calories due to

the restriction of protein because of the patient's underlying disease of CKD. For adequate enteral feeding, it is recommended to administer at least 70% of the intended calorie and protein amounts within the initial 48 to 72 hours of admission (Arsava *et al.* 2018). EN support is a valuable approach to meeting the nutritional needs of individuals with dysphagia after an acute stroke (Ojo & Brooke 2016). The European Society of Intensive Care Medicine (ESCI) advocates for the utilization of early EN to improve results and decrease mortality rates in critically ill patients, even those who have experienced ischemic and hemorrhagic strokes (Reintam Blaser *et al.* 2017).

This case study of Mr. R provides several critical learning points. It emphasizes the importance of assessing a patient's nutritional status through measures such as BMI, biochemical profiles, and food-nutrition-related history. Mr. R's normal BMI and the absence of recent weight loss suggested that his nutritional issues were primarily linked to his medical condition rather than chronic malnutrition. Mr. R's specific medical conditions, including uncontrolled diabetes and acute kidney injury on chronic kidney disease, necessitated adjustments in his enteral feeding regime. Switching to a diabetic-specific formula helped in better blood sugar control while considering his kidney function by giving protein of 0.8 g/kg body weight. The importance of setting short-term goals tailored to the patient's overall health objectives is another key learning point. In this case, the short-term goal was to provide adequate energy and protein to prevent malnutrition while controlling blood sugar levels. Achieving at least 70% of calculated energy requirements was considered sufficient, considering the constraints imposed by the patient's kidney condition. Continuous monitoring of the patient's progress, both biochemically and through physical findings, was crucial. The improvements seen in Mr. R's renal profile, red blood cell values, hemoglobin levels, and blood sugar levels demonstrated the effectiveness of the nutritional interventions. However, it's essential to remain vigilant for any changes in vital signs, as a drop in the Glasgow Coma Scale (GCS) indicated decreased alertness in this case. In future cases like this one, it's important to optimize the patient's nutritional intake, closely monitor their biochemical markers, and adjust the nutrition plan as needed to achieve optimal outcomes.

Additionally, effective communication among the healthcare team and promptly addressing any changes in the patient's condition will be essential for providing comprehensive care.

CONCLUSION

Mr. R's health and nutrition have improved since the first assessment. He has made progress in his condition, showing positive outcomes in blood tests, vital signs, and dietary patterns. The patient was able to receive more than 70% of the essential nutrients required and his blood sugar improved. Mr. R's case highlights the significance of tailored nutritional interventions in stroke survivors' recovery. Early and focused enteral nutrition support can lead to improved results and a better quality of life during the critical phase of stroke rehabilitation.

CONSENT

Verbal consent has been obtained from the patient.

ACKNOWLEDGEMENT

We would like to express my gratitude to Hospital Al-Sultan Abdullah for providing me with the opportunity to handle this case. This study was funded by Universiti Teknologi MARA, 600-RMC/KEPU 5/3 (006/2023).

DECLARATION OF CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest concerning the preparation and publication of this article.

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The Relationship between Folic Acid Intake and Depression among College Students

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ABSTRACT

The aim of this study was to investigate the relationship between folic acid intake and the incidence of depression among students of Universitas Muhammadiyah Surakarta, department of Nutrition. This cross-sectional study recruited 40 participants following the inclusion criteria. Sample collection was done by random sampling. Data collection on the adequacy of folic acid intake was carried out using the non-consecutive three days 24 four Food recall. The prevalence of depression was obtained by measuring the level of depression in the last two weeks using the Beck Depression Inventory-II (BDI-II) questionnaire. The results showed that 2.5% of the subjects had sufficient folic acid intake and 97.5% had insufficient folic acid intake with mean 78,5 mcg. About 47.5% of subjects experienced minimal depression, 20% experienced mild depression, 25% experienced moderate depression, and 7.5% experienced major depression with mean score 13.4. Futher analysis, the p-value ($p=0.145$) indicated that there was no significant relationship between folic acid and depression status. Recommended for using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to see acid intake folate and pay attention to other factors that cause depression.

Keywords: depression, folic acid

INTRODUCTION

The college period is a challenging time for students because of the amount of responsibility and busyness such as the demands of completing various kinds of assignments, and programs, and preparing a thesis to end their studies as a condition for obtaining a bachelor's degree (Monk FJ *et al.* 2002). These demands and responsibilities often become a pressure for students and cause psychological problems that often occur such as stress, anxiety, and depression (Sutjiato 2015). In Indonesia, more than 19 million people aged over 15 years experience emotional mental disorders, and more than 12 million people experience depression (MoH RI 2018).

Depression can occur due to a neurochemical imbalance in the part of the brain that is responsible for regulating mood, anxiety, and fear. Folic acid is a nutrient that plays an important role in various methylation reactions in the body such as the synthesis and methylation of brain neurotransmitters (Bjelland *et al.* 2003). Folic acid also plays a role in reducing the risk of neurological disorders such

as dementia, decreased cognitive function, and depression by suppressing homocysteine levels in the blood which, if increased, can cause hyperhomocysteinemia (Zhao *et al.* 2013).

Folate is consumed in the form of Dihydrofolate (DHF) which will then be converted to Tetrahydrofolate (THF). THF is then converted to 5,10 methyltetrahydrofolate (5, 10-MTHF) which is a substrate for the formation of 5-methyltetrahydrofolate (5-mthf) which functions as a methyl group donor in various methylation reactions including in the brain (Sharp & Little 2004; Tan *et al.* 1977). The 5-MTHF compound provides a methyl group for the homocysteine remethylation process to become a methionine compound which acts as a substrate in the formation of S-adenosylmethionine (SAM). Sam acts as a methyl donor in the methylation reactions of DNA, RNA, various neurotransmitters, and phospholipids in the central nervous system and histones. Therefore, folic acid deficiency will cause depression because it will inhibit the synthesis of neurotransmitters and inhibit

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(Received 24-07-2023; Revised 22-09-2023; Accepted 01-12-2023; Published 31-01-2024)

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methylation processes in the brain such as dopamine, serotonin, and norepinephrine (Kever *et al.* 2012).

Several studies investigating the relationship between nutrition and depression have been conducted, such as Rethorst (2014) in a study in the *Journal of Clinical Psychiatry* which found that for the brain to work properly, it is necessary to have an adequate amount of folic acid needed by the brain (Rethorst *et al.* 2014). However, limited studies were conducted in Indonesia regarding the relationship between intake of nutrients and folic acid with depression has not been widely carried out.

Based on a preliminary survey conducted on 20 Nutrition students at the Universitas Muhammadiyah Surakarta, it was shown that out of 20 students, 75% experienced depression, with details of 40% experiencing mild depression, 25% experiencing moderate depression, and 10% experiencing severe depression. In addition, all students have less folic acid intake. Therefore, this paper is aimed to investigate the relationship between folic acid levels and depression among nutritional science students at Universitas Muhammadiyah Surakarta.

METHODS

Design, location, and time

This study is an analytical observational study explaining the relationship between folic acid intake and the level of depression among nutrition students of the Universitas Muhammadiyah Surakarta. The design of this study uses a cross-sectional design that observes variables at the same time. The research was conducted in July 2023 and data collection was carried out at Muhammadiyah Surakarta Nutrition Study Program. The research code of ethics was obtained from the Health Research Ethics Commission, Faculty of Medicine, Universitas Muhammadiyah Surakarta with the ethical eligibility letter number 4929/B.1/KEPK-FKUMS/VII/2023.

Sampling

The population in this study were all 136 students of the Nutrition Study Program, Muhammadiyah University of Surakarta. The minimum sample size is determined using the Lemeshow formula and a sample size of 40

students was obtained. Sampling was done using a random sampling technique where everyone in the population has the same opportunity to be selected as a research subject. Sample selection was carried out randomly based on students who did not have a class schedule at the time of data collection.

Data collection

Folic acid intake was obtained using the Food Recall-24 hours form for 3 days nonconsecutive days to describe the eating habits of representative individuals (Gibson 2005). Individual food consumption amounts were obtained using a household measurement tool with a food photo book. The total intake of folic acid in three days was then averaged and compared with the Estimated Average Requirement (EAR) which was converted from the Nutritional Adequacy Figures 2019. EAR value is 320 mcg/day and then categorized into two categories, namely the adequate and inadequate category. Adequate category if the intake is more than or equal with 320 mcg/day and inadequate category if intake is less than 320 mcg/day.

Depression levels were obtained using the Beck Depression Inventory-II (BDI-II) questionnaire within the last two weeks of the Indonesian version which was tested for validity and reliability by Ginting *et al.* (2013) in the Indonesian population. The results of the validity test showed that the Indonesian version of BDI-II showed a significant positive correlation with two parallel measures, namely DS14 ($r=0.52, p<0.01$) and with BAI ($r=0.52, p<0.01$) and significantly negatively correlated with two opposite measures, namely MSPSS ($r=-0.39, p<0.01$) and LOT-R ($r=-0.46, p<0.01$). The results of the reliability test showed that the Indonesian version of the 21 BDI-II question items had a Cronbach Alpha of 0.90 so they had sufficient to high consistency.

The BDI-II questionnaire is scored from 0–3 on a Likert scale for each question answer. The answer that best fits the indicators or criteria for depression will have the highest score (score 0 for answer choice A, score 1 for answer choice B, score 2 for answer choice C, and score 3 for answer choice D). The score of each respondent is then summed up and ranked based on the total BDI-II score (Beck *et al.* 1967). The scores from each question are then added up and categorized with a score of 0–16 for minimal depression,

score 17–19 for mild depression, score 20–28 for moderate depression, and score 29–63 for severe depression.

Data analysis

Univariate analysis. Univariate analysis was performed to analyze each variable. The analysis is descriptive and presented in the form of percentages and frequencies. The data was analyzed and the distribution displayed was data on gender, age, place of residence, folic acid intake and level of depression. Data were analyzed using several software such as Nutrisurvey to analyze recall data and SPSS to analyze all data.

Bivariate analysis. Bivariate analysis was carried out to examine the relationship between the independent variable and the dependent variable, namely between folic acid intake and the level of student depression. Before carrying out bivariate analysis, the data normality was tested using the Kolmogrov-Smirnov test. Since the data are normally distributed the correlation test is used to study the relationship between the independent and dependent variables.

RESULTS AND DISCUSSION

The research results consist of the results of bivariate and univariate analysis. Univariate analysis includes data on participants characteristics such as gender, age, place of residence, intake of folic acid, and level of depression. Bivariate analysis included the relationship between folic acid intake and the respondent's level of depression.

The general characteristics of participants in this study are presented in Table 1. Based on Table 1, it can be seen that of the 40 participants 95% of them were female and the rest were male. Majority of participants in this study were female 95%, n=38. There are several studies that state that gender also affects mental health in general, where depressed women are more likely to experience social isolation and withdraw (Otten *et al.* 2021).

Meanwhile, the age of most students was 21 years old with a total of 29 students (72.5%) and most participants resided in boarding houses with a total of 29 participants (72.5%). Data on the characteristics of the participants shows that the age range of the participants was 20–22 years old with the majority of participants

Table 1. Characteristics of participants (n=40)

Variable	n	%
Gender		
Male	2	5
Female	38	95
Age		
20	5	12.5
21	29	72.5
22	6	15
Place of residence		
Boarding house	29	72.5
Home	11	27.5
Total	40	100

aged 21 years (72.5%). This age is classified as young adulthood and a transitional period from adolescence (Terlizzi & Villarroel 2020). This is in line with other research which states that this age is the ideal age range for studying as a student so that they are very vulnerable to experiencing depression (Matsari & Ediati 2020).

The distribution of participants based on the level of depression is presented in Figure 1. Based on Figure 1, was shown that 47.5% of the participants were in the category of minimal or no depression, 25% experienced moderate depression, 20% experienced mild depression, and 7.5% experienced severe depression.

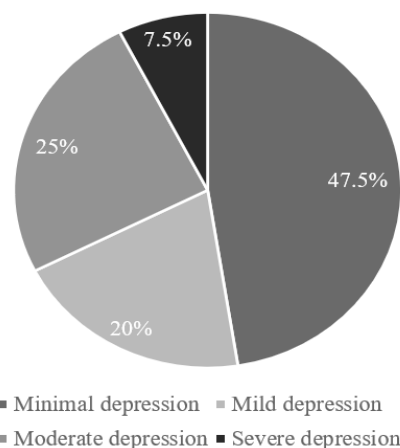


Figure 1. Distribution of participants based on level of depression

Meanwhile, the distribution of participants based on folic acid intake is presented in Figure 2. Based on Figure 2, it can be seen that out of 40 participants only 2.5% had adequate folic acid intake, and the remaining 97.5% had inadequate folic acid intake.

Depression is a impaired mental condition characterized by bad moods, feelings of guilt, loss of interest in everything, decreased concentration, loss of energy, hunger strikes, and sleep problems (WHO 2017). Based on the Pearson correlation test results in Table 2, it was concluded that there was no significant relationship between folic acid intake and depression in nutrition students of the Universitas Muhammadiyah Surakarta ($p=0.145$). These results indicate that folic acid intake is not a direct factor that influences the depression level of Nutrition Science students at the Universitas Muhammadiyah Surakarta.

Participants' folic acid intake tended to be inadequate (<320 mcg/day based on EAR). Lack of folic acid intake can be caused by a lack of awareness of the importance of meeting folic acid intake for health. In addition, most of the participants live in boarding houses and are far from their parents, so their eating patterns become less regular because the participants are focused on other things, such as obligations to do college assignments and demands to live independently.

Depression can be caused by other factors such as psychosocial conditions (Lidya *et al.* 2021), social support (Nurfatimah & Entoh 2017), and workload (Setiawati & Ismahmudi 2020). Therefore, when investigating the relationship between folic acid intake and depression levels, it is necessary to pay attention to other factors such as cognitive function and

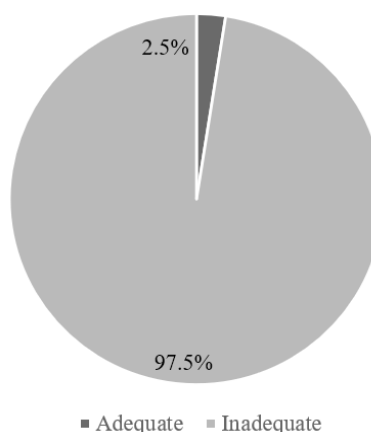


Figure 2. Distribution of participants based on folic acid intake

other psychosocial conditions. Based on the BDI-II questionnaire, it was found that the majority of participants experienced depression because of the many tasks and obligations that had to be completed simultaneously. Apart from that, some of the participants felt they had failed and were disappointed in their lives, which caused them to feel guilty and continue to grieve within themselves.

Another factor that can cause depression in students is physical condition. The tight lecture schedule and the large amount of subject matter that needs to be understood often reduces the time and quality of student rest. The quality of student sleep can influence levels of stress, anxiety and depression (Aryadi *et al.* 2018).

Symptoms of depression experienced by students consist of physical symptoms in the form of irregular sleeping, irregular eating, headaches,

Table 2. Distribution of participants' levels of ldepression based on folic acid intake

Level of depression	Folic acid intake						p
	Adequate		Inadequate				
	n	%	n	%	n	%	
Minimal depression	1	2.5	18	45	19	47.5	0.145
Mild depression	0	0.0	8	20	8	20	
Moderate depression	0	0.0	10	25	10	25	
Severe depression	0	0.0	3	7.5	3	7.5	
Total	1	2.5	39	97.5	40	100	

swollen eyes, aches, and fatigue, emotional symptoms, namely anxiety that gradually lasts a long time, is depressed, and irritability, symptoms of cognitive consists of loss of concentration, daydreaming, mind jumping and unable to focus, interpersonal symptoms arise in the form of not contributing to the surrounding environment, friends and family (Giyarto & Uyun 2018).

CONCLUSION

It can be concluded that there is no significant relationship between folic acid intake and level of depression as indicated by $p=0.145>0.05$. Therefore, it is hoped that future studies will be able to look further at the relationship between folic acid intake and student depression levels by taking into account other factors such as cognitive factors, psychosocial conditions, place of residence, and workload.

ACKNOWLEDGEMENT

This research can be successfully pursued with support from various sources. Therefore, the researcher would like to thank to Nutrition Science Study Program Universitas Muhammadiyah Surakarta for providing support and research grants in this research.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Association between Sleep, Stress and BMI with Chrononutrition Behaviors among Military Personnel in Malaysia

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ABSTRACT

This study aimed to find the association between sleep quality, stress level, and Body Mass Index (BMI) with the chrononutrition behaviors of military personnel. Six chrononutrition behaviors were assessed using the Chrononutrition Profile Questionnaire (CPQ). Sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI) and perceived stress using the Perceived Stress Scale (PSS-10). The associations between chrononutrition behaviors and sleep quality, stress level, and BMI were determined using the Fisher exact test. Data was collected from 210 participants (median age: 27.5 years). Most military personnel, 62% (n=129) experienced moderate stress. Approximately 59.2% (n=122) demonstrated poor sleep quality. Out of six chrononutrition behaviors, sleep quality was significantly associated with evening eating (p=0.004) and night eating (p=0.028). Stress level was significantly associated with evening eating (p=0.051), night eating (p=0.019), and eating window (p=0.014). No association was found between chrononutrition behaviors and BMI of military personnel. Chrononutrition behaviors are associated with sleep quality and stress level but not body mass index in military personnel. Further understanding of sleep quality and stress among military personnel is imminent to prevent future weight issues concerning altered eating behaviors in this population.

Keywords: BMI, chrononutrition, circadian rhythm, sleep quality, stress

INTRODUCTION

Chrononutrition can describe the association between food intake and the circadian clock and generally represents the timing of eating on health. It is acclaimed that sleep and food intake exhibit 24-hour patterns, and health problems can occur as a result of the interruptions of these patterns. Psychological, biological, and social factors may affect many nutritional behaviors and influence the behavioral components of chrononutrition. The chrononutrition behaviors that are possible to have a detrimental effect on health are breakfast skipping, the largest meal, evening eating, evening latency, night eating, and eating window (Veronda *et al.* 2020). Circadian rhythms play a vital function in the physiological processes involved in energy metabolism and balance. The alteration of the circadian clock is associated with changes in time of feeding behavior as well as increased weight gain (Engin 2017).

In emergencies, military personnel must be available 24/7, with working hours varying based

on unit and tasks. This leads to occasional work during unconventional hours. Shift work induces circadian misalignment, as the working timetable overlaps with the sleep-wake cycle, particularly affecting individuals on rotating, night, or early morning shifts (James *et al.* 2017). Working during the daytime has caused individuals to be active during their rest time, thus disturbing the circadian rhythm (James *et al.* 2017). Likewise, the timing of food intake will be modified, and the feeding–fasting cycle will be deliberately altered.

Military personnel reside and operate within an exclusive cultural environment characterized by physically, emotionally, and cognitively demanding tasks that can elevate the probability of encountering restricted food availability, heightened stress levels, and insufficient sleep, which can impact dietary behaviors (Cole *et al.* 2021). Given their physical training, military personnel are expected to be of normal weight compared to the general population. However, military personnel worldwide, particularly in the United States, Saudi Arabia, Czech Republic,

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(Received 17-07-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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Nigeria, and India, have been found to have a high prevalence of overweight and obesity (Aliyu *et al.* 2014; Horaib *et al.* 2013; Fajfrová *et al.* 2016; Ray *et al.* 2011; Reyes-Guzman *et al.* 2015).

In Malaysia, a previous study has shown that 29.3% of male Royal Malaysian Navy were overweight, and 7.2% were obese (Sedek *et al.* 2010). However, the study of body mass index among military personnel in Malaysia does not include chrononutrition, rendering the relationship unknown. Military personnel's social and physical environment is unlike the general population; therefore, detailed comprehension of the risk factors causing overweight and obesity is crucial. Thus, this study aimed to find the association between stress, sleep, and BMI with chrononutrition behaviors.

METHODS

Design, location, and time

A cross-sectional study was carried out to observe the association between sleep, stress, and BMI with chrononutrition behaviors among military personnel in Malaysia. Ethical approval of this research was obtained from UiTM ethical committees (REC/08/2021 (MR/701)).

Sampling

The sampling method in this study was convenient sampling to ensure the chance of each member of the subset being selected as a part of the sampling process was equal and bias could be avoided. The inclusion criteria for recruitment were Malaysian armed forces, including the Malaysian army, Royal Malaysian Air Forces, and Royal Malaysian Navy, aged 18 to 50 years old and still in service. The exclusion criteria were veterans or someone with a history of steroid use, either as medication or supplements.

Data collection

Informed consent was acquired from all subjects before recruitment into this study. All information was kept confidential. Participation in this research is entirely voluntary, and individuals have the right to decline participation or withdraw from the study without facing any negative consequences.

A set of questionnaires was distributed through Google Forms. Consented subjects were given a set of questionnaires that consisted of four

sections about sociodemographic characteristics, self-reported anthropometry, chrononutrition behaviors and preferences, sleep quality, and stress level.

Sociodemographic. The first section included data on age, gender, marital status, ethnicity, household income, education level, duration of services, health status, and employment. The employment questions were composed of the location of the workplace (military base), working hours (shift), unit, and rank.

Self-reported anthropometry. The respondents were required to measure their height and weight filled in centimetres (cm) for height and kilograms (kg) for weight. The data collected was used to calculate the Body Mass Index (BMI) by using the formula $BMI = \text{Weight (kg)} / (\text{Height (m)})^2$. BMI was classified based on the World Health Organization (WHO) as underweight (<18.5), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), or obese class I (30.0–34.9 kg/m²), II (35.0–39.9 kg/m²) and III (≥ 40 kg/m²).

Chrononutrition behaviors and preferences. The validated Chrononutrition Profile Questionnaire (CPQ) was used to assess the individual chrononutrition behaviors, sleep timing, eating timing, and frequency. The questionnaire was translated into Malay language and also back translation. There were six components of chrononutrition behavior, which were breakfast skipping, largest meal, evening eating, evening latency, night eating, and eating window. They were assessed into good (scored 0), fair (scored 1), and poor (scored 2). The total chrononutrition profile score was obtained through the sum of six chrononutrition behavior scores and ranged from 0–12, in which 0 = 'Good chrononutrition status' while 12 = 'Poor chrononutrition status'.

Sleep quality. The validated Pittsburgh Sleep Quality Index (PSQI) was used to measure the sleep quality of participants. The total sum of the seven components produced one global score ranging from 0 to 21 points, with scores ranging from 0 to 5 indicating good sleep quality while scores ranging from 6 to 21 indicating poor sleep quality.

Stress level. The validated Perceived Stress Scale (PSS-10) consist of 10 items that was rated on a 5-point Likert scale, ranging from 0 (never) to 4 (very often). The total score was obtained

from the sum of the scores of each item and the reversed score of items 4, 5, 7, and 8. The PSS total scores ranged from 0 to 40, in which '0–13' is low stress, '14–26' is moderate stress, and '27–40' is high perceived stress.

Data analysis

All statistical analysis was performed using SPSS software. The normality of the distribution of continuous variables was assessed using Kolmogorov-Smirnov tests, where $p < 0.05$ is considered as not normal. Descriptive statistical analysis such as frequency and percentage were carried out to describe collected data of sociodemographics. Continuous data was reported in the median and interquartile range, while categorical data was reported in number and percentage. Fisher exact test was used to find the association between chrononutrition behaviors and body mass index categories, stress level, and sleep quality. The statistically significant variable outcome was indicated by $p < 0.05$.

RESULTS AND DISCUSSION

Characteristic of participants

Table 1 compares the characteristics of participants based on their Body Mass Index (BMI) categories. There was no significant association between the three different branches of the military with BMI categories ($p = 0.292$). However, the rank of the military personnel ($p = 0.001$) and duration of services ($p < 0.001$) were significantly associated with BMI categories. The age of the participants ranged from 18 to 50 years, with a median of 27.5 years. There were significant age differences between the three BMI categories. Gender had a significant association with BMI categories ($p < 0.01$).

Components of chrononutrition profile questionnaire

Table 2 details the components of the participants' Chrononutrition Profile Questionnaire (CPQ) in a week (seven days span). The average weekly sleep duration ranged from 0 to 8.73 hours, with the midpoint ranging from 1:26 a.m. to 7:23 a.m. One hundred eight participants did not sleep during the workday.

All components of the eating timing variable were significantly correlated between workday and free day ($p < 0.05$). Most participants

had lunch as their largest meal, with a frequency of 149 (71%), followed by dinner with a frequency of 41 (19.5%). The participants' breakfast skipping, nighttime snacking, and night eating behaviors ranged from 0 to 7 days per week, with a median of 1, 0, and 0.

Association between chrononutrition behaviors and BMI categories

Table 3 shows the chrononutrition behaviors with three cut-offs: good, fair, and poor with body mass index categories. Most of the participants had fair evening eating behaviors 145 (69.0%), good eating window 201 (95.7%), good breakfast skipping behaviors 110 (52.4%), good night eating behaviors 157 (74.8%), and fair scores for the largest meal 149 (71.0%). Almost half of the participants had good evening latency 87 (42.2%), while the other half had fair evening latency 99 (48.1%). All chrononutrition behaviors were not significantly associated with BMI categories ($p > 0.05$).

Association between chrononutrition behaviors and sleep quality

Table 4 depicts the chrononutrition behaviors with three cut-offs for good, fair, and poor sleep quality. No association was found between evening latency, eating window, breakfast skipping, and the largest meal with sleep quality. However, evening eating ($p = 0.004$) and night eating ($p = 0.028$) were found to have a significant association with sleep quality. Most of the participants had good night eating behaviors 154 (74.8%) and fair evening eating behaviors 141 (68.4%).

Association between chrononutrition behaviors and stress levels

Table 5 presents the association between chrononutrition behaviors and stress levels. The stress level was divided into three categories: low stress, moderate stress, and high perceived stress. There were no participants who had high perceived stress. Among all chrononutrition behaviors, evening eating ($p = 0.051$), eating window ($p = 0.014$), and night eating ($p = 0.019$) were significantly associated with stress.

Association between BMI and chrononutrition behaviors

I. Eating window. Our study found neither significant association between eating window

Table 1. Characteristics of participants (n=210)

Characteristics	Total (n=210)	Body mass index			<i>p</i>
		Underweight (n=5)	Normal (n=135)	Overweight/Obese (n=70)	
Branches ^b					0.292
Malaysian army	102 (48.6)	1 (0.5)	65 (31.0)	36 (17.1)	
Air Force	82 (39.0)	3 (1.4)	50 (23.8)	29 (13.8)	
Navy	26 (12.4)	1 (0.5)	20 (9.5)	5 (2.4)	
Rank ^b					0.001
Officer	86 (41.0)	2 (1.0)	56 (26.7)	28 (13.3)	
Non-commissioned officer	98 (46.7)	0 (0.0)	58 (27.6)	40 (19.0)	
Recruit	3 (1.4)	0 (0.0)	2 (1.0)	1 (0.5)	
Cadet officer	23 (11.0)	3 (1.4)	19 (9.0)	1 (0.5)	
Age ^a	27.5 (7)	21.0 (5)	26.0 (6)	30.5 (8)	<0.01
Gender ^b					<0.01
Male	160 (76.2)	0 (0.0)	101 (48.1)	59 (28.1)	
Female	50 (23.8)	5 (2.4)	34 (16.2)	11 (5.2)	
Live in barracks ^b					0.071
Yes	90 (42.9)	0 (0.0)	63 (30.0)	27 (12.9)	
No	120 (67.1)	5 (2.4)	72 (34.4)	43 (20.5)	
Working at night ^b					0.782
Yes	121 (57.6)	3 (1.4)	75 (35.7)	43 (20.5)	
No	89 (42.4)	2 (1.0)	60 (28.6)	27 (12.9)	
Frequency night work ^b					0.407
No	7 (3.4)	0 (0.0)	4 (2.0)	3 (1.5)	
Less than a week	102 (49.8)	3 (1.5)	68 (33.2)	31 (15.1)	
1–2 weeks	56 (27.3)	1 (0.5)	38 (18.5)	17 (8.3)	
≥3 weeks	40 (19.5)	1 (0.5)	22 (10.7)	17 (8.3)	
Education level ^b					0.336
High school	82 (39.0)	2 (1.0)	49 (23.3)	31 (14.8)	
Diploma	40 (19.0)	0 (0.0)	28 (13.3)	12 (5.7)	
Bachelor degree	75 (35.7)	3 (1.4)	52 (24.8)	20 (9.5)	
Postgraduate studies	13 (6.2)	0 (0.0)	6 (2.9)	7 (3.3)	
Ethnicity ^b					0.012
Malay	192 (91.4)	3 (1.4)	123 (58.6)	66 (31.4)	
Chinese	5 (2.4)	1 (0.5)	4 (1.9)	0 (0.0)	
Indian	5 (2.4)	1 (0.5)	1 (0.5)	3 (1.4)	
Others	8 (3.8)	0 (0.0)	7 (3.3)	1 (0.5)	
Marital status ^b					0.012
Single	99 (47.1)	4 (1.9)	82(39)	13(6.2)	
Married	108 (51.4)	0 (0.0)	51(24.3)	57(27.1)	
Separated	3 (1.4)	1 (0.5)	2(1.0)	0(0.0)	
Total household income ^b					
Less than RM2,500	62 (29.5)	2 (1.0)	49 (23.3)	11 (5.2)	
RM2,500–RM4,851	95 (45.2)	2 (1.0)	59 (28.1)	34 (16.2)	
RM4,851 per to RM10,970	45 (21.4)	1 (0.5)	21 (10)	23 (11.0)	
RM10,971 and above	8 (3.8)	0 (0.0)	6 (2.9)	2 (1.0)	

^aData between the groups were tested using the Kruskal-Wallis and reported as median (IQR); ^bData between the groups were analyzed using the Fisher exact test and reported as n (%)

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Table 2. Components of the chrononutrition profile questionnaire

Characteristic	Overall range	Average	Work day	Free day	<i>p</i>
Sleep timing variable					
Sleep duration (hr)	0.00–8.73	3.15 (4.01)	3.00 (6.0)	6.5 (2.0)	0.399 ^a
Sleep midpoint (hh:mm)	1:26–7:23	4:04 (1:56)	4:00 (3:00)	3:15 (1:30)	0.327 ^a
Eat timing variable					
Eating window (hr)	4.36– 3.43	8.76 (2.14)	12.00 (3.0)	12.00 (2.5)	<0.01 ^a
Morning latency (hr)	0.20–7.5	2.00 (1.50)	2.00 (1.50)	2.00 (1.50)	<0.01 ^a
Lunch latency (hr)	0.00–8.5	5.00 (1.54)	5.00 (1.50)	4.75 (1.50)	<0.01 ^a
Afternoon latency (hr)	3.5–12.29	7.50 (2.08)	7.50 (2.50)	7.50 (2.50)	<0.01 ^a
Evening latency (hr)	1.00 –15.71	5.29 (4.57)	5.75 (6.5)	3.50 (2.0)	0.01 ^a
Evening eating (hh:mm)	17:00–1:17	20:30 (1:43)	20:30 (2:00)	20:30 (2:00)	<0.01 ^a
Frequency variable					
Breakfast skipping (day/week)	0–7	1.0 (4) ^b			
Largest meal					
Breakfast		17 (8.1) ^c			
Lunch		149 (71.0) ^c			
Dinner		41 (19.5)			
Supper		3 (1.4) ^c			
Nighttime snacking (day/week)	0–7	3.0 (3) ^b			
Night eating (day/week)	0–7	0.0 (2) ^b			
Total chrononutrition profile score	0–9	4.0 (2) ^b			

^a*p*-value between the work day and free day was tested using Spearman's correlation; ^bData between groups were reported as median (IQR); ^cData were reported as n (%)

Table 3. Association between chrononutrition behaviors and body mass index categories

Chrononutrition behaviors	n	Cut off	Total	BMI categories			<i>p</i>
				Under weight n (%)	Normal n (%)	Overweight/ Obese n (%)	
Evening eating ^a	210	Good	45 (21.4)	0 (0.0)	30 (14.3)	15 (7.1)	0.471
		Fair	145 (69.0)	5 (2.4)	89 (42.4)	51 (24.3)	
		Poor	20 (9.5)	0 (0.0)	16 (7.6)	4 (1.9)	
Evening latency ^a	206	Good	87 (42.2)	1 (0.5)	52 (25.2)	34 (16.5)	0.331
		Fair	99 (48.1)	3 (1.5)	68 (33.0)	28 (13.6)	
		Poor	20 (9.7)	1 (0.5)	14 (6.8)	5 (2.4)	
Eating window ^b	210	Good	201 (95.7)	5 (2.4)	128 (61.0)	68 (32.4)	0.776
		Fair	9 (4.3)	0 (0.0)	7 (3.3)	2 (1.0)	
		Poor	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Breakfast skipping ^a	210	Good	110 (52.4)	3 (1.4)	71 (33.8)	36 (17.1)	0.639
		Fair	45 (21.4)	0 (0.0)	32 (15.2)	13 (6.2)	
		Poor	55 (26.2)	2 (1.0)	32 (15.2)	21 (10.0)	
Night eating ^a	210	Good	157 (74.8)	3 (1.4)	95 (45.2)	59 (28.1)	0.064
		Fair	35 (16.7)	2 (1.0)	24 (11.4)	9 (4.3)	
		Poor	18 (8.6)	0 (0.0)	16 (7.6)	2 (1.0)	
Largest meal ^a	210	Good	17 (8.1)	1 (0.5)	8 (3.8)	8 (3.8)	0.179
		Fair	149 (71.0)	2 (1.0)	97 (46.2)	50 (23.8)	
		Poor	44 (21.0)	2 (1.0)	30 (14.3)	12 (5.7)	

^aData between the groups were tested using the Fisher exact test and reported as n (%); ^bData between the groups were analyzed using the Kruskal-Wallis and reported as median (IQR)

Table 4. Association between chrononutrition behaviors and sleep quality

Chrononutrition behaviors	n	Cut off	Total	Sleep quality		p
				Good n (%)	Poor n (%)	
Evening eating ^a	210	Good	45 (21.8)	26 (12.6)	19 (9.2)	0.004
		Fair	141 (68.4)	55 (26.7)	86 (41.7)	
		Poor	20 (9.7)	3 (1.5)	17 (8.3)	
Evening latency ^a	202	Good	85 (42.1)	37 (18.3)	48 (23.8)	0.632
		Fair	98 (48.5)	41 (20.3)	57 (28.2)	
		Poor	19 (9.4)	6 (3.0)	13 (6.4)	
Eating window ^b	206	Good	197 (95.6)	83 (40.3)	114 (55.3)	0.086
		Fair	9 (4.4)	1 (0.5)	8 (3.9)	
		Poor	0 (0)	0 (0)	0 (0)	
Breakfast skipping ^a	206	Good	108 (52.4)	48 (23.3)	60 (29.1)	0.151
		Fair	44 (21.4)	20 (9.7)	24 (11.7)	
		Poor	54 (26.2)	16 (7.8)	38 (18.4)	
Night eating ^a	206	Good	154 (74.8)	70 (34.0)	84 (40.8)	0.028
		Fair	34 (16.5)	7 (3.4)	27 (13.1)	
		Poor	18 (8.7)	7 (3.4)	11 (5.3)	
Largest meal ^a	206	Good	16 (7.8)	7 (3.4)	9 (4.4)	0.967
		Fair	146 (70.9)	59 (28.6)	87 (42.2)	
		Poor	44 (21.4)	18 (8.7)	26 (12.6)	

^aData between the groups were analyzed using the Chi-square test ; ^bData between the groups were analyzed using the Fisher exact test

Table 5. Association between chrononutrition behaviors and stress levels

Chrononutrition behaviors	n	Cut off	Total	Stress level			p
				Low stress n (%)	Moderate stress n (%)	High perceived stress n (%)	
Evening eating ^a	210	Good	45 (21.4)	21 (10.0)	24 (11.4)	0 (0)	0.051
		Fair	145 (69.0)	57 (27.1)	88 (41.9)	0 (0)	
		Poor	20 (9.5)	3 (1.4)	17 (8.1)	0 (0)	
Evening latency ^a	206	Good	87 (42.2)	33 (16.0)	54 (26.2)	0 (0)	0.836
		Fair	99 (48.1)	38 (18.4)	61 (29.6)	0 (0)	
		Poor	20 (9.7)	9 (4.4)	11 (5.3)	0 (0)	
Eating window ^b	210	Good	201 (95.7)	81 (38.6)	120 (57.1)	0 (0)	0.014
		Fair	9 (4.3)	0 (0)	9 (4.3)	0 (0)	
		Poor	0 (0)	0 (0)	0 (0)	0 (0)	
Breakfast skipping ^a	210	Good	110 (52.4)	44 (21.0)	66 (31.4)	0 (0)	0.348
		Fair	45 (21.4)	20 (9.5)	25 (11.9)	0 (0)	
		Poor	55 (26.2)	17 (8.1)	38 (18.1)	0 (0)	
Night eating ^a	210	Good	157 (74.8)	69 (32.9)	88 (41.9)	0 (0)	0.019
		Fair	35 (16.7)	7 (3.3)	28 (13.3)	0 (0)	
		Poor	18 (8.6)	5 (2.4)	13 (6.2)	0 (0)	
Largest meal ^a	210	Good	17 (8.1)	5 (2.4)	12 (5.7)	0 (0)	0.312
		Fair	149 (71.0)	55 (26.2)	94 (44.8)	0 (0)	
		Poor	44 (21.0)	21 (10.0)	23 (11.0)	0 (0)	

^aData between the groups were analyzed using the Chi-square test ; ^bData between the groups were analyzed using the Fisher exact test

and BMI. Similarly, a study among adults with obesity or overweight showed no significant association between eating window and BMI (Popp *et al.* 2021). Typically, an eating window is defined as the time between the first and last eating events; however, this definition is prone to misreport actual mealtimes and unlogged (missed) meals (Popp *et al.* 2021). Ninety-five point seven percent (95.7%) of our samples had a good eating window, meaning their eating window was 12 hours or less. The inconsistent working hours of military personnel may affect their eating time and patterns. Eating habits were also substantially influenced by the modern lifestyle, which cause a prolonged eating phase of more than 14 hours daily (Gill & Panda 2015). The eating and fasting phases influence peripheral clocks and thus metabolism, which contributes to the development and progression of chronic disease (Heilbronn & Regmi 2020; Regmi & Heilbronn 2020).

II. Night eating. Night eating in this study is the days per week in which participants wake up at night to eat (Veronda *et al.* 2020). One population-based study among German adults reported a positive association between night eating and BMI among individuals aged 31 to 60, but only among younger or older adults within this age range (Meule *et al.* 2014). Consequently, in younger cohorts such as students, the relationships between night eating and weight may either be absent or only marginally apparent. In our study, there was no association between night eating and BMI, which could be attributed to the participant's age, as most of participants were young adults with a median age of 27.5.

III. Evening eating. Evening eating is the last eating event of the day (Veronda *et al.* 2020). We found no significant association between evening eating and BMI categories ($p=0.471$). Similarly, a study among Korean adults found that evening eating was not associated with obesity (Ha & Song 2019). Another study found that having late dinner and bedtime snack were associated with a higher risk of being overweight (Okada *et al.* 2019). Through chrononutrition, the evening is regarded as the time when one can quickly gain weight, but not in our study.

IV. Evening latency. Evening latency is the duration of time between the last eating event and sleep onset time (Veronda *et al.* 2020). The range for evening latency in this study was 1 hour to 15

hours 43 minutes. In this study, the association between evening latency and BMI categories was not significant ($p=0.331$). A significant correlation between eating dinner within three hours of going to bed and BMI was discovered by Watanabe *et al.* (2014). In our study, because some of the participants did not sleep during the workday, our findings for evening latency may be inaccurate due to circadian disrupting working hours.

V. Largest meal. Individuals that ate the most at breakfast were classified as exhibiting good chrononutrition behavior, those who ate the most at lunch were categorized as having fair chrononutrition behavior, and those who ate the most at dinner or supper were labeled with poor chrononutrition behavior. Our study found that most of the participants 149 (71.0%) had their largest meal during lunch. The association between the largest meal and BMI categories was not significant ($p=0.179$). To compare, a study on the timing of energy intake found no association between morning energy intakes with BMI (Wang *et al.* 2014). The study found that eating more of the total daily caloric intake at midday is linked to a lower risk of being overweight/obese while eating more at night is connected to a higher risk.

VI. Breakfast skipping. In this study, breakfast skipping was the frequency of days the breakfast is skipped, and good breakfast skipping behavior is for one or fewer days/week, fair for two to three days/week, and poor for four or more days/week. No association was found between breakfast skipping and BMI. However, a study by Watanabe *et al.* (2014) reported that skipping breakfast was associated with a higher prevalence of obesity. Another study on breakfast skipping but with a different population also found an association between breakfast skipping and obesity among older people (Otaki *et al.* 2017).

Association between sleep quality and chrononutrition behaviors

Sleep quality may affect health; however, in the population of military personnel, it does not appear to be a driver of weight gain since most poor sleepers have normal BMI. Poor sleep quality and inadequate sleep are viewed as 'normal' and 'unavoidable' among military personnel due to the nature of military operations and special missions that often require shift work, long-term field training, and fast deployment across multiple time zones (Yarnell & Deuster

2016). In our study, only evening eating and night eating were significantly associated with sleep quality. Similarly, the frequency of snacking and irregularity of night eating among Korean military service members were associated with poor sleep quality (Choi *et al.* 2022). In another study, late dinner was positively associated with poor sleep quality (Lopes *et al.* 2019).

Association between stress & chrononutrition behaviors

Military personnel can experience stress as a result of military exercises, continuous training, humanitarian missions, peacekeeping activities, interpersonal relationship tension, military rank issues, separation from family, and sleep problems (Sareen *et al.* 2007; Adams *et al.* 2013; Rigs & Rigs 2011; Don Richardson *et al.* 2014), as cited in Chou *et al.* (2016). We found more than half (n=129, 61.4%) of participants with moderate stress, while 81 (38.6%) with low stress.

Surprisingly, none of them had high perceived stress despite working in military service, which was ranked as one of the most stressful professions in 2018 (Jayne *et al.* 2020). Consistent with a study among United States Army, the mean perceived stress score of military personnel in the sample was in the moderate range, probably due to the many unique sources of stress faced by many soldiers (Jayne *et al.* 2020). A study among young male military recruits in compulsory service reported that 75% of the participants were low-stress and only 25% were higher-stress (Tonon *et al.* 2020).

It was reported that people who perceived themselves as more vulnerable to stress had fewer eating occasions (Barrington *et al.* 2014) and the presence of higher stress hormones was found in the person who eats later in the evening (Lucassen *et al.* 2013). Our study reveals a significant association between evening eating, night eating, and eating window with stress levels aligning with the findings of Tan & Chow (2014) that heightened stress levels were linked to increased eating dysregulation and emotional eating.

CONCLUSION

In summary, no association was found between chrononutrition behaviors and the BMI of military personnel. Chrononutrition behaviors were associated with sleep quality and stress level

but not body mass index in military personnel. Sleep quality was not associated with evening latency, eating window, breakfast skipping, and the largest meal. Evening eating and night eating were found to be associated with sleep quality. Among all chrononutrition behaviors, evening eating, eating window, and night eating were significantly associated with stress levels.

Our findings highlight the importance of considering the timing of intake relative to sleep and stress when studying the associations of meal timing with obesity. We encourage future research to examine the effects of meal timing on body mass index by using an experimental design, particularly randomized trials, to minimize bias. Based on our findings, future trials should consider other body composition measurements, as BMI may not accurately reflect the body fat and its distribution.

ACKNOWLEDGEMENT

We would like to thank subjects who participated in this research and Norbaizura binti Abu Bakar for assisting in data collection. This work is supported by Universiti Teknologi MARA and the Ministry of Higher Education Malaysia (FRGS/1/2021/SKK06/UITM/03/3).

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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The Effect of Caffeine Consumption on Sleep Quality among Undergraduate Students in Malaysia

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ABSTRACT

This study aims to determine the effect of caffeine consumption on sleep quality among university students. This was a cross-sectional study that used a quantitative approach method. The data for this study was collected using a structured online questionnaire and distributed via online platforms to identify eligible participants. All the participants self-administered all three sections of the questionnaire, which were sociodemographic variables, the caffeine questionnaire tool, and the Pittsburgh Sleep Quality Index (PSQI). A chi-squared test was used to investigate the association between caffeine intake and sleep quality and the measured study characteristics. About 300 students, with a mean age of 21.95 ± 1.43 years old, were recruited. The average caffeine intake of the study population was 193.54 mg per day. The respondents had good sleep quality was 44.7% while 55.3% had poor sleep. The study also found that there was a significant association between caffeine intake and sleep quality (p -value <0.01). Meanwhile, there was no significant association between sociodemographic characteristics and caffeine intake or sleep quality. This study shows that a student's excessive intake of caffeine is correlated with poor sleep quality. Therefore, prevention strategies should be used to raise awareness of the issue and understand how consuming too much caffeine might result in poor sleep quality.

Keywords: caffeine, Malaysia, sleep quality, students

INTRODUCTION

Caffeine is a naturally produced stimulant commonly present in tea, coffee, and cacao plants. It is stated that caffeine works by stimulating the brain and the central nervous system (Watson *et al.* 2016). The same study suggested that caffeine helps individuals in maintaining alertness and reducing the onset of fatigue. Nowadays, the use of caffeine is widespread, particularly among students. A research that was published in the National Library of Medicine found that 79% of college students who consume coffee also use caffeine to remain awake (Mahoney *et al.* 2019). According to the US Food and Drug Administration (FDA), healthy adults should not exceed 400 mg of caffeine per day in terms of recommended daily intake.

According to the Centers for Disease Control and Prevention (CDC 2022), people

need to get plenty of sleep because it can have a negative impact on their health. Additionally, university students are included in the more than one-third of American people who habitually lack sleep. Adequate sleep is important for university students since it significantly influences their general health and well-being. To stay focused, enhance concentration, and enhance academic performance, students should get the recommended amount of sleep at night. Centers for Disease Control and Prevention (CDC) recommended that individuals between the ages of 18 and 60 should aim to obtain a minimum of seven hours of sleep per night to enhance their overall health and well-being.

Different studies have been done to determine the effect of caffeine consumption on the quality of sleep. A study conducted by AlSharif *et al.* (2018) found that most college

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(Received 11-08-2023; Revised 22-09-2023; Accepted 27-10-2023; Published 31-01-2024)

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students had poor sleep quality. This was caused by consuming too many caffeine-containing beverages. Another study by Ngu *et al.* (2017) stated that most pre-clinical medical students in Malaysia have poor sleep quality. In the same study, it was also proven that poor sleep quality was associated with caffeinated beverage intake. However, in another study, it was stated that there was no association between subjective sleep quality and the amount of caffeine consumed, with higher amounts of caffeine consumed related to decreased time in bed (Watson *et al.* 2016).

The general objective of this study is to determine the effects of caffeine consumption on sleep quality among undergraduate students in Malaysia. Meanwhile, the specific objectives are to determine the daily caffeine intake that students usually consume among undergraduate students in Malaysia. Secondly, to assess sleep quality over the past month among undergraduate students in Malaysia. Lastly, to investigate the association between caffeine consumption and sleep quality among undergraduate students in Malaysia. In Malaysia, there has not been much research about the association between caffeine intake and sleep quality. Nowadays, university students tend to consume caffeine in their daily lives to increase wakefulness, overcome fatigue, and enhance cognitive performance. This can have a significant impact on their ability to sleep and their overall performance. Hence, by conducting this study, it can show how caffeine intake is associated with sleep quality.

METHODS

Design, location, and time

This was a cross-sectional study that uses a quantitative approach method. The location of the study was Malaysia. This includes both peninsular Malaysia and east Malaysia. This study was conducted among all undergraduate students in both public and private universities. The participants for this study will be undergraduate university students aged 18–24 years. The study was conducted from July 2022 to July 2023 among university students. The ethics application has been approved by the Faculty Ethics Review Committee (FREC), Universiti Teknologi MARA (UiTM), [reference number: FERC/FSK/MR/2023/0037].

Sampling

The sample size for this study was 300 participants. The sample size was calculated using the RaoSoft sample size calculator with a 95% confidence level, a 5.61% error margin, and a 50% response distribution. A convenience sampling method was used for this study. This sampling method was chosen by using judgment and deliberate effort to pick Malaysian students who meet specific criteria for this study. The inclusion criteria for this study include undergraduate university students aged 18–24 years from all programme, and the participant must be able to understand English as the questionnaire will be in English only. The participation of the participants was completely unpaid and voluntary. Meanwhile, international students and those who did not meet all the criteria for this study were excluded. The consent form and an explanation about the study and procedure were distributed together with the questionnaire.

Data collection

The data for this study was collected through a structured online questionnaire and distributed via online platforms to identify eligible participants. The questionnaire consists of three sections: 1) sociodemographic variables (Lieberman *et al.* 2019), which include age, gender, ethnicity, year of study, and type of university that the participants are currently staying at; 2) the caffeine questionnaire tool, where the participants will complete the 24-hour recall caffeine questionnaire form (Bühler *et al.* 2013); and 3) the Pittsburgh Sleep Quality Index (PSQI), which was a self-reported questionnaire including 19 items that assessed sleep quality over the preceding month. The participants self-administered all three sections of the questionnaire. The consent form and an explanation about the study and procedure were distributed together in the questionnaire.

Data analysis

The Statistical Package for Social Scientists (SPSS) Version 27 statistical analysis was used to analyse the research findings and data. To provide descriptive results, the mean, standard deviation, frequency, and percentage were used. The continuous variable, age and average caffeine intake were computed as Standard Deviation (SD) and mean. For categorical variables, gender,

ethnicity, year of study, type of university, caffeine intake and sleep quality, frequency and percentages were utilized. Independent t-test was used to determine the association between age and sleep quality while, for the association of age and caffeine intake, One-way ANOVA was used. The association between caffeine intake and sociodemographic variables as well as the association between caffeine intake and sleep quality will be examined using the Chi-square test. A statistical test is considered significant when the p-value is below the threshold of 0.05 ($p < 0.05$).

RESULTS AND DISCUSSION

Table 1. shows that the average age of the respondents is 21.95 ± 1.43 . In this study, 74.0% of the respondents are female students, while 26.0% are male, respectively. Based on the results, 18.7% of the participants were first-

Table 1. Sociodemographic characteristics of the participants (n=300)

Variables	n (%)
Age (Mean± SD)	21.95±1.43
Gender	
Male	78 (26.0)
Female	222 (74.0)
Ethnicity	
Malay	213 (71.0)
Chinese	37 (12.3)
Indian	19 (6.3)
Bumiputera (Sabah & Sarawak)	29 (9.7)
Others	2 (0.7)
Year of study	
First year	56 (18.7)
Second year	63 (21.0)
Third year	145 (48.3)
Fourth year	36 (12.0)
University	
Public university	227 (75.7)
Private university	73 (24.3)

SD: Standard Deviation

year students, followed by second-year (21.0%), third-year (48.3%), and fourth-year (12.0%). Among all respondents, 75.7% studied at a public university, while the other 24.3% studied at a private university.

Table 2 summarizes that 5.7% of the respondents reported no caffeine intake. In comparison, 80.0% of the respondents reported a tolerable caffeine intake, and the other 14.3% reported an excessive caffeine intake. Additionally, the average caffeine intake among the respondents was 193.54 ± 142.74 mg daily.

A study conducted in Bahrain reported that students' average daily caffeine intake was 268 mg (Jahrami *et al.* 2020). Kharaba *et al.* (2022) found that the average intake of caffeine for the total population of the study was 264 mg per day. In addition, Mahoney *et al.* (2019) found that the average caffeine intake was 159 mg daily in five universities in the United States,

The present study found that most university students (94.3%) consumed caffeine. The results were from students who had caffeine in a tolerable and excessive amount. Lohsoonthorn *et al.* (2013) stated in their study that 58% of students used stimulant beverages. In another study that was conducted at a public university in Malaysia, the mean daily caffeine intake among the students was 67.98% (Isa *et al.* 2021). A study conducted at a private university in Malaysia reported that most students consume caffeine from tea, coffee, soft drinks, and chocolate drinks (Isa *et al.* 2021). Most young adults consume a lot of energy drinks and other stimulants to avoid falling asleep and increase their academic performance (Sanchez *et al.* 2013). It was also reported that students consume caffeinated beverages to increase alertness and concentration during study, polish their memory,

Table 2. Caffeine intake of the participants (n=300)

Variable	n (%)	Mean±SD
Caffeine Intake		193.54±142.74
None	17 (5.7)	
Tolerable	240 (80.0)	
Excessive	43 (14.3)	

SD: Standard Deviation

and improve their mood (Kharaba *et al.* 2022; Peng *et al.* 2020).

Table 3 shows there was no association between sociodemographic variables (age, gender, ethnicity, year of study, type of university) and caffeine intake among undergraduate students in Malaysia. There was no association between gender and caffeine intake. This finding was supported by a study conducted at Zayed University in Dubai, which reported no association between gender and caffeine intake (M Al Ghali *et al.* 2017). Inconsistent with our findings, there was an association found between gender and caffeine intake, as female respondents have a higher average caffeine intake compared to male respondents (Kharaba *et al.* 2022).

A study conducted among the US adult population reported that ethnicity strongly shows

an association between ethnicity and caffeine intake (Lieberman *et al.* 2019). However, there is a lack of literature and discussion about the association between ethnicity or race and caffeine intake. In contrast, a study conducted at Florida State University among college students reported that levels of education were associated with caffeine intake. Additionally, it is found that people at higher levels of education usually consume more caffeine than those at lower levels of education (Bertasi *et al.* 2021). Limited studies also look for an association between years of study and caffeine. Additionally, there is a lack of literature about this relationship and a weak line between this association

Table 4 shows the results of the frequency and percentage of sleep quality among the respondents. Sleep quality was categorised into

Table 3. The association between sociodemographic factors and caffeine intake of the participants (n=300)

Variable	Caffeine intake			Total n	X ² (df)/ F (df)	p
	None n (%)	Tolerable n (%)	Excessive n (%)			
Age ^a (Mean± SD)	21.65±1.17	21.95±1.44	22.07±1.49	300	2.12 (2)	0.53
Gender ^b					3.69 (2)	0.16
Male	2 (2.6)	68 (87.2)	8 (10.3)	78		
Female	15 (6.8)	172 (77.5)	35 (15.8)	222		
Ethnicity ^b					4.54 (4)	0.81
Malay	13 (6.1)	169 (79.3)	31 (14.6)	213		
Chinese	3 (8.1)	28 (75.7)	6 (16.2)	37		
Indian	0 (0)	15 (78.9)	4 (21.1)	19		
Bumiputera (Sabah & Sarawak)	1 (3.4)	26 (89.7)	2 (6.9)	29		
Others	0 (0)	2 (100.0)	0 (0)	2		
Year of Study ^b					2.26 (2)	0.89
First year	3 (5.4)	43 (76.8)	10 (17.9)	56		
Second year	3 (4.8)	50 (79.4)	10 (15.9)	63		
Third year	10 (6.9)	116 (80.0)	19 (13.1)	145		
Fourth year	1 (2.8)	31 (86.1)	4 (11.1)	36		
University ^b					0.72 (2)	0.70
Public university	14 (6.2)	182 (80.2)	31 (13.7)	227		
Private university	3 (4.1)	58 (79.5)	12 (16.4)	73		

SD: Standard Deviation; ^aOne-Way ANOVA reported is in F (df) *p*-value; ^bChi-square test reported is in X² (df) and *p*-value

Effect of caffeine consumption on sleep quality among students

Table 4. Sleep quality of the participants (n= 300)

PSQI Score	n (%)
≤5 (Good sleep quality)	134 (44.7)
>5 (Poor sleep quality)	166 (55.3)

PSQI: Pittsburgh Sleep Quality Index

two groups: ≤5, which indicates good sleep quality, and >5, which indicates poor sleep quality. Based on the results, 44.7% respondents had good sleep quality and 55.3% respondents had poor sleep.

In the present study, 55.3% of the respondents showed poor sleep quality. The reasons half of the students had poor sleep quality might be related to their coursework, assignments, and activities at the university (Emmy *et al.* 2023; Ab Hamid *et al.* 2021). The present results were in line with previous studies. In a study in Ethiopia, Lemma *et al.* (2012) reported that more than half of the students (55.8%) had poor sleep quality. The prevalence of poor sleep quality was higher among university students in Saudi Arabia at 80% (AlSharif *et al.* 2018), which is higher than the present study. A study from Thailand reported that 48.1% of the participants had poor sleep quality (Lohsoonthorn *et al.* 2013). Most students consume caffeine to stay awake and result in poor sleep quality (Zhang *et al.* 2022). Many factors contribute to poor sleep quality, such as noise, cigarette smoke, and the quality of the air (Altun *et al.* 2012). Sleeping in a room with exposure to tobacco was the most chosen reason for poor

sleep quality for half the college students (Altun *et al.* 2012).

Sociodemographic variables such as age, gender, ethnicity, year of study, and type of university were found to have no statistical association with sleep quality. According to Mahoney *et al.* (2019), there is no correlation between gender and sleep quality, which is in line with the findings of this study. Even the study's results indicate that male students are likelier than female students to have poor sleep quality. However, there was no association between these two characteristics. However, it was reported female students have poor sleep quality compared to male students in Saudi Arabia (AlSharif *et al.* 2018). Nevertheless, the present study result is at par with a study done in Malaysia, which found no statistical association between ethnicity and sleep quality (Yi *et al.* 2022).

There was no association between the year of study and sleep quality. The reasons might be due to different coursework and academic schedules that eventually lead to the student's daily routine. In line with the current study, a study conducted in Korea reported that grade was not associated with sleep quality among non-smoking students (Choi 2020). However, there was a lack of clarification and discussion about the relationship between the current semester and sleep quality.

Table 5 highlighted that there was a significant association between caffeine intake and sleep quality among undergraduate students in Malaysia ($p < 0.01$). The results of this study are in line with previous studies. A study conducted in Saudi Arabia stated that 476 college students with high caffeine intake had poor sleep quality

Table 5. The association between caffeine intake and sleep quality of the participants using Chi square test (n=300)

Variable	Sleep quality		Total n	X ² (df)	p
	Good n (%)	Poor n (%)			
Caffeine Intake ^b				25.12 (2)	<0.01*
None	15 (88.2)	2 (11.8)	17		
Tolerable	111 (46.3)	129 (53.8)	240		
Excessive	8 (19.2)	35 (81.4)	43		

^bChi-square test reported in X² (df) and p-value; *Significant of p-value < 0.01

compared to those who did not take any caffeine (AlSharif *et al.* 2018). According to Lemma *et al.* (2012), 75% of the students with high caffeine intake have poor sleep quality compared to students with good sleep quality. Vélez *et al.* (2013) also found that caffeine intake was associated with poor sleep quality, especially for those who consume energy drinks.

O'Callaghan *et al.* (2018) stated that caffeine can improve performance; however, the most known side effect is sleep deprivation. One study found that 400 mg of caffeine taken 0, 3, or 6 hours before bedtime significantly interrupts sleep, and the findings for this study also stated that even at 6 hours, caffeine reduces sleep time by more than an hour (Drake *et al.* 2013). Snel and Lorist (2011) reported in their study that caffeine is one of the stimulants that can produce harmful effects on sleep quality, as it has already proven its effectiveness in counteracting sleepiness. Adenosine increases drowsiness, improves slow wave activity during sleep, and lowers the electroencephalogram (Nehlig 2015), while caffeine, an adenosine-receptor antagonist, primarily affects performance via occupying the adenosine receptor (Van Donghen *et al.* 2001). Additionally, caffeine acts primarily on adenosine A1 and adenosine A2A receptors that are related to the function of the brain and are associated with sleep, arousal, and cognition (Ribeiro & Sebastio 2010). In another study, it is mentioned that the presence of caffeine and its main paraxanthine will trigger a change in the adenosine system and will affect sleep (Reichert *et al.* 2022).

CONCLUSION

In conclusion, this study also demonstrates that the majority of the study population consumes caffeine daily while more than half of university students had poor sleep quality. This study also highlighted that there is an association between caffeine intake and sleep quality among undergraduate students in Malaysia.

Hence, to limit daily caffeine intake among students, individuals and the community need to spread awareness regarding this issue so that they become more aware of the negative health outcomes that will happen to them. In addition, the university also plays an important role in handling this issue, as they can limit the number of vending machines that sell caffeinated

beverages to reduce the caffeine intake among university students.

ACKNOWLEDGEMENT

We would like to express our gratitude to the University Technology MARA Faculty Ethics Review Committee for approving and allowing us to conduct this research, as well as the Faculty of Health Science, which has helped with this research in any way. Last but not least, we would also like to thank all the students who agreed to participate in our study.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Knowledge, Attitude and Behavior of Dietary Salt Intake among Staff at a Public University in Selangor

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ABSTRACT

This study examines knowledge, attitude and behavior related to dietary salt intake among UiTM Puncak Alam staff. A cross-sectional study was conducted among 300 UiTM Puncak Alam staff. Respondents were recruited conveniently to complete a self-administered questionnaire that provides information on knowledge, attitude and behavior related to dietary salt. Descriptive statistics were used to report the survey findings. Results showed that most of the respondents (95.7%) had a knowledge that overeating salt could damage their health. However, only 35.7% of the respondents recognized the daily recommendation of salt intake and 40.0% of them were able to identify the difference between salt and sodium. Regarding attitude, only 28.3% of respondents believed their salt intake would exceed dietary guidelines. In practice, 31.4% of respondents controlled their salt intake by avoiding consuming processed food, and 18.0% referred to salt labels on food packages. This study showed that UiTM Puncak Alam staff was knowledgeable on particular aspects of salt. However, their attitudes are less favorable, and they need to improve their practices toward dietary salt intake to achieve target salt intake.

Keywords: attitude, behavior, hypertension, salt, knowledge

INTRODUCTION

Sodium chloride (NaCl), called 'salt', is an essential micronutrient that stimulates salty taste. Sodium chloride provides many functions, especially in improving food's sensory properties by increasing saltiness, reducing the bitterness in food, and other flavor effects (Li *et al.* 2022). While sodium is essential for normal human functioning, current dietary sodium intake far exceeds the recommended level for good health (Patel & Joseph 2020). The 2017 Recommended Nutrient Intake for Malaysia recommends that people aged nine years and above consume less than 1,500 mg of sodium daily (RNI 2017). A previous study that investigates the dietary intake of salt among Malaysian found that the sodium intake was 1,696 mg per day, which exceeded the recommended intake of 1500mg per day (Lee & Wan Muda 2019). In addition, based on the Malaysia National Health and Morbidity Survey 2019, it was found that 6.4 million people of Malaysians are suffers from hypertension (Institute for Public Health (IPH) 2019).

Based on a previous study, there is clear evidence of a strong positive relationship between sodium intake and blood pressure. Overconsumption of dietary sodium is highly associated with increased blood pressure or hypertension, a risk factor for cardiovascular diseases (Grillo *et al.* 2019). In Malaysia, the leading cause of Cardiovascular Disease (CVD) death in 2016 was coronary artery disease at 13.2% followed by stroke at 6.9% (Sazlina *et al.* 2020). Excess dietary sodium consumption has also been linked to numerous other adverse health effects, including gastric cancer, the development of chronic kidney disease, and osteoporosis (Strazzullo 2014). Reducing dietary salt intake reduces cardiovascular diseases, including hypertension and can lower the mortality rate (Unger *et al.* 2020). Therefore, many efforts are directed at developing and implementing strategies to reduce dietary salt intake.

Nutrition knowledge and beliefs are related to diet quality. Individuals with poor nutrition knowledge tend to consume low-quality diets, including a high-salt diet. A study also

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(Received 09-08-2023; Revised 22-09-2023; Accepted 27-10-2023; Published 31-01-2024)

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found that the rate of awareness and control of hypertension improved over time. However, when compared with other countries, Malaysian awareness and control of hypertension were still low (Naing *et al.* 2016). Awareness programs and activities, including World Salt Awareness Week, were introduced, specific tools were developed, and the Ministry of Health Malaysia introduced intervention programs to improve the knowledge, attitude, and behavior related to dietary salt intake among ministry staff and the public. They also introduced the "Salt Reduction Strategies to Prevent and Control NCD (non-communicable diseases), 2015–2020" policy which aims to reduce the mean salt intake among the public. As a result, this study aimed to evaluate consumers' knowledge, attitude and behavior before developing strategies to reduce dietary salt intake among consumers.

METHODS

Design, location, and time

A cross-sectional study design was employed in Universiti Teknologi MARA (UiTM) Selangor, Puncak Alam Campus, from July until October 2019.

Sampling

The sample size was estimated using an equation proposed by Krejcie and Morgan (1970). It was decided to have a total sample of 462 respondents in case of dropouts and incomplete questionnaires. A convenient sampling method was used to reach each participant. A total of 500 questionnaires were distributed to UiTM Puncak Alam staff, and 300 questionnaires were retained for analysis of the knowledge, attitude and behavior related to dietary salt intake among respondents after eliminating 65 questionnaires that were found to be incomplete. Only 300 respondents successfully participated in this study.

Data collection

A multicomponent questionnaire was used in this study. The questionnaire was adopted from The Victorian Survey-Knowledge, Attitude and Behaviors related to Dietary Salt Intake questionnaire (Grimes *et al.* 2017). It was pilot tested in 15 adults to test the reliability of the questionnaire. The questionnaires were distributed

to the staff at the faculties in UiTM Puncak Alam. Staff were appointed as liaison officers to help the researchers inform and distribute the questionnaire to the respective faculties. Ethical clearance and official permission were obtained from Universiti Teknologi MARA (UiTM) Research Ethics Committee (REC/418/19). Oral consent was obtained before enrolling in the study. The subjects' privacy and the confidentiality of the data was maintained.

Data analysis

All data were collected and analyzed using IBM SPSS software package version 21.0. Descriptive statistics, mean, standard deviation and proportion were used to describe respondent characteristics and responses to each question. The mean and the standard deviation were used for expressing the quantitative variables, and the relative frequencies and their percentage were used for describing categorical values variables.

RESULTS AND DISCUSSION

A total of 300 respondents agreed to complete the survey. Just over three-quarters (77.7%) of the sample were female, and the majority (96.3%) were Malay. The respondents' age were grouped into five groups: age group between 18 and 24 were 5.3%; between 25 and 34 years were 25.0%; between 35 and 44 years were 45.3%; between 45 and 54 years were 19.7% and those with age between 55 and 56 were 4.7%. By ethnicity, 96.3% were Malay and 3.7% were non-Malay (Table 1).

Most respondents (95.7%) knew overeating salt could damage their health (Table 2). Almost half (44.3%) of the respondents knew that most salt in the diet comes from processed foods. Nearly half (40%) of respondents could correctly identify the relationship between salt and sodium. Almost four-fifths (78%) believed Malaysians eat either far too much or too much salt. However, slightly more than a third (35.7%) of respondents could correctly identify the recommended maximum amount of salt to eat daily. Less than a third (28.3%) of respondents believed their salt intake would exceed dietary guidelines.

Figure 1 shows participants' level of agreement on a range of attitudes related to salt intake. Slightly more than two-thirds (67.7%) of respondents agreed that specialty salts are higher

Table 1. Socio-demographic characteristics of study participants (n=300)

Characteristics	n	%
Gender		
Female	233	77.7
Male	67	22.3
Age		
18–24	16	5.3
25–34	75	25.0
35–44	136	45.3
45–54	59	19.7
55–56	14	4.7
Ethnicity		
Malay	289	96.3
Non-Malay	11	3.7
Education level		
STPM /Certificate/Diploma	89	29.7
Degree	107	35.7
Master	59	19.7
PhD	45	15.0
Work experience		
Less than one year	13	4.3
1–3 year	36	12.0
4–6 year	34	11.3
More than six year	217	72.3
Income		
RM 2,000–RM3,000	85	28.3
RM 3,001–RM4,000	62	20.7
RM 4,001–RM5,000	61	20.3
RM 5,000 and above	92	30.7

than regular table salt. Approximately four-fifths (80%) of the respondents agreed that salt should be added to food to make it tasty. Similarly, most (85%) believed their health would improve if they reduced the amount of salt in their diet. Sixty-four percent of respondents reported that it was hard to understand sodium information displayed on food labels. Less than two-thirds (61.7%) agreed that finding low-salt options when eating out was challenging. Similarly, less than two-thirds (63.7%) of respondents decided that laws should limit the amount of salt added to manufactured foods.

The level of public concern regarding food-related issues was relatively high, with 44–57% of respondents reporting that they were either very or extremely concerned with each food-related issue (Figure 2). More than a third (36.3%) of respondents were very worried about the calories in food. In total, less than half (44%) of the respondents were very concerned about the amount of fat in food and half (50.3%) were very concerned about the amount in food. Sugar and salt were the nutrients of most concern. In contrast, more than half (57%) of the respondents were very concerned about the amount of sugar in food. More than half (53.6%) were very or highly worried about the amount of salt in food.

Figure 3 shows the respondents' behavioral practices to reduce salt intake performed in the past month. Within the total sample, the most commonly reported behaviors to lower salt intake in the past month included avoiding eating packaged food (31.4%), using spices/herbs instead of salt when cooking (28.4%), avoiding eating food from takeaway stores (28.0%), avoid eating food from fast food restaurants (27.7%) and purchased salt-reduced foods (26.0%), these behaviors were reported by about a third of the sample. Fewer respondents, about less than one-fifth, reported using the sodium information on food labels (18.0%) and asked to prepare meals without salt when eating out (10.7%).

In this study, Knowledge, Attitude, and Behaviours (KAB) toward dietary salt intake was assessed. The finding of this study revealed that, in general, UiTM Puncak Alam staff are knowledgeable and specific aspects of salt-related knowledge are well understood among them. Most respondents were aware of the harmful effect of excess dietary salt intake on health, including the link with other health conditions such as raised blood pressure and coronary heart diseases. However, fewer were aware of the connection between excessive dietary salt consumption and other health conditions; notably, almost a third of respondents did not identify stroke as a health risk related to excessive dietary salt consumption. However, the findings from present study is contradict with another research that found the majority participants of Malay elderly had fair and poor knowledge on sodium and hypertension (Haron *et al.* 2020). Fewer were aware of its connection with other health conditions related to excessive salt consumption, such as stroke

Table 2. Knowledge about dietary salt

Questions and answers	n (%)
Do you think that overeating salt could damage your health?	
Yes	287 (95.7)
No	7 (2.3)
Don't know	6 (2.0)
What is the relationship between salt and sodium?	
They are the same	78 (26.0)
Salt contains sodium	120 (40.0)
Sodium contains salt	39 (13.0)
Don't know	63 (21.0)
Which of the following do you think is the primary source of salt in the diet?	
Salt added during cooking or at the table	102 (34.0)
Salt from processed foods such as bread, sausages and cheese	133 (44.3)
Salt from natural food sources	54 (18.0)
Don't know	11 (3.7)
In general, how much salt do you think Malaysian eat?	
Far too much	41 (13.7)
Too much	193 (64.3)
Just the right amount	63 (21.0)
Too little	1 (0.3)
Far too little	2 (0.7)
Health professionals recommend that we should eat no more than a certain amount of salt each day. How much salt do you think this is?	
3 g (about 1/2 a teaspoon)	67 (22.3)
5 g (about one teaspoon)	107 (35.7)
8 g (about one and 1/2 teaspoons)	25 (8.3)
10 g (about two teaspoons)	29 (9.7)
15 g (about three teaspoons)	10 (3.3)
Don't know	62 (20.7)
How do you think your daily salt intake compares to the amount of salt recommended by health professionals?	
I eat less salt than recommended	65 (21.7)
I eat about the right amount of salt	107 (35.7)
I eat more salt than recommended	85 (28.3)
I don't know	43 (14.3)

and stomach cancer. The message that high salt consumption can cause serious health problems such as high blood pressure, kidney disease, and coronary heart disease is reaching the public. Still, there is a need to raise greater awareness

of stroke risk, particularly given that stroke were one of the leading cause of death in Malaysia.

Most respondents were aware that most Malaysians consume too much salt daily, and most respondents perceived they consumed

Knowledge, attitude and behavior of dietary salt intake

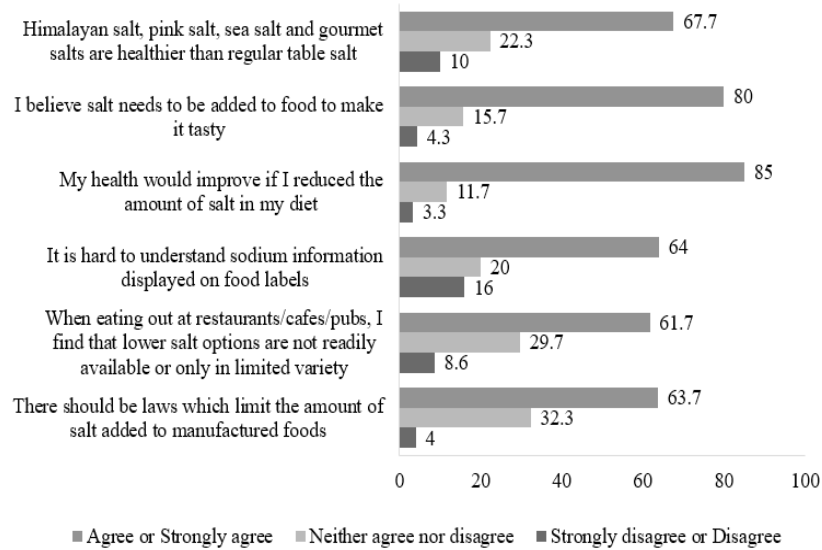


Figure 1. Percentage level of agreement with attitude statement related to salt intake (n=300)

about the right amount of salt in their daily diet. However, this study showed that less than half (35.7%) of respondents needed clarification on the recommendation of salt intake in a day. At the same time, less than a third (28.3%) of respondents believed their daily salt intake would exceed the recommendations. In contrast, a study in China found that, among 7512 participants, the 65.7% knew consuming less salt can reduce blood pressure and 71.1% had knowledge of the complications of taking more than the recommended salt intake (Du *et al.* 2022).

Consumers believe they consume the right amount of dietary sodium daily because they may underestimate their daily salt intake. This may happen for at least two reasons. Firstly, their knowledge of dietary salt recommendations was poor. Secondly, consumers may still be unaware of or underestimate dietary salt sources hidden across the food supply and daily food items (Grimes *et al.* 2017). Thus, awareness should be raised on recognizing foods that contribute high salt to the diet. In addition, about 85% of respondents believed their health would improve

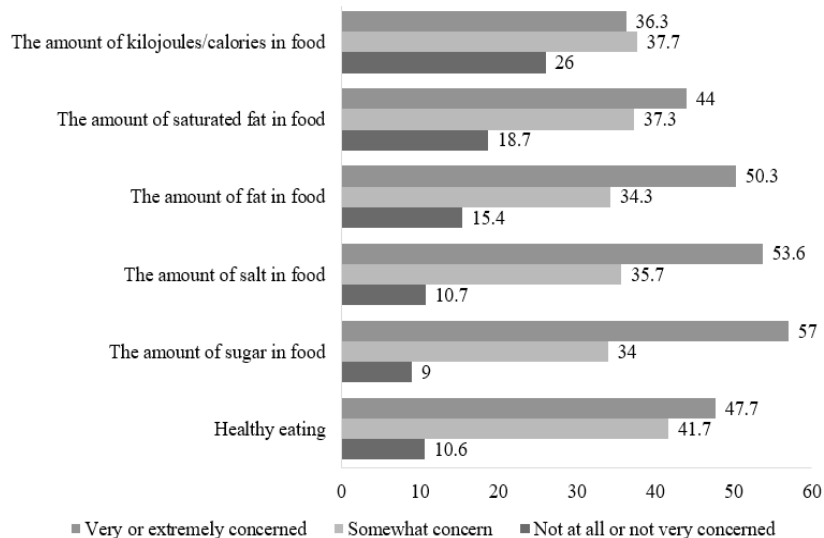


Figure 2. Percentage level of public concern for food-related issues (n=300)

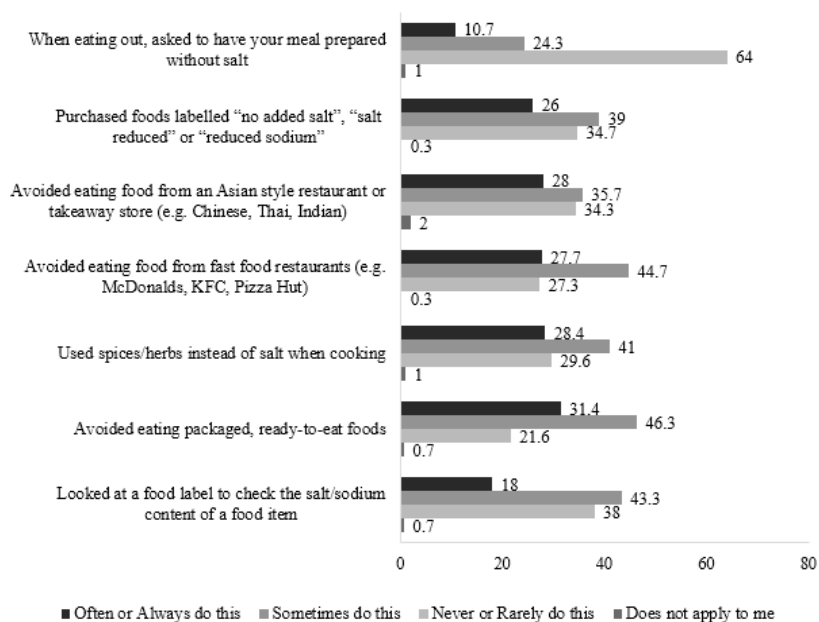


Figure 3. Behavioral practices to reduce salt intake performed in the past month (n=300)

if they reduced salt in their diet. This may explain why more than half (53.6%) of the respondents were concerned about the amount of salt in their diet. Yet, it is still alarming that nearly half of the respondents were somewhat or not very concerned about the amount of salt in their diet. However, there was clear evidence that related excess consumption of dietary salt to an increased risk of getting non-communicable diseases. This finding shows that UiTM Puncak Alam Staff were less concerned about dietary salt issues.

Knowledge and attitude influence the practice of dietary salt intake of an individual. A prior research investigation in Sharjah, UAE, revealed that the level of knowledge among university students concerning salt and sodium was notably limited. Additionally, a lower proportion of students indicated their willingness to adopt measures aimed at reducing salt and sodium intake in their diets (Cheikh Ismail *et al.* 2019). Hence, shifting consumers' attitudes to concern about dietary salt intake may be an important factor in changing salt-related behavior. The finding in this study revealed that less than two-thirds of respondents reported difficulty understanding sodium content on food labels. In Malaysia, regarding nutrition labels concerning sodium labelling, according to the Malaysian

Food Act 1983, sodium may be declared on the label, the amount present is shown in mg per 100 g or 100 mL or per package if the package contains only a single portion and per serving as shown on the label. This requires consumers to do a manual calculation to determine the salt content of food. However, only 40% of the respondents knew the difference between salt and sodium. This indicates that it would be challenging for the consumers to interpret how sodium content relates to overall salt intake.

Food labels play an important role to guide consumers to choose healthier products. A systematic review strongly indicates the food labels do indeed lead to a significant improvement in the healthiness of the diets selected by consumers (Shangguan *et al.* 2019). It is also recommended to establish a consumer-friendly nutrition labelling system that includes salt on the front of the pack or uses traffic light labelling as these will indicate the level of salt in each food packaging. This study finding also shows that only ten% of respondents could correctly identify that there were no health differences between regular table salt and other salt. This indicates that accurate food choice information is not reaching consumers. Hence, it is essential to raise awareness in enabling customers to understand

food labels correctly and have accurate food choice information.

The Malaysia Institute of Public Health show that the major contributor of sodium in the Malaysian diet is cooked food (IPH 2016). Individuals often find it challenging to regulate their salt consumption when dining out, as the latest study indicated that participants observed a scarcity of options for low-sodium foods when dining at restaurants. When eating out, consumers frequently encounter difficulties in making health-conscious choices, and this is partly due to the absence of detailed nutritional information and other important criteria (Bray *et al.* 2019). The increasing amount of sodium consumption may be due to changes in people's lifestyles, from home to outside meals. This indicates that the food and beverage industry is one of the critical factors for increasing salt awareness and future salt reduction programs.

Overall, the task of influencing and changing dietary behavior is challenging. Thus, a collaborative multidisciplinary approach is required to implement successful reduction of dietary sodium consumption strategies. They need to construct interventions targeting improving knowledge, attitude and behavior and focusing on other determinants of diet quality, such as motivation and intention, by providing a supportive environment for salt reduction. This can be done by the government and food industry by reducing processed food and restaurant food sodium content rather than consumer behavior. The government should apply standard purchased food items to have a sodium limit, and the food industries should produce foods within the limit. There should also be a labelling system that uses traffic light labelling as these will indicate the salt level in each food packaging.

CONCLUSION

The findings demonstrate that UiTM Puncak Alam staff in this survey are knowledgeable. However, attitudes are less favorable, and behaviors related to dietary salt intake could be improved. Public awareness of the link with other health conditions related to excessive salt consumption is still low. There is a need to raise awareness of salt-related health risks, as it is one of Malaysia's leading causes of death. Public concern about dietary salt is still

low as many people remain unaware of their salt intake, where the majority underestimate their daily sodium consumption and minimize the extent of salt content across the food supply and list of everyday food items that are high in salt content.

ACKNOWLEDGEMENT

The authors thank healthcare facilities at the university who granted permission for data collection.

DECLARATION OF CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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Factors Affecting Chronic Energy Deficiency among Pregnant Women in East Nusa Tenggara Province, Indonesia

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ABSTRACT

This study aims to investigate the relationship between maternal and household characteristics with the Chronic Energy Deficiency (CED) occurrence among pregnant women in East Nusa Tenggara (ENT). CED was observed through Mid-Upper Arm Circumference (MUAC) measurement of < 23.5 cm. Utilizing a cross-sectional design using secondary data from the 2018 Indonesia Basic Health Survey (Riskesmas) involving 387 pregnant women. Bivariate analysis (chi-square test) and multivariate analysis (multiple logistic regression) were conducted. Significant associations with the CED included parity ($p=0.002$), education level ($p=0.018$), access to hospital (transportation mode) ($p=0.032$), and access to primary healthcare facilities (travel time) ($p=0.032$). Multivariate analysis identified parity as the most influential variable for the CED occurrence among pregnant women ($p=0.016$; OR=1.868). In conclusion, mothers with a parity of less than two or more than three children had a higher risk of experiencing CED during pregnancy in ENT. To prevent CED and its consequences, it is recommended to emphasize family planning, address parity concerns, and prioritize maternal nutritional status before and during pregnancy.

Keywords: CED, maternal, pregnant, parity

INTRODUCTION

Chronic Energy Deficiency (CED) in pregnant women occurs when a mother experiences prolonged or long-term energy deprivation. CED in pregnant women can be identified with Mid-Upper Arm Circumference (MUAC) measurement (<23.5 cm). According to the Ministry of Health Republic of Indonesia 2002, CED can lead to various health problems for pregnant women (MoH RI 2002). In addition, CED also indirectly contributes to maternal and infant mortality rates (Apriyanti 2017). The 2018 Indonesia Basic Health Survey (Riskesmas) stated that the CED prevalence in Indonesia is still relatively high (17.3%). East Nusa Tenggara is one of the provinces in Indonesia with the highest CED prevalence in pregnant women (36.8%) (MoH RI 2018). According to various studies, CED in pregnant women leads to suboptimal fetal growth, low birth weight, premature birth, increased risk of miscarriage, malnutrition, and infant mortality at birth. Pregnant women with CED potentially have a 4.85 times higher risk of giving birth to stunted children (Ruaida

& Soumokil 2018). The CED occurrence in pregnant women can also have long-term impacts on children. If the child experiences malnutrition, such as stunting, they will have a higher risk of degenerative diseases later in adulthood (Sandjaja 2014; Tejayanti 2020).

Various factors can influence the CED occurrence in pregnant women, such as age, parity, infectious disease, Antenatal Care (ANC), education level, residential area, environmental hygiene, and access to healthcare facilities. Those factors can be classified into two groups based on the characteristics of the pregnant women and the household characteristics. The factors that are considered as the characteristics of the pregnant women are age, parity, infectious disease, ANC, and education level, while the other factors such as residential area, environmental hygiene, and access to healthcare facilities are considered as the household characteristics. Considering its high prevalence in East Nusa Tenggara (ENT) and potential harm it may impose, this study aims to investigate the relationship between maternal and household characteristics with the occurrence of CED in pregnant women in East

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(Received 15-07-2023; Revised 22-09-2023; Accepted 18-11-2023; Published 31-01-2024)

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Nusa Tenggara Province based on the 2018 Riskesdas data. In hope, this study will provide insights for designing appropriate intervention programs to prevent future maternal and child nutrition problems within in the region.

METHODS

Design, location, and time

This is a quantitative study with a cross-sectional design. This study analyzed the 2018 Riskesdas data collected by the Health Development Policy Agency of the Ministry of Health, Republic of Indonesia, in East Nusa Tenggara (ENT) Province. Ethical approval was obtained from the Ethics Commission for Health Research at UPN Veteran Jakarta with the number 81/V/2023/KEPK.

Sampling

The population in this study was pregnant mothers in ENT from the 2018 Riskesdas. The inclusion criteria in this research are pregnant women who have MUAC data through measurements and the exclusion criteria is pregnant women with extreme MUAC value.

The data initially obtained was 395 respondents who were then selected according to the sample inclusion criteria. No extreme MUAC value was found. After further cleaning of missing data on MUAC (n=8), therefore, the final research sample size was 387 respondents.

Data collection

The sampling technique used in Riskesdas 2018 was the Probability Proportional to Size (PPS) method, which involves implicit stratification of all census blocks based on socioeconomic strata to ensure the representation of household characteristic diversity.

The instruments used in this research were Household Instruments and Individual Instruments from Riskesdas 2018. MUAC measurements were carried out using MUAC tape with an accuracy of 1 mm.

The CED prevalence in pregnant women was observed through MUAC measurement. The MUAC measurement of <23.5 cm indicates that the pregnant woman is considered at risk of CED (MoH RI 2017). MUAC is the preferred tool to measure CED due to its independency of the pregnancy status. The composition of the upper

arm mainly consists of fat and muscle, so it is not affected by body fluid and can be measured at any time during pregnancy (Sufyan *et al.* 2020).

Data analysis

This study used two stages of analysis; bivariate and multivariate analysis. The bivariate analysis was performed using the Chi-square test with a significance level of 5%. Furthermore, the multivariate analysis was performed using the Multiple Logistic Regression test. All statistical analysis was performed using the IBM SPSS Statistics 24 software.

RESULTS AND DISCUSSION

The independent variables in this study have different frequencies (n) for each variable. Based on the power of test analysis to assess the accuracy, a result of 98% was obtained. This indicates that the study can detect the true relationship between the variables under investigation.

Based on Table 1, it is shown that 36.8% of pregnant women in ENT Province were at risk of CED. It means that 36.8% of pregnant women in ENT Province were experiencing CED during their pregnancy. CED among pregnant women is a significant public health concern, and that high prevalence in East Nusa Tenggara Province in Indonesia is considered as a concerning statistic.

Association between the characteristics of pregnant women and CED

Table 2 shows a significant relationship between parity and the CED occurrence in pregnant women (p<0.05). A significant relationship was also found between educational level and the CED occurrence in pregnant women (p<0.05). However, no statistically significant relationships were observed between age,

Table 1. The CED prevalence

CED	Frequency (n)	Percentage (%)
Not CED	254	63.2
CED	133	36.8
Total	387	100

CED: Chronic Energy Deficiency

Factors affecting chronic energy deficiency among pregnant women

Table 2. Association between characteristics of pregnant women and CED

Variables	CED		Not CED		p
	n	%	n	%	
Age (years)					
20–35	102	36.2	180	63.8	0.270
<20 and >35	31	29.5	74	70.5	
Parity					
2–3	33	24.1	104	75.9	0.002
<2 and >3	100	40.0	150	60.0	
Infectious Disease					
No	99	32.7	204	67.3	0.229
Yes	34	40.5	50	59.5	
ANC visits					
≥4x	52	32.1	110	67.9	0.868
<4x	18	34.6	34	65.4	
Education Level					
High	39	26.7	107	73.3	0.018
Low	94	39.0	147	61.0	

ANC: Antenatal Care; CED: Chronic Energy Deficiency; p-value written in bold indicates a significant relationship (p<0.05)

infectious disease, and ANC visits with the CED occurrence in pregnant women.

Age. Based on the current study, there is no significant relationship between age and the CED occurrence in pregnant women (p>0.05). This finding is consistent with a study conducted by Novitasari *et al.* (2019), which found no statistically significant relationship between maternal age and the occurrence of CED. This could be due to the indirect relationship between age and the occurrence of CED. Other factors influencing CED occurrence include infectious disease, parity, nutritional knowledge, and dietary factors (Fitri *et al.* 2022). However, several studies found a relationship between age and CED occurrence in pregnant women. It was found that pregnant women of younger age (<20 years) or older age (>35 years) were at a higher risk of experiencing CED (Mustafa *et al.* 2021; Tejayanti 2020). Young pregnant women require additional nutrient intake not only for their growth and development but also to be allocated to support their fetal development. On the other hand, older pregnant women need higher energy intake to compensate for weakened organ functions. Therefore, both younger and older maternal age

is associated with increased nutritional needs and a higher risk of CED (Sipahutar *et al.* 2013).

Parity. Based on the current study, there is a significant relationship between parity and the occurrence of CED in pregnant women (p<0.05). These findings are in line with a study conducted by Novelia *et al.* (2021), which also found a significant relationship between parity and the occurrence of CED in pregnant women (p=0.009).

The most optimal pregnancies are in the 2–3 parity, while the first and more than three parity carry higher risks. Primiparous women (first-time mothers) are more likely to experience CED due to a lack of experience and knowledge, leading to less attention to their nutritional needs (Nugraha *et al.* 2019). During the first pregnancy, mothers may focus only on dealing with pregnancy-related discomforts, such as nausea, and may consume foods based on their desires without considering their increased nutritional requirements (Renjani & Misra 2017). On the other hand, a mother with high parity (having more than three children) can also contribute to conditions that affect the nutrient optimization of the mother and fetus during pregnancy,

leading to CED (Novelia *et al.* 2021). Pregnant women with high parity (grand multipara) often face difficulties caring for themselves. Usually, mothers struggle with household chores and the need to share food with family members while their nutritional needs increase (Harismayanti *et al.* 2019).

Infectious disease. Based on the bivariate analysis, it was found that there was no significant relationship between infectious diseases and CED occurrence in pregnant women ($p>0.05$). This result was suspected to be due to the CED caused by infectious diseases that was highly dependent on the severity of the infection. A study mentioned that if the infection is recent and its severity level is low, the influence on pregnant women's nutritional status is insignificant. However, if the infection becomes chronic and lasts for a long period, it can affect the nutritional status of pregnant women (Renjani & Misra 2017).

Conversely, a study found a significant association between infectious diseases and CED in pregnant women ($p=0.001$; $OR=6.171$; $95\% CI=2.155-17.675$) (Kartini 2017). It was found that infectious diseases, particularly Pulmonary Tuberculosis (TB), were the most dominant variable linked to CED among pregnant women in Indonesia in 2018. TB patients require increased energy intake to support their increased metabolism, which can lead to weight loss. Furthermore, inadequate food intake can worsen malnutrition due to decreased appetite and indigestion. The Mycobacterium tuberculosis infection triggers an inflammatory response involving cytokines release, leading to malnutrition due to lipolysis and proteolysis stimulation and increased leptin levels (Mustafa *et al.* 2021). Other infectious diseases such as Respiratory Tract Infections (RTIs) and diarrhea can also contribute to significant weight loss in pregnant women due to prolonged coughing, decreased appetite, oxidative stress, and dehydration, ultimately affecting the nutritional status of pregnant women and fetal health (Institute of Medicine 1992; Newman *et al.* 2019; Widia 2017).

ANC visits. Based on the current study, it was shown that there was no significant relationship between ANC visits and the CED occurrence in pregnant women ($p>0.05$). These findings are consistent with the studies by Lestari

(2021) and Teguh *et al.* 2019, which found no significant relationship between the frequency of ANC visits and the occurrence of CED in pregnant women.

However, another study stated that pregnant women with fewer than four ANC visits were 2.7 times more likely to experience CED ($p=0.000$; $OR=2.700$; $95\% CI=1.651-4.415$) (Fitrianiingtyas *et al.* 2018). When pregnant women receive recommended ANC visits during pregnancy, they receive additional information about their maternal health from healthcare providers. The continuity of ANC visits directly enhances their knowledge, potentially changing their perceptions and behaviors regarding the importance of adhering to healthcare provider recommendations to reduce the risk of CED (Teguh *et al.* 2019).

Education level. Based on the current study, the maternal education level has a significant relationship with the occurrence of CED in pregnant women ($p<0.05$). Consistent with the findings of this study, other studies also found a significant relationship between education level and CED occurrence in pregnant women (Nurdin *et al.* 2018; Tejayanti 2020).

A study stated that pregnant women with a low education level have a two times higher risk of experiencing CED compared to those with a higher education level (Mahirawati 2014). The higher the level of education, increase the chances to receive information, resulting in broader knowledge. Conversely, low education levels can hinder the development of an individual's attitude toward accepting new information and values (Notoatmodjo 2012). Education level plays an important role in influencing people's understanding of acquired knowledge. Generally, people with higher levels of education tend to have better knowledge. A higher level of education makes it easier for individuals to understand information and apply it to their daily behaviors and lifestyles related to health and nutrition, including understanding nutritious food for pregnant women to prevent nutritional problems (Harismayanti *et al.* 2019).

Association between household characteristics and CED

According to Table 3, it can be observed that there was a significant relationship between the transportation mode used to have access to

Factors affecting chronic energy deficiency among pregnant women

Table 3. Association between household characteristics and CED

Variables	CED		Not CED		<i>p</i>
	n	%	n	%	
Residential area					
Urban	15	27.8	39	72.2	0.345
Rural	118	35.4	215	64.6	
Environmental hygiene access to a clean water source					
Minimum access (≥ 20 L)	101	32.9	206	67.1	0.354
Less than minimum (< 20 L)	31	39.2	48	60.8	
Waste management					
Good	4	21.1	15	78.9	0.322
Bad	128	34.9	239	65.1	
Access to hospital					
Transportation mode					
Motorized vehicle	83	31.4	181	68.6	0.032
Non-motorized vehicle	37	45.1	45	54.9	
Travel time					
Short time (< 60 mins)	39	28.3	99	71.1	0.054
Long time (≥ 60 mins)	81	38.9	127	61.1	
Transportation cost					
Affordable ($< 40,000$ IDR)	51	30.5	116	69.5	0.147
Not affordable ($\geq 40,000$ IDR)	69	38.5	110	61.5	
Access to primary healthcare (<i>Puskesmas</i>)					
Transportation mode					
Motorized vehicle	89	33.8	174	66.2	0.956
Non-motorized vehicle	41	34.7	77	65.3	
Travel time					
Short time (< 20 mins)	50	28.2	127	71.8	0.032
Long time (≥ 20 mins)	80	39.2	124	60.8	
Transportation cost					
Affordable ($< 10,000$ IDR)	38	29.5	91	70.5	0.208
Not affordable ($\geq 10,000$ IDR)	92	36.5	160	63.5	
Access to primary healthcare (Clinic)					
Transportation mode					
Motorized vehicle	29	21.8	104	78.2	0.397
Non-motorized vehicle	8	32.0	17	68.0	
Travel time					
Short time (< 20 mins)	12	18.8	52	81.3	0.341
Long time (≥ 20 mins)	25	26.6	69	73.4	
Transportation cost					
Affordable ($< 10,000$ IDR)	9	25.7	26	74.3	0.891
Not affordable ($\geq 10,000$ IDR)	28	22.8	95	77.2	

CED: Chronic Energy Deficiency; IDR: Indonesian Rupiah; *p*-value written in bold indicates a significant relationship ($p < 0.05$)

the hospital and the CED occurrence in pregnant women ($p < 0.05$). Additionally, the travel time to primary healthcare facilities (*Puskesmas*—a community health center in Indonesia) also showed a significant relationship with the CED occurrence in pregnant women ($p < 0.05$). However, variables such as residential area, environmental health (access to a clean water source and household waste management), travel time to the hospital, transportation costs to the hospital, transportation mode to the *Puskesmas*, transportation costs to the *Puskesmas*, transportation mode to the clinic, travel time to the clinic, and transportation cost to the clinic did not show a significant relationship with the CED occurrence in pregnant women ($p > 0.05$).

Residential area. Based on the current study, it was known that there was no significant relationship between place of residence and CED occurrence in pregnant women ($p > 0.05$). This finding is inconsistent with the results of a study conducted by (Tejayanti 2020), where a significant relationship was found between residential areas and the occurrence of CED in pregnant women ($p = 0.000$). These differences may be due to the higher proportion of respondents living in rural areas compared to those living in urban areas.

A meta-analysis and systematic review conducted in Africa stated that the risk of malnutrition is higher among pregnant women living in rural areas, with a 2.6 times higher chance of experiencing malnutrition (Desyibelew & Dadi 2019). Pregnant women experiencing nutritional problems in rural areas are more prevalent than those in urban areas due to limited access to healthcare facilities and nutrition information. A study conducted on the differences in maternal dietary intake behaviors between rural and urban environments in Poland showed that pregnant women in rural areas consume fewer high-calorie and high-protein foods compared to pregnant women in urban areas (Suliga 2015; Wojtyła *et al.* 2011).

Environmental health. Based on the current study, there is no significant relationship between access to clean water and the CED occurrence in pregnant women ($p > 0.05$). A study from Uganda stated that individuals from families using water from unprotected sources tend to have lower body weight. Lack of access to safe drinking water has a 1.7 times higher risk of experiencing underweight (Sabud *et al.*

2020). Individuals facing difficulties in accessing clean water may experience repeated episodes of diarrhea, leading to the loss of significant amounts of fluids and important nutrients, such as zinc, from their bodies. Zinc deficiency can hinder proper intestinal recovery during diarrhea episodes, resulting in malnutrition (Mshida *et al.* 2018).

Regarding household waste management, according to Table 3, there was no significant relationship between household waste management and CED occurrence in pregnant women ($p > 0.05$). A study conducted in Ethiopia found that "WASH (Water, Sanitation, and Hygiene)" behaviors can affect the risks of CED in pregnant women. The better the "WASH" behavior, the lower the proportion of mothers at risk of CED. Inadequate waste management in environmental sanitation is a primary factor leading to the emergence of infectious diseases. Infectious diseases can disrupt the body's ability to digest and absorb nutrients, resulting in weight loss. Chronic malnutrition can occur if this condition persists for a long period without adequate nutritional intake for recovery (Junanda *et al.* 2022).

Access to healthcare facilities. Based on the current study, there is a significant relationship between transportation mode to the hospital and CED occurrence in pregnant women ($p < 0.05$). Pregnant women with motorized vehicles tend to visit healthcare facilities more often. Travel time to *Puskesmas* also shows a significant relationship with CED occurrence ($p < 0.05$). However, other factors such as travel time, transportation cost, and transportation mode for different healthcare facilities do not show a significant relationship with CED occurrence ($p > 0.05$).

Accessible healthcare facilities mean that individuals can receive healthcare without being hindered by geographical and economic factors such as distance, travel time, transportation mode, transportation cost, and other barriers that may prevent them from accessing healthcare (Khatimah *et al.* 2018). Individuals with private motor vehicles tend to use healthcare facilities more than those who do not have vehicles. Transportation availability has a significant impact on the accessibility of healthcare facilities (Davy *et al.* 2016). The research findings by Masters *et al.* (2013) indicate that distance and

travel time influence pregnant women's behavior in accessing healthcare facilities.

Studies mention that the under-utilization of healthcare facilities can impact nutritional status. The easier the access to healthcare facilities for individuals, the greater the likelihood of receiving good healthcare. This condition promotes a better opportunity for appropriate management and education related to nutritional problems (Kusumawati & Rahardjo 2012).

Factor influencing the CED occurrence

Variables included in the multivariate analysis with $p \leq 0.25$ were parity, infectious disease, mothers' education level, transportation mode (hospital), travel time (hospital), transportation cost (hospital), travel time (*Puskesmas*), and transportation cost (*Puskesmas*). The model also included the age variable because, according to theory, age is associated with other variables included in the multivariate model, such as education.

After performing multivariate analysis using multiple logistic regression (Table 4), it was found that the variables significantly associated with CED were parity ($p=0.016$), education level ($p=0.036$), and travel time to the *Puskesmas* ($p=0.038$). This study found that parity was the

most influential variable to the CED occurrence in pregnant women (OR=1.868; 95% CI=1.122–3.109).

Based on the research findings, it can be concluded that parity was the most dominant variable influencing the occurrence of CED in pregnant women (OR=1.868; 95% CI=1.122–3.109). This finding indicates that women with a parity of less than two and more than three children are at a 1.8 times higher risk of experiencing CED compared to those with 2 to 3 children. Previous studies also found that CED during pregnancy can lead to Low Birth Weight (LBW) babies. Therefore, if a pregnant woman with a parity of less than two and more than three children experiences CED, the risk of giving birth to an LBW baby will be higher (Ekowati *et al.* 2017). Furthermore, according to Table 4, there were also confounding variables identified in this study: transportation mode to the hospital ($p=0.084$) and age ($p=0.070$).

Different age groups may have experienced different historical and social contexts. For example, people who were educated in earlier decades may have had different educational opportunities and experiences compared to those educated more recently. These cohort effects can influence the relationship between education

Table 4. Multiple logistic regression test results

Variable	Crude Odds Ratio (COR)				Adjusted Odds Ratio (AOR)			
	p	OR	95% CI		p	OR	95% CI	
			Lower	Upper			Lower	Upper
Parity								
<2 and >3	0.002	2.101	1.318	3.349	0.016	1.868	1.122	3.109
2–3	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education level								
Low	0.018	1.754	1.120	2.748	0.036	1.689	1.034	2.758
High	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Transportation mode (Hospital)								
Motorized vehicle	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Non-motorized vehicle	0.032	1.793	1.080	2.976	0.084	1.588	0.939	2.758
Travel time (<i>Puskesmas</i>)								
Short time	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Long time	0.032	1.637	1.068	2.511	0.038	1.643	1.029	2.623
Age (years)								
20–35	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
<20 and >35	0.270	0.739	0.455	1.200	0.070	0.601	0.347	1.042

level and maternal nutrition because the content and quality of education may have changed over time (Raghupathi & Raghupathi 2020).

Parity can be associated with socioeconomic status, which can limit their access to transportation and healthcare. Accessing hospitals becomes challenging for individuals who do not have access to motorized transportation or reside in areas with limited public transportation options. This restricted access can result in missed healthcare appointments and subsequent delays in receiving necessary medical care (Lucas *et al.* 2008). Parity and access to healthcare are often correlated. Moreover, women with higher parity may have more children to take care of, making it challenging for them to access healthcare facilities for routine check-ups or to address health issues. On the other hand, women with lower parity may find it easier to access healthcare. This differential access can confound the relationship between parity and malnutrition if healthcare access itself is a determinant of malnutrition (Alzboon & Vural 2021).

Study strength and limitation

One of the strengths of this study is its utilization of secondary data from the Indonesia Basic Health Survey (Riskesdas) 2018, which involved a relatively large sample of 387 pregnant women. This large sample size enhances the statistical power of the study, increasing the likelihood of detecting meaningful associations and allowing for more robust conclusions to be drawn about the relationship between maternal and household characteristics and the occurrence of CED among pregnant women in the East Nusa Tenggara Province.

There may be limitations in the depth and specificity of the data available, which could have influenced the ability to explore certain risk factors or potential confounding variables in detail. Furthermore, as the study is based on cross-sectional data, it can establish associations but cannot prove causation. Thus, while the study identifies significant variables associated with CED, it cannot definitively determine causality or the temporal sequence of events. Longitudinal research may be needed to address these limitations and provide a more comprehensive understanding of the factors influencing CED among pregnant women in East Nusa Tenggara Province.

CONCLUSION

Based on the analysis results, it can be concluded that the factors significantly associated with CED occurrence among pregnant women are parity, education level, transportation mode to the hospital, and travel time to the *Puskesmas*. Factors with the greatest influence on the occurrence of CED among pregnant women are parity.

Therefore, it is recommended to consider family planning options, the number of parity, and prioritize the nutritional status of mothers before and during pregnancy to prevent CED and its consequences. Future research is suggested to use larger datasets, including energy and protein intake information, to further explore factors related to CED in pregnant women. In addition, stakeholders are encouraged to focus on infrastructure development in ENT and increase the number of healthcare facilities, ensuring better access for pregnant women.

ACKNOWLEDGEMENT

The researchers would like to thank the Health Development Policy Agency, Ministry of Health, Republic of Indonesia, for conducting the survey and granting permission to use the data to conduct this study and provide new insights for all of us.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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The Food Insecurity Issues in Gastronomy Tourism among Local and International Tourists in Malaysia

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ABSTRACT

The objectives of this study are to investigate the food security issues arising in gastronomic tourism, to verify the food insecurity experiences encountered by tourists, and to determine the tourists' dining satisfaction from the gastronomic tourism experiences in Malaysia. A quantitative approach was selected for this study. These issues were concluded from the data collection via questionnaire forms disseminated online through multiple social media platforms consisting of 250 participants of both local and international tourists visiting Malaysia. The Independent T-test and Mann-Whitney test were used as the main statistical test to establish if any tourist groups had food security-related issues during their visit. The results showed that local tourists are more likely to be affected by food security issues, food insecurity, and dining experiences. Overall, this study discovered that both local and international tourists have contrasting experiences in gastronomy tourism in Malaysia.

Keywords: dining satisfaction, food accessibility, food security, gastronomy tourism

INTRODUCTION

Food security, as articulated by the World Health Organization, is "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Nevertheless, the emergence of COVID-19, war, and significant climate change has adversely affected global food production and distribution, ultimately leading to a global food crisis. In the current landscape, emerging food security issues are causing the tourism industry to collapse. The issues consist of escalating food supply costs (Jalaluddin *et al.* 2022) and insufficient food supplies due to overdependency reliance on imported goods due to insufficient domestic production (Ahmed & Siwar 2013).

This study aims to address the pressing issue of food security within gastronomy tourism, particularly concerning the scarcity of food supplies in Malaysia. This scarcity has resulted in price surges and limited food accessibility, impacting local and international tourists. As

Hashim *et al.* (2019) outlined, the annual escalation of food expenses further exacerbates existing food security issues. Additionally, the growing number of tourists intensifies the severity of food security issues, and necessary governmental management is required to meet demands (Hashim *et al.* 2019) adequately. This study will help in recognizing the difficulties faced by both local and international tourists regarding food security-related issues, thereby revealing the current state of food insecurity in Malaysian gastronomy tourism in Malaysia.

The objectives of this study include investigating the food security issues in domestic tourism among local and international tourists, verifying the food insecurity experiences encountered by local and international tourists, and determining the tourists' dining satisfaction from the gastronomy tourism experiences in Malaysia.

In essence, this study strives to comprehend better the struggles local and international tourists encounter when it comes to food security and accessibility in Malaysia due to a variety

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(Received 10-08-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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of factors, including food supply scarcity due to livestock shortages, rising food prices driven by demand and supply imbalance, as well as the satisfaction (Gani *et al.* 2017) and contentment of visitors concerning food consumption and accessibility while visiting.

METHODS

Design, location, and time

A quantitative approach was adopted for this study as its research design since it aligned seamlessly with the study's objectives. Additionally, cross-sectional and non-experimental methods were utilised to determine emergent food security issues within the population. The study was conducted across the entirety of Malaysia, involving both local and international tourists. Data collection was expedited through the distribution of Google Form link via various social media platforms such as Facebook, Twitter, TikTok and YouTube. An informed consent was also been asked to the respondents before they continue to fill in the online Google Form.

Sampling

Quota sampling was selected to ensure that the respondents accurately represented local and international tourist groups by meeting the inclusion and exclusion criteria. The inclusion criteria for this study consisted of Malaysian citizens as local tourist respondents, foreign visitors to Malaysia as international tourist respondents, and the participants have consumed local cuisine during their Malaysian visit. As for the exclusion criteria, participants were excluded if they were Malaysians residing in other countries, foreigners residing within Malaysia, or participants who did not purchase or consume local cuisine. A sample size of 250 people, inclusive of both local and international tourists, was designated for the study, and the determination of sample size was facilitated through G*Power software for a two-tailed independent t-test, which indicated a minimum sample size of 210 individuals. To anticipate potential missing data during analysis, an additional 40 participants were included. The respondents' nationality was identified before approaching them to facilitate the grouping process.

Data collection

Data collection centered on a questionnaire as the primary source of data from the samples, and it was developed by adapting the questions from previous research. The questionnaire, consisting of 39 questions divided into 4 sections, utilized the Likert scale to inquire about the respondents' opinion regarding the food security situation where 1 (least valued) and 5 (most valued). Before distribution, a validity assessment was conducted on the questionnaire using Cronbach's alpha to ensure its appropriateness for distribution to respondents. The Cronbach's Alpha value obtained was 0.954, indicating a very high level of internal consistency for the scale used. This assessment was based on a total of 33 items.

Data analysis

The data were analysed using IBM SPSS 27. Categorical data was presented as frequency and percentages, whereas numerical data underwent descriptive analysis and was presented in mean and standard deviation or median and interquartile range depending on the normality distributions of the data. Independent t-test and Chi-Square or the Karl Fischer test were applied to achieve both objectives in this study. Not normally distributed variables were analysed using the Mann-Whitney test. The statistical significance for this study was $p < 0.05$.

RESULTS AND DISCUSSION

Based on the data gathered from the questionnaire, each section underwent individual analysis encompassing descriptive analysis, normality test, and inferential analysis, which were the independent t-test and the Mann-Whitney test.

Table 1 presents insights into the demographic backgrounds of the respondents consisting of their gender, age, education level, nationality, occupation, and average annual income.

Table 2 illustrates the mean score for attributes about food security issues with 'the food available is enough for the tourists to order during peak seasons' (4.16) receiving the highest rating while the lowest rated is 'the prices are reasonable' (3.44).

Mean difference in food security issues between local and international tourists which

Table 1. Characteristics of the respondents

Variables	n	%
Gender		
Male	97	38.8
Female	153	61.2
Age		
18–29	144	57.6
30–39	44	17.6
40–49	48	19.2
50–59	9	3.6
60 or older	5	2.0
Education level		
Primary	9	3.6
Secondary	20	8.0
Tertiary	221	88.4
Nationality		
Malaysian	208	83.2
International	42	16.8
Occupation		
Full-time	103	41.2
Part-time	4	1.6
Retired	6	2.4
Self-employed	35	14.0
Student	96	38.4
Unemployed	6	2.4
Average annual income (MYR)		
0	59	23.6
1–9,999	57	22.8
10,000–24,999	26	10.4
25,000–49,999	29	11.6
50,000–74,999	25	10.0
75,000–99,999	14	5.6
>100,000	40	16.0

MYR: Malaysian Ringgit

proved to be statistically significant ($p=0.022$; 95% CI: 0.03–0.41). The mean score attributed to international tourists (3.96) exceeded that of local tourists (3.74). This observation shows that the attributes associated with the food security

issues had a noticeable impact on local tourists.

The initial hypothesis noted that the food security issues in Malaysia were substantial, and the result of this study confirmed that hypothesis across various aspects such as the food prices, hygiene conditions, and the adequacy of the nutrient content of the food prepared. However, the study outcomes revealed that local tourists were facing challenges to a greater extent than international tourists as they were the ones taking the toll from the factors that contributed to the escalation of food security issues. In essence, the food security issues that are currently affecting gastronomy tourism in Malaysia have unfortunately become a discouragement to the local tourists from enjoying a vacation within their homeland.

The tourists were prompted to express their level of agreement concerning their encounters with food insecurity experiences during their visit to Malaysia. As depicted in Table 3, the mean score for the attributes in food insecurity experiences is revealed. Notably, the attribute with the highest mean score was ‘there are varieties of local specialities available’ (4.16), signifying positive feedback among tourists. In contrast, the lowest valued attribute was ‘all items from the menu are available when requested’ (3.44).

The outcomes of this study affirm that both local and international tourists encountered food insecurity during their stay. However, it is noteworthy that the local tourist group exhibited a lower mean score, indicating that they were vulnerable to these experiences compared to the international tourists. Several aspects fell below expectations in contributing to the gastronomic experience of the tourists, which led to the food insecurity experiences. This implies that the tourists within Malaysia were having a less pleasurable experience of the gastronomic scene in Malaysia as their needs in terms of food were not being fulfilled during their holiday, hence confirming the hypothesis.

The last section of the questionnaire asked respondents about their dining satisfaction while purchasing and consuming food in Malaysia. Table 4 shows the mean score for the attributes in dining satisfaction, where the highest rated being ‘As a whole, Malaysia is a good food tourism destination’ (4.38) and the lowest rated being ‘The food fulfils the dining experience in terms of hygiene and sanitation.’ (3.58).

Table 2. The mean score for the attributes in food security issues

Code	Items	Mean	SD
B1	The food available is enough for the tourists to order during peak seasons	4.16	0.85
B2	The food is available at any time of the day	4.10	0.87
B3	There is reliable access to a sufficient quantity of affordable nutritious food	3.77	0.93
B4	The food is safe to consume	4.02	0.82
B5	The food is prepared in hygienic procedures	3.50	0.84
B6	The prices are reasonable	3.44	1.08
B7	The food available is socially accepted in terms of the portion	3.82	0.88
B8	The food is nutritionally adequate for standard consumption requirements	3.55	0.88
B9	The weather affects the availability of food in commercial settings	3.58	1.07

Due to non-normal data distribution, the Mann-Whitney test was used to analyse dining satisfaction between local and international tourists. It shows the comparison of mean rank and sum of ranks between local and international tourist groups, which indicates that the international tourist group has a larger mean rank (156.21) than the local tourist group (119.30). The statistical significance of the Mann-Whitney U test ($p < 0.003$) between local and international tourists, indicating higher dining satisfaction among international tourists than local tourists.

The results revealed a Mann-Whitney U value of 3,078.00. The test statistic, denoted as Z, was found to be -3.020. This result was statistically significant, as indicated by an asymptotic significance (2-tailed) of 0.003. This suggests a notable difference in dining satisfaction between local and international tourists confirms the statistical significance of the Mann-Whitney U test ($p < 0.003$) between local and international tourists, indicating higher dining satisfaction among international tourists than local tourists.

As conveyed by the respondents, the evaluations of dining satisfaction illuminate

Table 3. The mean score for the attributes in food insecurity experiences

Code	Items	Mean	SD
C1	The food available caters to the needs of all ages	3.66	0.97
C2	There are varieties of local specialties available	4.16	0.80
C3	There are varieties of international choices of food on the menu at popular tourist destinations	3.90	0.93
C4	There is sufficient information to guide tourists on the accessibility to local food	3.55	1.02
C5	There is sufficient information to guide tourists on the accessibility to international food	3.61	0.98
C6	All items from the menu are available when requested	3.44	1.02
C7	The food catered is fit for the dietary requirement of the tourists such as vegan, vegetarian, halal, kosher, etc	3.56	1.03
C8	Food providers use varieties of cooking methods	3.92	0.86

Table 4. The mean score for the attributes in dining satisfaction

Code	Items	Mean	SD
D1	The food fulfills the dining experience in terms of hygiene and sanitation	3.58	0.86
D2	The food fulfills the dining experience in terms of taste	3.90	0.88
D3	The food is well presented.	3.70	0.87
D4	Comfortable eating surroundings	3.66	0.80
D5	Food spots are located in convenient places	3.82	0.85
D6	The food is rich in flavors	4.12	0.85
D7	The food is appealing to the human sense	4.02	0.85
D8	The food contributes to the quality of my visiting experience	4.14	0.81
D9	The food contributes to my eating pleasure	4.15	0.84
D10	The food adds to my visiting enjoyment	4.18	0.84
D11	The food experience in this country meets my expectation	4.06	0.85
D12	I will recommend Malaysian food to my friends and family	4.32	0.81
D13	I have a good impression of the food available in Malaysia	4.29	0.81
D14	I strongly remember my food experiences in this country during my vacation	4.26	0.82
D15	As a whole, Malaysia is a good food tourism destination	4.38	0.81
D16	I will revisit Malaysia for its gastronomy attractions	4.25	0.84

a distinct contrast between the experiences of international and local tourists. It was priorly speculated that both groups were satisfied with their dining experience, but the result showed a significant difference. It was deemed that some attributes listed under this variable, such as hygiene and comfort, were less agreeable to the local tourists, hence, the lower mean score.

The critical factor contributing to this difference seems to be the specific attributes associated with dining satisfaction, particularly hygiene and comfort. These elements were presumably less satisfactory to local tourists, reflected in their lower mean scores. This suggests that local tourists have different expectations or standards regarding these aspects of dining compared to international tourists.

This outcome indicates the importance of understanding and catering to different tourist groups' varied preferences and expectations.

These findings could be instrumental in tailoring services and improving overall customer satisfaction (Rimmington & Yuksel 1998) in the hospitality and tourism industry (Hall & Mitchell 2001). It emphasises the need for a nuanced approach to evaluate and enhance the dining experience, considering the diverse perspectives of both international and local visitors.

CONCLUSION

In conclusion, the study outcomes emphasise an imbalance of experiences between local and international tourists in gastronomy (Leong *et al.* 2017) tourism in Malaysia. The local tourist group sustained a major disadvantage in gastronomic tourism compared to the international tourists, as evidenced by the result. This imbalance can be disheartening, indicating that local tourists cannot fully appreciate and enjoy

their vacation within their homeland. In contrast, international tourists exhibit higher contentment and satisfaction with Malaysia's gastronomic (Mora *et al.* 2021) offerings despite the low number of respondents from various countries. In light of these findings, the authorities in the tourism sector must address the root causes of these issues and brainstorm mitigative actions to correct this situation, thus providing an enriching gastronomic experience for all tourists.

ACKNOWLEDGEMENT

The authors are grateful to Dr. Siti Nor Ismalina Isa for the assistance in data analysis.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Reduction of Saturated Fat in Dark Chocolate using Sacha Inchi (*Plukenetia volubilis*) Oil Oleogel

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ABSTRACT

This research studied the effectiveness of Sacha Inchi Oil Oleogel (SIOO) as a partial replacement for saturated fat in dark chocolate. Sacha inchi (*Plukenetia volubilis*) oil is high in polyunsaturated fatty acids (α -linolenic and linoleic acids) and a good source of tocopherols. This study prepared oleogels using sacha inchi oil as a base oil and food-grade beeswax as an oleogelator. Different percentages of SIOO (1%, 2.5% and 5.0%) were added in the dark chocolate. Dark chocolate without SIOO was used as a control. Fatty acid profile, total polyphenols, antioxidant activity and sensory evaluation of the formulated dark chocolates with SIOO were investigated. The incorporation of SIOO significantly ($p < 0.05$) lowered the saturated fat and increased the polyunsaturated fatty acids in dark chocolate samples. This study also showed that the total polyphenols and antioxidant activity of dark chocolates enriched with 2.5 and 5.0% SIOO were significantly higher ($p < 0.05$) than the other chocolate samples. Sensory evaluation showed that control and dark chocolates added with SIOO (1% and 2.5%) received similar scores for all sensory attributes. However, the highest concentration of SIOO decreased significantly ($p < 0.05$) the scores for the taste and overall acceptability of dark chocolate. Therefore, the enrichment of sacha inchi oil oleogel as a functional ingredient could reduce the saturated fat and increase the polyunsaturated fatty acids and antioxidant activity of the formulated dark chocolate, which is well-accepted by consumers.

Keywords: dark chocolate, polyunsaturated fatty acid, sacha inchi oil oleogel, saturated fat

INTRODUCTION

Dark chocolate is one of the confectionery products admired by people of all ages (Merlino *et al.* 2021). Dark chocolate mainly consists of cocoa liquor followed by sugar, cocoa butter and emulsifier. The high content of cocoa liquor in dark chocolate possesses antioxidant properties due to polyphenols and flavonoids, which may provide several health benefits (Shahanas *et al.* 2019). The market demand for dark chocolate is predicted to increase from \$48.29 billion to \$67.88 billion by 2029 (Market Research Report 2022). However, the incorporation of solid fats such as cocoa butter equivalents, cocoa butter substitutes and cocoa butter replacers in the dark chocolate

formulation increases the content of saturated fat, which may have a negative impact on people's health such as obesity, cardiovascular diseases, high cholesterol, cancer and type II diabetes (Li & Liu 2019). For that reason, consumers demand healthy and functional chocolate products with less saturated fats by increasing the content of Polyunsaturated Fatty Acids (PUFAs) compared to conventional chocolates (Selvasekaran & Chidambaram 2021).

Edible vegetable oils (soybean, canola, sunflower and corn) are high in PUFAs, which consist of linoleic (omega-6) and α -linolenic acids (omega-3) (Loganathan & Kim-Tiu 2022). Recently, oleogels developed as the latest innovative technology for oil structuring

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(Received 17-07-2023; Revised 22-09-2023; Accepted 29-12-2023; Published 31-01-2024)

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to entrap bulk vegetable oils within a thermo-reversible and three-dimensional gel network by food-grade oleogelators (Perța-Crișan *et al.* 2023). At the same time, vegetable oils are transformed into solid fat by lowering the content of saturated fats, increasing the amount of PUFAs and retaining the chemical composition of the oils (Manzoor *et al.* 2022). Various edible oleogelators are commonly used as oleogel to entrap bulk vegetable oil, including waxes, lecithin, sterols, and monoacylglycerols. Beeswax is a natural wax produced by honey bees in the bee hives. Beeswax is the most common oil structure-forming agent used for the production of vegetable oil oleogels (sunflower oil, olive oil, linseed oil and canola oil) (Frolova *et al.* 2022; Issara *et al.* 2022).

Vegetable oil oleogels are frequently used in many food products such as bakery products, filling creams and ice cream to replace saturated fat while improving the food quality and nutritional value (Jing *et al.* 2022; Cabrera *et al.* 2020; Pehlivanoglu *et al.* 2018). Regarding chocolate products, Li & Liu (2019) produced dark chocolate added with corn oil-monoglyceric stearate based oleogel to replace cocoa butter partially. The authors reported that incorporating oleogels lowered the saturated fats and increased the PUFAs of dark chocolate samples. Alvarez *et al.* (2021) also stated that the replacement of cocoa butter in the milk chocolate formulations by sunflower-oil-Hydroxypropyl Methylcellulose (HPMC) reduced the saturated fats and increased the content of PUFA and Monounsaturated Fatty Acids (MUFAs).

Sacha inchi oil has high PUFAs content (linoleic acid: 34.1% and α -linolenic acid: 48.2%). Antioxidant compounds such as tocopherols (γ & β) and phytosterols (campesterol, stigmasterol & β -sitosterol) are also present in sachu inchi oil. Furthermore, total phenols, total flavonoids and total antioxidant activity of sachu inchi oil are 6.20 mg GAE/100 g, 0.34 mg rutin eq./g oil extract and 18.2–95.0 μ mol TE/g, respectively (Goyal *et al.* 2022; Cisneros *et al.* 2014; Zanqui *et al.* 2016). Regarding pharmacological activity, sachu inchi oil has shown its capacity to lower total cholesterol, increase high-density lipoprotein cholesterol, and exhibit anticancer action against tumour cells (Schiessel *et al.* 2015).

To the knowledge of an author, sachu inchi oleogel has not been utilised directly to reduce the saturated fats in dark chocolate. Limited

information is about the impact of oleogel-based vegetable oil on the total phenolic, antioxidant activity and sensory acceptability of chocolate products. In this study, sachu inchi oil was used as a representative of vegetable oil rich in PUFAs to develop sachu inchi oil-based oleogel with beeswax for reducing the saturated fats of dark chocolate. The objective of the present study was to investigate the effects of sachu inchi oil-based oleogel at different concentrations on the fatty acid composition, total phenolic content, antioxidant activity and sensory acceptability of dark chocolate.

METHODS

Design, location, and time

The research was conducted in the Cocoa Innovative and Technology Centre, Malaysian Cocoa Board, Negeri Sembilan and the Department of Food Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia. The study was carried out from September 2022 to February 2023.

Materials and tools

Cold-pressed sachu inchi oil (Khatijah Herbs, Malaysia) and natural yellow beeswax (Personal Formula Resources, Malaysia) were used as materials to prepare Sachu Inchi Oil Oleogel (SIOO). Meanwhile, ingredients used in the production of dark chocolate were cocoa liquor, cocoa butter, icing sugar, and soy lecithin as emulsifier from Malaysian Cocoa Board, Nilai, Negeri Sembilan. Chemicals used in this study were: methanolic potassium hydroxide (KOH), n-hexane and sodium carbonate (Na_2CO_3) from R & M Chemicals, Malaysia. Meanwhile, gallic acid, Folin-Ciocalteu and 2,2-diphenyl-1-picrylhydrazyl (DPPH) reagents were obtained from Sigma-Aldrich, United States.

Procedures

Preparation of sachu inchi oil oleogel.

SIOO was prepared according to the method of Calligaris *et al.* (2020) with slight modification. Firstly, Sachu Inchi Oil (SIO) and 10% beeswax were heated by stirring them in a dark room at not more than the maximum melting temperature of beeswax (65°C) for 30 min. The heating process is completed when the beeswax is fully soluble

in the SIO. SIOO was cooled overnight at room temperature (27°C) and stored at 20°C for analysis and usage in dark chocolate formulations.

Development of dark chocolate added with different percentages of sacha inchi oil oleogel.

The addition of SIOO at different percentages (1.0%, 2.5% and 5.0%) in dark chocolate was conducted. Four dark chocolate formulations were prepared as follow: dark chocolate without SIOO was used as a control sample (F1); dark chocolate with 1.0% SIOO (F2); dark chocolate with 2.5% SIOO (F3) and dark chocolate with 5.0% SIOO (F4). Dark chocolate was produced according to the method described by Biswas *et al.* (2017). Dark chocolate ingredients (cocoa liquor, sugar and a quarter of melted cocoa butter) were mixed in a concher (Pascal Engineering, England) at 45°C for 5 min. After that, the particle sizes of the chocolate mixtures were reduced three times to less than 30 µm using a triple roller mill (Pascal Engineering, England). After refining, the chocolate mixtures and the remaining melted cocoa butter were mixed in concher for 6 h at 45°C. Two hours before the completion of the conching process, SIOO and soy lecithin were added to the chocolate mixtures. Afterwards, the liquid dark chocolate was tempered manually on the marble slab by reducing the temperature of the liquid chocolate from 45°C to 27°C to obtain the most stable form of fatty acid crystals of cocoa butter. The tempered dark chocolate was poured into a polycarbonate mould and cooled at 13±1°C for 60 min to solidify the chocolate. The dark chocolate was then removed from the mould and stored in a plastic container at room temperature for further analysis (fatty acid composition, total phenolic content, antioxidant activity and sensory acceptability).

Determination of fatty acid profile. The fatty acid composition of the dark chocolate added with different percentages of SIOO was determined as described by Md Ali & Dimick (1994). Gas Chromatography (GC) (Hewlett-Packard 6890, Agilent Technologies, Palo Alto, CA, USA) with a flame ionisation detector was used to analyse the fatty acid methyl esters (FAMES) of chocolate samples. Fatty acid profiles of the chocolate sample were measured according to the chromatogram peak of the FAMES.

Determination of total polyphenol content. The total polyphenol content of dark chocolate added with different percentages of

SIOO was determined according to de Camargo *et al.* (2015). The total polyphenol content was expressed as gallic acid equivalents in milligrams per gram of sample (mg GAE/g dark chocolate) with the following formulation:

$$\frac{\left(\frac{10}{1000}\right) \times C}{M}$$

Where C is the concentration determined from the standard curve (mg/L), and M is the mass of the extracted sample (g).

Determination of antioxidant activity.

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity of the dark chocolate added with different percentages of SIOO was measured according to Urbńska & Kowalska (2019). DPPH free radical scavenging activity of the chocolate sample was calculated using the following formula:

$$\text{Free radical scavenging activity (\%)} = \frac{(A_1 - A_2)}{A_1} \times 100$$

Where A1 is the absorbance of the control sample, and A2 is the absorbance of the chocolate sample. The free radical scavenging activity is recorded in percentage.

Sensory evaluation. Hedonic scale rating test was carried out to evaluate the sensory acceptability of dark chocolate added with different percentages of SIOO (da Silva *et al.* 2013). Fifty untrained panelists consist of staff (academic and laboratory) and students aged 20–55 from the Department of Food Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia. The 7-point hedonic scale was made by an unstructured 10 cm horizontal linear ruler, with both ends marked with a legend. The panels indicate the intensity of each sensory attribute for chocolate sample on the 10 cm unstructured scale (where 1="least liked" and 7="most liked").

Data analysis

Total polyphenol content and antioxidant activity of dark chocolate added with different percentages of SIOO were carried out in three replications (n=3), while fatty acid profile and sensory evaluation of dark chocolate added with different percentages of SIOO were conducted in two replications (n=2). All data obtained are analysed using one-way Analysis of Variance (ANOVA) and Tukey's post-hoc test to determine if there was a significant difference between

samples. A confidence level of 95% ($p < 0.05$) was used to see significant differences between samples. All data are expressed as mean \pm standard deviation.

RESULTS AND DISCUSSION

The fatty acid composition of dark chocolate added with different percentages of SIOO is showed in Table 1. Palmitic and stearic acids (saturated fatty acids), oleic acid (monounsaturated fatty acid), linoleic and α -linolenic acids (PUFAs) were identified in dark chocolate samples. Saturated fatty acids (palmitic and stearic acids) are the major fatty acids in all chocolate samples due to the incorporation of cocoa butter as fat medium in the chocolate formulation. The control sample contains the highest amount of saturated fatty acids (66.12%). Results showed that adding different SIOO significantly decreased ($p < 0.05$) the content of saturated fatty acids (57.02–64.11%) compared to the control sample. At the same time, the content of PUFAs (linoleic and α -linolenic acids) in dark chocolate increased significantly ($p < 0.05$) with the concentrations of SIOO (from 1.0–5.0%). These findings were reasonably expected due to the high concentration of PUFAs

present in SIO (Rodzi *et al.* 2022). Li & Liu (2019) reported that the addition of different corn oil-based oleogels (monoglyceric stearate, β -sitosterol and lecithin and ethyl cellulose) in dark chocolate decreased significantly ($p < 0.05$) the saturated fatty acids (21.17–21.84%) compared to the control sample (dark chocolate with 100% cocoa butter) (37.86%). The authors also proved that the PUFAs (57.24–57.88%) of dark chocolate increased significantly by adding different corn oil-based oleogels. Enrichment of PUFAs from SIO-based oleogel in dark chocolate might lower heart diseases, prevent cancer risk and cardiovascular diseases, and improve high-density lipoprotein blood (Nguyen *et al.* 2020). Therefore, adding sacha inchi oil oleogels at different concentrations decreases the saturated fatty acids and enhances the content of PUFAs in dark chocolate.

Table 2 presents the Total Polyphenol Content (TPC) of dark chocolate added with different percentages of SIOO. The result showed that the TPC for dark chocolate added with 2.5 and 5.0% SIOO (27.35–28.69 mg GAE/g) were significantly higher ($p < 0.05$) than F1 and F2 samples (24.39–25.32 mg GAE/g). However, the difference in TPC between F1 and F2 samples is insignificant ($p > 0.05$). The lowest concentration

Table 1. Fatty acid profiles of the dark chocolate added with different percentages of sacha inchi oil oleogels

Fatty acid	Sample			
	F1	F2	F3	F4
Saturated fatty acid				
Palmitic acid (%)	28.19 \pm 0.14 ^a	27.01 \pm 0.01 ^b	25.09 \pm 0.01 ^c	23.93 \pm 0.17 ^d
Stearic acid (%)	37.93 \pm 0.21 ^a	37.10 \pm 0.02 ^b	35.36 \pm 0.07 ^c	33.09 \pm 0.29 ^d
Total saturated fatty acid (%)	66.12 \pm 0.44 ^a	64.11 \pm 0.05 ^b	60.45 \pm 0.05 ^c	57.02 \pm 0.50 ^d
Monounsaturated fatty acid				
Oleic acid (%)	30.62 \pm 0.03 ^a	28.89 \pm 0.11 ^b	29.08 \pm 0.04 ^b	27.75 \pm 0.24 ^c
Polyunsaturated fatty acids				
Linoleic acid (%)	2.90 \pm 0.02 ^d	3.54 \pm 0.03 ^c	5.90 \pm 0.00 ^b	7.53 \pm 0.09 ^a
α -Linolenic acid (%)	0.21 \pm 0.01 ^d	2.03 \pm 0.52 ^c	4.13 \pm 0.06 ^b	6.64 \pm 0.17 ^a
Total polyunsaturated fatty acids (%)	3.11 \pm 0.02 ^d	5.57 \pm 0.53 ^c	10.03 \pm 0.08 ^b	14.17 \pm 0.28 ^a
Total unsaturated fatty acid (%)	33.73 \pm 0.05 ^d	34.46 \pm 0.41 ^c	38.11 \pm 0.04 ^b	41.92 \pm 0.50 ^a

Values are mean \pm standard deviation (n=2)

^{a-d}Values in each row with different letters are significantly different ($p < 0.05$).

Dark chocolate formulations containing sacha inchi oil oleogel: F1: Dark chocolate without sacha inchi oil oleogel; F2: Dark chocolate with 1.0% sacha inchi oil oleogel; F3: Dark chocolate with 2.5% sacha inchi oil oleogel; F4: Dark chocolate with 5.0% sacha inchi oil oleogel

Table 2. Total polyphenol content and free radical scavenging of the dark chocolate added with different percentages of sacha inchi oil oleogels

Sample	Total polyphenol content (mg GAE/g)	Free radical scavenging activity (%)
F1 (Dark chocolate without sacha inchi oil oleogel)	25.32±0.63 ^c	79.82±0.51 ^b
F2 (Dark chocolate with 1.0% sacha inchi oil oleogel)	24.39±2.10 ^c	79.89±3.23 ^b
F3 (Dark chocolate with 2.5% sacha inchi oil oleogel)	27.35±0.22 ^b	83.51±1.27 ^{ab}
F4 (Dark chocolate with 5.0% sacha inchi oil oleogel)	28.69±0.08 ^a	84.59±0.36 ^a

Values are mean±standard deviation (n=3)

^{a-c}Values in each column with different letters are significantly different (p<0.05)

of SIOO (1.0%) did not increase (p>0.05) the TPC of the dark chocolate (24.39 mg GAE/g). Ramos-Escudero *et al.* (2021) reported that simple phenol, isocoumarin, lignan, flavonoids, and secoiridoid are the major phenolic classes detected in 27 commercial sacha inchi oil samples. For that reason, the addition of SIOO increased the TPC of dark chocolate. To the best of our knowledge, the TPC of chocolate or any food product added with vegetable oil oleogel has not yet been investigated. Urbańska & Kowalska (2019) reported that the polyphenol content of chocolate using different roasted beans from various countries (Venezuela, Dominican Republic, Ghana, Columbia and Venezuela) ranged from 9.1–40.55 mg/g chocolate. In the present study, the TPC of all dark chocolate samples are in the range of those reported by Urbańska & Kowalska (2019). EFSA Panel on Dietetic Products, Nutrition and Allergies [NDA] (2012) and Andújar *et al.* (2012) stated that the high amount of cocoa liquor used in dark chocolate contributed to the great source of polyphenols, which provides numerous positive health benefits such as prevention of cancer, cardiovascular and inflammatory diseases as well as protection of low-density lipoprotein cholesterol against oxidative stress. It clearly showed that adding 2.5 and 5.0% sacha inchi oil oleogel significantly increased the total phenolic content of dark chocolate.

The DPPH(2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity was carried out to determine the antioxidant activity of dark chocolate added with different percentages of SIOO, as shown in Table 2. The results showed that F1 and F2 samples had the lowest (p>0.05) free radical scavenging activity (79.82–79.89%) compared to F3 (83.51%) and F4 (84.59%).

A higher amount of SIOO (2.5 and 5.0%) can definitely improve the antioxidant activity of dark chocolate. To our knowledge, there has yet to be published data on the effects of vegetable oil oleogel on the antioxidant activity of chocolate or all types of food products. Ramos-Escudero *et al.* (2019) reported that 27 commercial SIO samples contain several lipid-soluble antioxidant compounds, such as tocopherols (γ - & δ -) and sterols (campesterol and stigmasterol), which attributed to the antioxidant activity. Also, polyphenolic compounds play a synergistic role with other antioxidant compounds (tocopherols and sterols) in SIO (Cárdenas *et al.* 2021; Liu *et al.* 2014). Moreover, tocopherols and polyphenols act as antioxidants and provide health benefits in preventing hypertension, atherosclerosis and certain cancers (Liu *et al.* 2014). The health benefits associated with this high radical scavenging activity of dark chocolate added with sacha inchi oil oleogel are worth further investigation.

The mean scores for each attribute of dark chocolate added with different percentages of SIOO are presented in Table 3. Results showed that the mean scores for the overall acceptability of the dark chocolate samples were 4.22–5.20, which corresponded to “neither like nor dislike” and “like” based on the seven-point hedonic scale. Dark chocolate samples (F1, F2 and F3) received similar score (5.01–5.20) “like” (p>0.05) for overall acceptability. Not only that, mean scores for texture, aroma, taste, bitter aftertaste and glossiness of dark chocolate added with SIOO (1.0 & 2.5%) were similar (p>0.05) with the control sample. However, panelists gave the lowest sensory score (4.22) (p<0.05) for the overall acceptability of the F4 sample. Besides that, mean scores for different sensory attributes

Table 3. Mean scores for each sensory attribute of dark chocolate added with different percentages of sacha inchi oil oleogel

Sample	Attributes					
	Glossiness	Texture	Aroma	Taste	Bitter aftertaste	Overall acceptability
F1	5.28±1.21 ^a	5.38±1.31 ^a	5.10±1.27 ^a	4.96±1.58 ^a	4.84±1.56 ^a	5.20±1.28 ^a
F2	5.24±1.10 ^a	5.2±1.21 ^a	5.22±1.02 ^a	4.96±1.54 ^a	4.74±1.48 ^a	5.03±1.27 ^{ab}
F3	5.50±1.23 ^a	5.22±1.17 ^a	4.78±1.27 ^{ab}	4.38±1.62 ^a	4.58±1.58 ^a	5.01±1.51 ^{ab}
F4	5.38±1.01 ^a	5.30±1.18 ^b	4.34±1.26 ^b	3.90±0.67 ^b	3.84±0.68 ^b	4.22±0.50 ^c

Values are mean±standard deviation (n=50)

^{a-c} Values in each column with different letters are significantly different (p<0.05).

Dark chocolate formulations containing sacha inchi oil oleogel: F1: Dark chocolate without sacha inchi oil oleogel; F2: Dark chocolate with 1.0% sacha inchi oil oleogel; F3: Dark chocolate with 2.5% sacha inchi oil oleogel; F4: Dark chocolate with 5.0% sacha inchi oil oleogel

(texture, aroma, taste and bitter aftertaste) of the F4 sample were the lowest (p<0.05) compared to other chocolate samples. The panelists commented that F4 sample contains strong bean and grass odours. This can be explained that SIO has a flavour profile includes a green aroma, which is associated with the presence of several volatile compounds such as hexanal, 3-pentanone and 1-penten-3-ol (Ramos-Escudero *et al.* 2021). Thus, the highest percentage of SIOO (5%) added to the dark chocolate received the lowest score for all sensory attributes except glossiness. Regarding the taste attribute of the F4 sample, their mean score was the lowest (3.90) compared to other chocolate samples due to the intense bitter flavour and a strong herbal taste after consumption, which panelists do not prefer. The finding of Espert *et al.* (2021) is in line with the present study that the taste of the milk chocolate added with 1.5 and 2% sunflower oil-hydroxypropyl methylcellulose based oleogels is dominated by a bitter taste. This suggested adding SIOO into the dark chocolate at concentrations of 1.0 to 2.5% to obtain an acceptable score for overall customer acceptance and sensory attributes, similar to standard dark chocolate.

CONCLUSION

This research uses different percentages of sacha inchi oil oleogel as a partial cocoa butter replacer to produce dark chocolate with reduced saturated fat. Enriching sacha inchi oil oleogel in dark chocolate significantly increased the content of polyunsaturated fatty acids by lowering the saturated fatty acids compared to the standard dark

chocolate. Sacha inchi oil oleogel significantly improved the dark chocolate's total phenolic content and antioxidant activity compared to the standard dark chocolate. When sacha inchi oil oleogels at concentrations of 1.0% and 2.5% are used together with cocoa butter in the formulation, dark chocolate has similar attributes to standard dark chocolate. However, the panelists rated the lowest score for all sensory attributes of dark chocolate added with 5% sacha inchi oil oleogel. These findings verify that healthier dark chocolate with higher polyunsaturated fat content, total phenolic content and antioxidant activity and lower saturated fat content, as well as optimal sensory acceptability can be obtained by adding sacha inchi oil oleogel in the production of dark chocolate.

ACKNOWLEDGEMENT

The research work was funded by the Development and Pre-Commercialisation of Cocoa Functional Food Products under RMK-12: PTJ120712.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Banana Peels as Potential Prebiotic and Functional Ingredient

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ABSTRACT

This study aims to determine the prebiotic potential of the banana peel on the growth of probiotic *Lactobacillus* spp. in vitro and to utilize the peel as a functional ingredient in preparing biscuits. Peels of dessert banana (*pisang berangan*) and plantain (*pisang nangka*) were oven-dried and homogenized, and the total sugar content was determined. Subsequently, different cultivation media were made by substituting the carbon source with Banana Peel Powder (BPP), Plantain Peel Powder (PPP), glucose, and inulin. These media were later fermented with probiotic *Lactobacillus* spp., extracted from a probiotic drink. The growth performance was accessed following 24 hours of incubation. BPP and PPP were incorporated into the preparation of biscuits as functional ingredients. A portion of wheat flour was substituted with 10%, 20%, and 30% of BPP and PPP, respectively, during the preparation of the biscuits. These biscuits were then analyzed for proximate composition, physical properties, and estimated Glycaemic Index (eGI). The supplementation of BPP and PPP in the media improved the probiotic bacteria's growth rate and generation time as the media had a significantly higher amount of *Lactobacillus* spp. compared to others. Both BPP- and PPP-supplemented media had significantly low pH, indicating intense metabolic activity of the bacteria utilizing the peels. Results also showed significant differences in the total dietary fiber and protein content of BBP- and PPP-incorporated biscuits. The addition of BPP and PPP did not significantly affect the physical properties of the biscuit, and such incorporation resulted in lower eGI when compared to the control. BPP and PPP possess potential prebiotic properties and can be utilized as functional ingredients. Further study is warranted to explore other prebiotic properties of banana peels and to investigate consumers' acceptance of banana peel-incorporated foods.

Keywords: banana peel, functional food, prebiotic

INTRODUCTION

Banana is a popular fruit widely cultivated and consumed in many tropical nations, including Malaysia, Thailand, and Indonesia (Zaini *et al.* 2022). To fulfil the increasing local demand for bananas, banana trees are widely cultivated in Malaysia (Fizar *et al.* 2022). High production of bananas is associated with the generation of banana by-products. Banana peel is usually discarded, thus generating massive amounts of household and industrial food waste (Ahmed *et al.* 2006).

Banana peel is an underpredicted functional food source as it contains soluble fibre oligosaccharide (Liang *et al.* 2022). Fructooligosaccharide was found in banana peels and had prebiotic properties (Azam *et al.* 2020). Besides soluble fibre, banana peel also

contains insoluble fibre. Since banana peels have a remarkable amount of fibre; thus, they may exhibit a low Glycaemic Index (GI) value when the wheat flour is substituted with a specific ratio of banana peel powder (Chakraborty *et al.* 2021). Indeed, utilizing this agricultural waste as a functional food or value-added food item is critical for long-term sustainability, in line with the Sustainable Development Goal (SDG) No.12, which aims to ensure sustainable consumption and production patterns.

There is limited study on the prebiotic potential of banana peels. A few published studies have shown contradicted findings of banana peels (Hernández-Alcántara *et al.* 2016). Other studies have reported banana peels' antioxidant and antimicrobial properties, but there is still limited study of banana peels on the activity of *Lactobacillus* spp. growth. Besides,

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(Received 16-07-2023; Revised 22-09-2023; Accepted 31-12-2023; Published 31-01-2024)

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there is no study comparing the GI of banana peel-incorporated biscuits from several types of bananas. Only one study compared GI between wheat-based and unripe banana peel biscuits (Bakar *et al.* 2020). Therefore, this study aims to determine the prebiotic potential of the banana peel on the growth of probiotic *Lactobacillus* spp. in vitro and to utilize the peel as a functional ingredient in the preparation of biscuits.

METHODS

Design, location, and time

This was an in vitro experiment and it was carried out at the Nutrition Laboratory, Department of Nutrition, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, from July 2022 until February 2023.

Materials and tools

Banana peels were obtained from Kerepek Azadila, Puchong, Selangor, Malaysia, dried in an oven (Memmert GmbH, Germany) and ground (Waring Commercial, USA) to prepare banana peel powder. Anthrone reagent, concentrated H₂SO₄, 2.5 NHCl, sodium carbonate, centrifuge machine (Hettich, Germany), and water bath (Memmert GmbH, Germany) were used to determine the carbohydrate content of the banana peel powder. A probiotic drink was purchased from a nearby supermarket in Serdang, Selangor, and used as a source of probiotics, *Lactobacillus* spp. Both de Man Rogosa and Sharpe (MRS) agar and broth were prepared in a fume cupboard to culture and enumerate *Lactobacillus* spp. To prepare the batch culture medium, peptone, yeast extract, Tween 80, and L-cysteine hydrochloride were mixed with 1 L of distilled water and sterilised with autoclave (HVE-50, Hirayama, Japan). Petroleum ether, extraction thimble (Sigma-Aldrich, St. Louis, MO, USA), condenser, rotary evaporator (Büchi® R-200 Rotavapor System), were used in Soxhlet while concentrated H₂SO₄, HCl, and Kjeldahl's distillation unit (KT 200 Kjeltec™ Distillation Unit) were used in the Kjeldahl methods. For the total fiber determination, 78% ethanol, 95% ethanol, acetone, and megazyme total dietary fiber assay kit (NEOGEN, Michigan USA) were used. To estimate GI, 0.1 M potassium phosphate buffer solution (PBS) (pH 6.9), HCl, Potassium Hydroxide (KOH), pepsin, α -amylase, 3,5-Dinitrosalicylic acid (DNSA) reagent, and

Visking Dialysis Tube, Cellulose (Size 2, inflat D14.3/26 mm) were used.

Procedure

Preparation of banana peel powder.

The banana peel powder was prepared based on the method of Zahid *et al.* (2021) with some modifications. Dessert banana (*pisang berangan*) and plantain (*pisang nangka*) peels were washed with tap water and cut into small uniform pieces. They were dried in an oven at 50°C for 24 hours and ground into powder using a grinder. The dried Banana Peel Powder (BPP) and Plantain Peel Powder (PPP) were sieved to maintain a uniform particle size, packed in airtight bags, and stored in the chiller at 4°C until further use.

Determination of carbohydrate content in banana peel and banana peel-incorporated biscuits. The anthrone method by Ludwig and Goldberg (1956) was used to determine carbohydrate content. Samples were heated in a boiling water bath for 8 minutes after adding the anthrone reagent, and the absorbance was measured using a spectrophotometer at 620 nm. The carbohydrate content was extrapolated from a standard curve of glucose with varying concentrations (0.2–1 g/L).

Propagation of Lactobacillus spp. Briefly, 0.01 mL of probiotic drink was aseptically spread onto MRS agar and incubated at 37°C aerobically for 24–48 hours. Then, one colony of *Lactobacillus* spp. was inoculated into MRS broth and incubated at 37°C aerobically for 48 hours. At 3-hour intervals, 1 mL was taken, where the Optical Density (OD) was measured, and log colony forming unit per milliliter (log CFU/mL) was calculated. A graph of log colony forming units (log CFU/mL) against optical density (OD₆₀₀) of *Lactobacillus* spp. was plotted and these variables were positively correlated. Then the graph was used to extrapolate the amount of *Lactobacillus* spp.

Assessment of bacterial growth performance. The preparation of the batch culture medium and the fermentation of *Lactobacillus* spp. was based on the method in Azam *et al.* (2020) with some modifications. The amount of BPP and PPP with 2.39% w/v of carbohydrate content was extracted following the procedure by Pereira *et al.* (2018) to obtain the oligosaccharide. Peptone (1g/100 mL), yeast extract (0.5 g/100 mL), Tween 80 (0.1 mL/100 mL), and L-cysteine

hydrochloride (0.05 g/100 mL) were mixed in five vessels, respectively, with the extracted BPP and PPP solutions, 2.39% w/v of inulin, 2.39% w/v of glucose, and distilled water (control). All media were sterilized using an autoclave. The final volume in each vessel was 100 mL. One (1) colony of *Lactobacillus* spp. was inoculated separately into five different vessels containing batch culture media and incubated at 37°C for 24h. Samples from each vessel were taken (10 mL) at 15, 18, 21, and 24 hours of fermentation at 37°C for enumeration of *Lactobacillus* spp. and pH measurement.

Determination of mean growth rate constant (k) and mean generation time, (g) of *Lactobacillus* spp.. Formulas from Willey *et al.* (2018) were used to calculate the mean growth rate constant (k) and mean generation time (g) as follows:

$$k = (\log N_t - \log N_0) / (\log 2)t$$

$$g = 1/k$$

Where, $\log N_t$ = log CFU/mL at the end of fermentation

$\log N_0$ = log CFU/mL at the start of fermentation

t = final time of incubation

Preparation and proximate composition of BPP- and PPP-incorporated biscuits. One hundred (100) g of wheat flour, 56 g of sugar, 23.5 g of shortening, 1.1 g NaHCO₃, 0.89 g NaCl, and 12 mL of milk were mixed to form biscuit dough (Arun *et al.* 2015). The Wheat Flour (WF) was substituted with 10% (BPP10 or PPP10), 20% (BPP20, or PPP20), and 30% (BPP30 or PPP30) of BPP and PPP, respectively. The doughs were then molded into walnut-sized balls approximately 4 cm in diameter, placed on a greased tray, and baked in the oven for 15 minutes at 180°C or until golden brown. The biscuits were cooled at room temperature and stored in a polyethylene bag before analysis. Evaluation of moisture (gravimetric method with oven drying – AOAC 2000), ash (carbonization and incineration in the furnace – AOAC 2000), fat (Soxhlet method – AOAC 1996), protein (Kjeldahl – AOAC 2000), carbohydrate (Anthrone method), and total dietary fiber (enzymatic-gravimetric method – AOAC 991.43) of the cookies were conducted according to AOAC methods (Helrich 1990).

Determination of physical properties of BPP- and PPP-incorporated biscuits. The diameter (D) and thickness (T) of the biscuits were

measured using a ruler (Abu Bakar *et al.* 2018). The diameter of the biscuits was determined by arranging six biscuits edge to edge, and the overall diameter of the biscuits was measured. Then, the average diameter of the biscuits was recorded after six times of biscuit rearrangement. The procedure was repeated by stacking six biscuits on top of one another to determine the thickness of the biscuits. The averages of the diameter and thickness were reported in centimeters (cm) and used to calculate the spread ratio.

Estimation of glycaemic index. To predict the glycaemic response and estimate the Glycaemic iIndex (eGI) of the BPP- and PPP-incorporated biscuits, an in vitro starch hydrolysis was conducted according to Gibson *et al.* (2011). Briefly, samples were added into potassium phosphate buffer (pH 6.9) and kept at 37°C. Hydrochloric acid was used to adjust the pH of the samples to pH 2.5. Then, pepsin was added and placed in a water bath for 1 hour at 37°C. Potassium hydroxide was used to increase the samples' pH to 6.8. The mixtures were transferred into a dialysis tube after adding 2 mL α -amylase. Subsequently, the dialysis tube was placed in a buffer solution while the flask was set in a shaking water bath at 37°C. Forty (40) mL of buffer solution was extracted every 30-minute interval within 3 hours to determine the carbohydrate hydrolysis rate from the dialysis tube. 3,5-Dinitrosalicylic Acid (DNSA) reagent was used to estimate the amount of reduced sugar. The concentration-over-time curve (area under the curve) was determined, and the Hydrolysis Index (HI) was calculated by comparing the Area Under the Curve (AUC) of the samples and the AUC of maltose, which acts as the standard of reference food. Then, HI was calculated as $HI = (\text{Area under the curve, sample} / \text{Area under the curve, reference}) \times 100\%$ and it was later used to determine eGI.

Data analysis

Statistical analysis was conducted by using IBM SPSS Statistics 26. Results were expressed as means \pm standard deviation. One-Way ANOVA analysis was used to compare the data, and Post Hoc Comparison (Tukey HSD) was used to determine significant differences between the variables. P-values of <0.05 were regarded to be significant.

RESULTS AND DISCUSSION

Carbohydrate content in BPP and PPP

BPP had 34.0% carbohydrates, while PPP contained higher carbohydrates, 61.9%. According to Tsado *et al.* (2021), dessert banana peel and plantain peel contain around 63.8% and 74.1% of carbohydrates, respectively, compared to this study's result. The varied nutritional content is due to the genetic makeup, environmental factors, and addition of nutrients to the soil (Durgadevi *et al.* 2019). The ripening state can also affect the composition of the peels (Khawas & Deka 2016). Plantain peel contains more total starch and soluble sugar (glucose, fructose, and sucrose) than dessert banana peel at any maturation stage (Emaga *et al.* 2007).

Growth performance of *Lactobacillus* spp. in BPP- and PPP-supplemented media

The bacteria count significantly differed in media with different carbon sources ($p < 0.05$). Specifically, the growth of *Lactobacillus* spp. media supplemented with BPP and PPP was significantly higher than inulin, glucose, and without carbon source (Table 1). The finding of this study was in line with previous studies that showed the banana peel promotes the growth of probiotic bacteria (Syahpura *et al.* 2019; Zahid *et al.* 2021). Study showed that fructooligosaccharide is present in both dessert banana and plantain peel and possess prebiotic properties (Azam *et al.* 2020). Dessert banana peel contains more fructooligosaccharide than plantain peel (Syahpura *et al.* 2019). Thus,

it can be postulated that the higher count of *Lactobacillus* spp. in a medium with BPP could be due to the presence of fructooligosaccharide.

The findings of Rossi *et al.* (2005) indicated that the potential of fructooligosaccharide in promoting the growth of *Lactobacillus* spp. was higher than inulin, supporting the findings of this study. The growth of *Lactobacillus* spp. is more rapid with the presence of fructooligosaccharide compared to inulin because short-chain fructooligosaccharide has a lower degree of polymerization (< 10) compared to long-chain inulin (> 20). Inulin is a fructan with a longer chain length and larger molecule, which requires more time for the bacteria to ferment (Parhi *et al.* 2021). Thus, bacteria take a shorter time to ferment fructooligosaccharide.

As shown in Table 1, there was a significant difference in the final pH of the media with a different carbon source ($p < 0.05$). The pH of media supplemented with BPP and PPP was significantly lower than inulin, glucose, and no carbon source. The finding of this study was in line with previously reported study that showed the banana peel as a carbon source has a pH-lowering effect (Safdari *et al.* 2021). *Lactobacillus* spp. is lactic acid bacteria that can ferment carbohydrates to produce lactic acid (Wang *et al.* 2021). Thus, the activity of *Lactobacillus* spp. can be detected by measuring the pH of customized media.

The result showed that there was a significant difference between the mean growth rate constant (k) and mean generation time (g) of *Lactobacillus* spp. in media with a different carbon source ($p < 0.05$) (Table 1). The mean growth rate

Table 1. Final bacteria count (log CFU/mL), final pH, and growth performance of *Lactobacillus* spp. employed with different carbon sources

Carbon source	Mean \pm SD			
	Log CFU/mL	Final pH	Growth rate constant, k (log CFU/mL h ⁻¹)	Generation time, g (h)
No carbon source	8.28 \pm 0.01 ^a	4.65 \pm 0.03 ^a	0.03 \pm 0.00 ^a	33.83 \pm 0.10 ^a
Glucose	9.42 \pm 0.06 ^{b,f}	3.98 \pm 0.16 ^{b,f}	0.32 \pm 0.03 ^{b,f}	3.17 \pm 0.32 ^{b,f}
Inulin	9.49 \pm 0.15 ^{c,f}	3.87 \pm 0.05 ^{c,f}	0.32 \pm 0.02 ^{c,f}	3.09 \pm 0.15 ^{c,f}
BPP	11.25 \pm 0.04 ^d	3.43 \pm 0.04 ^d	0.90 \pm 0.07 ^d	1.11 \pm 0.09 ^d
PPP	9.86 \pm 0.07 ^e	3.78 \pm 0.02 ^e	0.37 \pm 0.02 ^e	2.68 \pm 0.11 ^e

Results are expressed as mean \pm standard deviation of two independent experiments ($n=2$); Value with different superscript letters shows significant differences

BPP: Banana Peel Powder; PPP: Plantain Peel Powder

constant (k) and mean generation time (g) of *Lactobacillus* spp. in a medium supplemented with BPP as a carbon source was significantly higher than in a PPP-supplemented medium.

The generation time (g) of *Lactobacillus* spp. in a medium without a carbon source is significantly the longest. From the finding, it is estimated that around 33.83 hours to complete binary fission and produce the next generation, without any supplementation. Hence, the environment without a carbon source is the least preferred by *Lactobacillus* spp., as the bacteria can hardly undergo cell division. In contrast, *Lactobacillus* spp. only require around 1.11 hours to complete cell division in media with dessert banana peel. It shows that the environment is the most preferred by the *Lactobacillus* spp., where it divides actively, as found in the present study.

The generation time differs widely among different bacteria. Even within the bacteria of the same species, the generation time might also be different due to the environmental factor (Mason 1935). The finding of this study is slightly different from the previous study, where the generation time of *Lactobacillus* spp. is between 0.62 hours and 2.25 hours (Mason 1935; Ahmed *et al.* 2006). This indicated that the *Lactobacillus* spp. used in this study duplicate slower compared to other species.

Proximate composition of BPP- and PPP-incorporated biscuits

As shown in Table 2, the moisture content in BPP-incorporated biscuits was significantly lower as the level of BPP substitution increased

($p < 0.05$). There was a significant difference and increasing trend in ash content between control and BPP-incorporated biscuits as the BPP level increased, while only PPP30 biscuits showed significance ($p < 0.05$). Besides, the protein content and total dietary fiber (TDF) were significantly different between the control and BPP- and PPP-incorporated biscuits ($p < 0.05$). Lower moisture content in BPP- and PPP-incorporated biscuits, indicates longer shelf life (Amarasinghe *et al.* 2021). Mahloko *et al.* (2019) also supported that microbial growth, mold, and insect manifestation could be resisted when the moisture content is less than 14%. It was expected that BPP- and PPP-incorporated biscuits to have low protein as their source from the wheat flour has been reduced. Nonetheless, these biscuits could be alternative sources of dietary fiber because they had higher TDF than wheat flour biscuits, as found in this study.

Diameter, thickness, and spread ratio of BPP- and PPP-incorporated biscuits

There was no significant difference in the diameter, thickness, and spread ratio of the biscuits ($p < 0.05$) (Table 3). The results were contradicted by other studies since the diameter of the biscuits tend to decrease as the level of BPP increases (Arun *et al.* 2015; Abu Bakar *et al.* 2018; Mahloko *et al.* 2019). On the other hand, Mahloko *et al.* (2019) demonstrated that biscuits containing both BPP and PPP also did not show any significance from the control ($p < 0.05$). As a result, the insignificant physical properties in both BPP- and PPP-incorporated biscuits

Table 2. Proximate composition of BPP- and PPP-incorporated biscuits

Parameter (%)	Control	BPP10	BPP20	BPP30	PPP10	PPP20	PPP30
Moisture	10.75±0.01 ^a	9.53±0.08 ^{ac}	9.13±0.30 ^{bc}	9.08±0.18 ^{bc}	10.62±0.29 ^a	10.60±0.25 ^a	10.16±0.18 ^{ac}
Ash	1.40±0.14 ^a	1.97±0.09 ^{ac}	2.72±0.26 ^{bc}	3.36±0.28 ^b	1.77±0.05 ^{ac}	2.15±0.03 ^{ac}	2.65±0.21 ^{bc}
Fat	15.09±0.12 ^{ac}	15.73±0.51 ^{ac}	16.43±1.73 ^{ac}	19.29±1.74 ^a	13.25±0.47 ^{bc}	13.71±0.37 ^{ac}	14.59±0.21 ^{ac}
Protein	4.55±0.49 ^a	2.02±0.12 ^b	2.02±0.12 ^b	1.93±0.25 ^b	2.17±0.09 ^b	2.45±0.00 ^b	2.51±0.08 ^b
TDF	1.76±0.11 ^a	2.98±0.03 ^b	3.00±0.02 ^b	3.25±0.03 ^{bd}	3.00±0.00 ^{bd}	3.15±0.12 ^{bd}	3.43±0.05 ^{cd}
TAC	67.26±0.90 ^a	63.57±0.84 ^a	62.67±0.83 ^a	61.13±2.16 ^a	66.12±1.22 ^a	65.02±0.21 ^a	64.30±0.52 ^a

Results are expressed as mean±standard deviation of two independent experiments (n=2); Value with different superscript letters shows significant differences

BPP: Banana Peel Powder; PPP: Plantain Peel Powder; TDF: Total Dietary Fiber; TAC: Total Available Carbohydrate

Table 3. Physical properties of BPP- and PPP-incorporated biscuits

Parameter (%)	Control	BPP10	BPP20	BPP30	PPP10	PPP20	PPP30
Diameter (cm)	4.28±0.05 ^a	4.31±0.14 ^a	4.34±0.38 ^a	4.42±0.23 ^a	4.37±0.06 ^a	4.42±0.14 ^a	4.40±0.1 ^{1a}
Thickness (cm)	8.21±0.60 ^a	7.41±0.01 ^a	7.30±0.50 ^a	6.34±0.02 ^a	8.15±0.69 ^a	7.55±0.32 ^a	7.66±0.23 ^a
Spread ratio	5.22±0.33 ^a	5.82±0.18 ^a	5.96±0.91 ^a	6.98±0.37 ^a	5.38± 0.38 ^a	5.86±0.06 ^a	5.74±0.04 ^a

Results are expressed as mean±standard deviation of two independent experiments (n=2); Value with different superscript letters shows significant differences

BPP: Banana Peel Powder; PPP: Plantain Peel Powder

demonstrated that the substitution of BPP and PPP did not cause major changes in the physical characteristics when compared to the standard one.

Hydrolysis Index (HI) and Estimated Glycaemic Index (eGI)

There was a significant difference in HI and eGI of control biscuits with both BPP- and PPP-incorporated biscuits ($p < 0.05$) (Table 4). On the other hand, there was no significant difference in HI and eGI between BPP- and PPP-incorporated biscuits ($p > 0.05$). The biscuits with the formulation of 100% wheat flour showed significantly greater values of HI and eGI than the other formulations. The incorporation of BPP and PPP in biscuits slows the starch hydrolysis rate due to the presence of fiber content. Indeed, BPP- and PPP-incorporated biscuits have much higher fiber content compared to wheat flour, thus resulting in lower HI and eGI. Furthermore, α -amylase has a lower capacity to digest the dietary fiber contained in the biscuits, thus, resulting in less digestion of starch (Chakraborty *et al.* 2021). High-fiber food allows the stomach to give signals to the liver to cease glucose production. Therefore, low hydrolysis rate and increment of glucose level can be seen over time. The lower hydrolysis rate determines a lower GI value (Bakar *et al.* 2020). Both BPP- and PPP-

incorporated biscuits meet with the classification of medium GI food (56–69) compared to control biscuits that fell into the high GI food category (≥ 70) (Dona *et al.* 2010).

CONCLUSION

The cultivation of *Lactobacillus* spp. in customized batch culture media containing BPP and PPP as the sole carbon source resulted in intense bacterial metabolic activities as observed by high cell counts (log CFU/mL), decreased in pH values and acceptable results of mean growth rate constant (k) as well as mean generation time (g) besides obtaining satisfactory prebiotic properties. Besides, incorporating BPP and PPP in biscuits can increase the total dietary fiber content and decrease the protein content of biscuits. Furthermore, such incorporation slowed down starch digestion and possessed lower eGI. In contrast, the physical properties of both BPP- and PPP-incorporated biscuits were not significantly affected.

For the future study, the use of probiotic bacteria with different species and strains (*Bifidobacterium* spp. and *Eubacterium* spp.) and pathogenic bacteria (*E.coli*) are recommended to determine the prebiotic effect of the banana peel on different probiotics. Moreover, the banana peel fiber can be introduced for *Lactobacillus*

Table 4. Hydrolysis index and estimated glycaemic index of BPP- and PPP-incorporated biscuits

Parameter (%)	Control	BPP10	BPP20	BPP30	PPP10	PPP20	PPP30
HI	55.84±0.80 ^a	34.94±2.93 ^b	34.61±1.00 ^b	34.78± 2.02 ^b	34.73±3.19 ^b	34.98±0.20 ^b	34.98± 2.48 ^b
eGI	70.36±0.44 ^a	58.89±1.61 ^b	58.7±0.55 ^b	58.81±1.12 ^b	58.78±1.75 ^b	58.92±0.11 ^b	58.91± 1.36 ^b

Results are expressed as mean±standard deviation of two independent experiments (n=2); Value with different superscript letters shows significant differences

BPP: Banana Peel Powder; eGI: estimated Glycaemic Index; HI: Hydrolysis Index; PPP: Plantain Peel Powder

spp. fermentation since insoluble fiber might also promote the growth of probiotics. Since the finding presented here is based on in vitro study, further in vivo and human research can be pursued to validate the prebiotic properties of banana peel and its incorporated biscuits. In addition, sensory evaluation is recommended to assess consumer satisfaction and acceptance towards the appearance, odor, taste, color, hardness, and texture of the biscuit incorporated with banana peels.

ACKNOWLEDGEMENT

This research is part of bachelor dissertations by Chee Yee Tan, and Nurul Nadiah Mohd Arifin submitted to Universiti Putra Malaysia (UPM). The authors acknowledge the technical assistance from staff of the Nutrition Laboratory, Department of Nutrition, Faculty of Medicine and Health Sciences, UPM.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Development and Validation of a Website on Early Childhood Nutrition

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ABSTRACT

This study aimed to develop and determine the content and face validation of eHealth website that can function as a one-stop information center for parents, caregivers, teachers, and healthcare professionals on early childhood nutrition. This study was divided into two phases. Phase 1 involved website development and was executed in three steps: Step 1: Need Assessment, Step 2: Design Arrangement, and Step 3: Website Construction. Phase 2 involved website validation, which included content validation by six professionals in nutrition/dietetics and early childhood education fields and face validation by six professionals and 50 target users, including parents, caregivers, nursery or preschool teachers, and students. The content validation obtained a score of 1.00. The face validation by professionals exceeds the minimum value of 80% except for the Quality of Information. In comparison, face validation by the users exceeds 80% except for Subjective Quality. Krippendorff's Alpha for each validation was below 0.66. In conclusion, the content validation of the website indicated high agreement, while the face validation indicated sufficient by the professionals and target users. The website will be a good start for intervening in long-term nutrition-related issues such as non-communicable diseases and obesity, as eating habits and food choices from young affect future health outcomes.

Keywords: early life nutrition, eHealth, nutrition education, validation study, website development

INTRODUCTION

Early childhood can be defined as a period until the age of 8, a period of rapid growth and brain development that needs to be reinforced by nutritious food to help these children grow to their full potential. (UNICEF 2019a). However, this potential can be stunted by nutrition inadequacy associated with the double burden of malnutrition, a lifetime adverse effect for these children (UNICEF 2019b).

The global report showed children under five years old were nutritionally vulnerable to malnutrition in the form of stunting (149.2 million), wasting (45.4 million), and overweight (38.9 million), while in Asia, more than half (53%) of children in the world were stunted, over two-thirds (70%) were wasted, and almost half (48%) of children under five worldwide were overweight (UNICEF, WHO, World Bank Group 2021). In Malaysia, children under five years old suffer from stunting (20.7%), wasting (11.5%), and overweight (6.0%) (Mannar *et al.* 2020). This double burden of malnutrition has been

associated with eating behaviors and food choices in the early years of life. Thus, establishing proper eating habits during early childhood is crucial as it shapes lifelong eating habits and food preferences (Brown 2017). Consequently, poor eating habits in early childhood will lead to detrimental effects of obesity and other non-communicable diseases in the future (UNSCN 2018).

The family contributes substantially to nutrition adequacy because its members are role models in determining children's eating patterns (Mutoro *et al.* 2019; Sirasa *et al.* 2019; Cepni *et al.* 2021). Other factors include peers, schooling or caretaking environment, and food availability, which may influence the mothers or caretakers and can indirectly affect the food intake of children (Soon & Tee 2014; Chaudhary *et al.* 2020; Ragelienė & Grønhøj 2021). However, mothers or caretakers usually need help seeking reliable support and suggestions. Many mothers complained about the long waiting hours during clinic visits to ask simple questions regarding their children's eating practices or nutritional intake

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(Received 17-07-2023; Revised 22-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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(National Academy of Sciences, Engineering, and Medicine 2016). Previously, the concept of an information center was related to health centers (clinics and hospitals), books, pamphlets, and mouth-to-mouth information (Plantin & Daneback 2009). However, modern society has advanced, and the internet has become a source of information-seeking platforms for various topics, helping its users in decision-making to reach an outcome that could substantially influence themselves and healthcare institutions (Bäckström *et al.* 2022). The internet's growth has allowed internet-based platforms to convey health-related information to a large number of people at relatively low cost (Burrows *et al.* 2015; Jefrydin *et al.* 2020; Reynolds *et al.* 2019). However, the reality is that - not all information is reliable, credible, and trusted to be used as guidance to its users, including mothers and caretakers (Burrows *et al.* 2015).

Hence, a reliable, convenient, and time-saving reference will benefit mothers, caretakers, or anyone seeking information about early childhood nutrition. Therefore, this study aims to develop and determine the content and face validation of an eHealth website, a one-stop information center to educate parents, caregivers, teachers, and healthcare professionals about early childhood nutrition.

METHODS

Design, location, and time

This study involved instrumentation design consisting of two phases. Phase One involved website development, and phase Two involved website validation. Phase One was executed in three steps, which include: 1) Step 1: Need Assessment; 2) Step 2: Design Arrangement, and 3) Step 3: Website Construction. Phase 2 consists of content validation and face validation. The study was conducted online and participants from Klang Valley were recruited through various online platform including professional emails, Facebook and Whatsapp.

The study's ethical approval was obtained from the Universiti Teknologi MARA (UiTM) ethics committee (Ref No: 600-TNCP(5/1/6)).

Sampling

Purposive sampling was used to identify suitable professionals to participate in the content

and face validation of the eHealth website. Convenience sampling was used to recruit parents, caregivers, teachers, and students to participate in the face validation of the eHealth website.

Data collection

Phase 1 involved three steps. Step 1, Need Assessment: Information regarding current data availability, information-seeking issues, and information on childhood nutrition during the first five years of life was gathered. The information was gathered from literature reviews, journal articles, and relevant publications to identify the participants' perspectives on eHealth websites. It was discovered that previous eHealth websites focused more on the population of obesity (Davies *et al.* 2014; Uesugi *et al.* 2016). However, Burrows *et al.* (2015) found that parents were more proactive in participating in informative programs rather than intervention or lifestyle change programs. Furthermore, websites from the Malaysian government, such as MyHealth, Bahagian Pemakanan, and NutritionistKKM, and non-government websites, such as Positive Parenting, comprise nutrition education. However, these websites focus on many different perspectives, including the general health of people from different age groups. These websites are beneficial for information dissemination but can be overwhelming for people searching for specific information within a particular age group. Therefore, this study focuses solely on nutrition for early childhood to give more insight and understanding nutrition in young children. Nevertheless, the mentioned websites above were one of the sources in guidance of building this eHealth website, and concurrently, were used to tailor to the cultural and local needs. Next, Step 2, Design Arrangement. In this step, the web hosting service, theme, design, theme, layout, and language of the website were discussed. Lastly, Step 3, Website Construction, was the execution of previous steps.

Next, phase 2, content and face validation, was executed. Content validation measures the relevance of the instrument, in this context, the - website through the viewpoint of professionals with experience or work in the related field (Zamanzadeh *et al.* 2015). Face validation is the degree to which raters evaluate the instrument's items as appropriate or inappropriate to the

targeted construct and assessment objective (Nevo 1985; Hardesty & Bearden 2004). Face validation in this study used professionals and laypeople such as parents, caregivers, teachers, and students because they are the expected end users of the website. This helped the researchers to observe the website's acceptance from both perspectives (Zamanzadeh *et al.* 2015). Six professionals were recruited to conduct the content and face validation. The professionals were from the nutrition/dietetics and early childhood education fields in Klang Valley. The number of professionals was determined by Polit and Beck (2006) and Yusoff (2019a), who recommended the number between six and not exceeding ten professionals. The professionals were approached through their email, available on their university website. The face validation involved 50 users in Klang Valley, including parents, caregivers, teachers, and students aged 18 and above. According to Beaton *et al.* (2007), 30 to 40 participants from a target setting are ideal. Yusoff (2019b) also stated that 30 is the common sample size. No sample size or calculation was indicated in this study or other validation studies. These users were enrolled online by publishing in online groups available on social media such as Facebook – parents and caregivers, directly emailing or contacting the number of the kindergartens listed in Klang Valley – kindergarten teachers, and WhatsApp group – students.

There were two instruments used in this website. First, the Evaluation of the Printed Education Material (EVALPEM) questionnaire by Silveira *et al.* (2007) used by professionals, and second, the User Validation of the Mobile Application Rating Scale (uMARS) by Stoyanov *et al.* (2016) used by the users. EVALPEM was used because the instruments contain both content and face validation evaluations. There are seven sections in the EVALPEM, with two sections, namely scientific accuracy and content for content validation, and five sections, namely literary presentation, illustrations, material sufficiently specific and understandable, legibility characteristics, and quality of information. Although EVALPEM was a printed version, this instrument had been used by previous studies to assess the content and face validation of the module and website (Lau *et al.* 2019; Rahmad & Teng 2020). The users used uMARS because

the instrument is more applicable to end-users as it can assess the quality of the website through three sections – quality ratings, subjective quality, and perceived impact. Each section contains one scale, except for quality ratings with four scales – engagement, functionality, aesthetics, and information quality. At the end of both questionnaires, spaces were provided for additional comments. Both instruments had minor adaptations to suit the current local research context.

Data analysis

In this study, the Item-Content Validity Index (I-CVI) was used to analyze the content validation by professionals. The I-CVI is the professionals' rate on the relevance of every item (scientific accuracy and content). The items were rated based on the professionals' agreement with the statement in the given questionnaire using a four-point Likert scale. The four-point scale was used to avoid an ambivalent midpoint, as suggested by Yusoff (2019a). The classification of the four-point Likert scale by numbering is: 1=totally disagree, 2=partially agree, 3=agree, and 4=totally agree. To obtain the result, the I-CVI was calculated by dividing the number of professionals who rated the items from 3–4 by the total number of professionals. A score was given based on the rating; the score is 0 if the professionals rated the item as 1 or 2, while 1 score was given if the professionals rated the item as 3 or 4. Then, all the added scores were divided by the total number of professionals. The obtained result was classified according to Zamanzadeh *et al.* (2015), where the I-CVI of 0.79 and above can be considered appropriate, while the I-CVI less than 0.79 will need revision.

Next, the Content Validity Index by Scale (S-CVI) was used to analyze the face validation by professionals. The S-CVI is the professionals' content validity rate (I-CVI) in terms of overall scale. The universal agreement among professionals (S-CVI/UA) and the Average S-CVI (S-CVI/Ave) were used to calculate the validity index. S-CVI/UA method measures the total agreement among professionals. Therefore, the sum of I-CVI with a score of 1 was divided by the total items. While the S-CVI/Ave method measured the average score of I-CVI, the sum of the I-CVI was divided by the total number of items. The values of S-CVI/UA 0.8 and above

and S-CVI/Ave 0.9 and above can be considered excellent content validity (Nor'ain i *et al.* 2017).

The EVALPEM used the binary scales 'agree' and 'disagree' in face validation. The item's score was 0 if the professionals disagreed and 1 if the professionals agreed with the given statement. While uMARS used a 5-point Likert scale of 1=Totally Disagree, 2=Disagree, 3=Natural, 4=Agree, 5=Totally Agree. The score for uMARS was 0 if the users rated the item from 1 to 3, and 1 if they rated 4 to 5. Both the EVALPEM and uMARS were calculated using the percentage agreement. In each section, the sum of the rated item was divided by the total item and multiplied by 100 percent. A percentage agreement of 80% and above for each section is appropriate, while less than 80% needs revision (Yusoff 2019b).

After the CVI calculation and percentage agreement, inter-rater reliability was calculated using Krippendorff's Alpha (Kalpha). Inter-rater reliability refers to the degree of similarity between examiners without influencing one another when rating the same questionnaires by considering chance agreement (Gwet 2014). In this study, Kalpha was chosen due to its flexibility to handle two or more raters and can be used to calculate dichotomous nominal data (Zapf *et al.* 2016). According to Hayes & Krippendorff (2007), a Kalpha value between 0.80 to 1.00 can be indicated as a reliable value, between 0.67 to 0.79 is acceptable, and 0.00 to 0.66 is not acceptable.

RESULTS AND DISCUSSION

Website development

The title of the eHealth website developed is 'e-CN: Early Childhood Nutrition'. The website was created in English using the hosting web service Wix. This service was chosen because no coding was needed, and attractive designs were provided without charges. The website URL is <https://ecnearlyphchildhoodn.wixsite.com/my-site>. The website contains five main pages: About e-CN, the Homepage, and three main topics: (1) Infant; (2) Toddler and Preschooler, and; (3) Research and Development. About e-CN explains the eHealth website's objectives, novelty, practicality, and usefulness. The homepage is the main page, highlighting the significance of early childhood nutrition and displays the three main

topics of the website. The topics on (1) Infant and (2) Toddler and Preschooler contain subtopics, which include: (a) learning activities; (b) global issues; (c) recipes and tips, and; (d) quizzes, games, and activities. The topic of (3) R&D contains recent research on early childhood nutrition.

Subtopic 1, "learning activities" consists of professional lectures on infant, toddler, and preschooler nutrition topics. The subtopic also includes study materials – lecture notes, other handouts, and references from trusted materials such as government websites and journal articles. Subtopic 2, "global issues", includes current issues concerning childhood nutrition and growth. This site consists of links to reports by global organizations such as WHO and UNICEF. Subtopic 3, which is "recipes and tips", includes a few examples of recipes that can be done according to the age of the children. Subtopic 4, "quizzes, games, and activities", consists of games and self-directed assessments to allow users to assess their knowledge and ability to learn and review the topics they read in a fun way.

The website was built for parents, caregivers, teachers, and students, as they are the potential end-users of the website. Topic (1) infant and (2) toddler and preschooler were specially built for non-nutrition background users such as parents, caregivers, and teachers because these topics include nutrition information that includes breastfeeding, complementary feeding, and food safety. The information is delivered simply using layperson's terms for easy understanding. The topic (3) R&D focuses more on students and professionals from a nutrition background because it contains the latest research about early childhood nutrition. However, parents and caregivers are the main focus of this website. Therefore, the website was built as an interactive information educational tool through videos and games to increase engagement between users and the website. A study by Hammersley *et al.* (2019) suggested that focusing on building educational websites could act as a preventive strategy for inculcating healthy eating behaviors from an early age. Parents were found to be more proactive when websites focus on informing rather than intervening (Burrows *et al.* 2015).

Content validation

A total of six professionals within the field of nutrition/dietetics (n=5) and early childhood

Table 1. Content validation for the eHealth website

Measured parameter	Item description	Professionals						Number of agreement	I-CVI*	Kalpha value**
		Nutrition			Early childhood					
		A1	A2	A3	A4	A5	A6			
Scientific accuracy	Contents are in agreement with the current knowledge	3	3	4	3	4	4	6	1	-0.1000
	Recommendations are necessary and are correctly approached	3	3	4	3	4	4	6	1	
Content	Objectives are evident	4	4	4	3	4	4	6	1	-0.1074
	Recommendation about the desired behavior is satisfactory	3	4	4	3	4	4	6	1	
	There is no unnecessary information	4	4	4	3	4	4	6	1	
	Important points are reviewed	4	3	4	3	4	4	6	1	
								S-CVI/Ave***	1	-0.0694
								S-CVI/UA****	1	

*I-CVI, item content validity index

**Kalpha, Krippendorff's alpha

***S-CVI/Ave, content validity index by scale, average

****S-CVI/UA, content validity index by scale, universal agreement

Rating: 1=Totally disagree; 2=Partially agree; 3=Agree; 4=totally agree

(n=1) participated in this study to review the eHealth website. The result obtained from the EVALPEM is shown in Table 1. The measured parameters of 'scientific accuracy' and 'content' obtain an I-CVI score of 1.00, indicating appropriate content validity (Zamanzadeh *et al.* 2015). The S-CVI/AU and S-CVI/Ave obtained scores of 1.00, indicating excellent content validity (Nor'ain *et al.* 2017). The CVI scores indicated that the professionals agreed with all items in the measured parameters. The overall Kalpha for content validation is -0.069, with Scientific Accuracy obtained at -0.1000 and Content obtained at -0.1074. As the results of the

Kalpha were less than 0.66, the content validation can be considered unacceptable (Hayes & Krippendorff 2007).

Face validation

Table 2 shows the face validation results of the eHealth website by professionals. The percentage of agreement obtained was 91.2%. Concurrently, individual results of quality of information, legibility characteristics, illustration, literary presentation, and material sufficiently specific and understandable obtained were 77.8%, 86.7%, 94.4%, 97.0%, and 100.0%, respectively. Based on these results, all measured

Table 2. Face validation by professionals for the eHealth website

Sections	Percent of agreement (%)	Kalpha value
Literary presentation	97.0	-0.0156
Illustration	94.4	-0.0294
Materials are sufficiently specific and understandable	100.0	None*
Legibility	86.7	-0.0212
Quality of information	77.8	-0.0769
Overall	91.2	0.0178

*Value unable to be obtained as the raw data is constant

parameters gained more than 80.0% agreement between professionals, except for the ‘quality of information’. Therefore, all measured parameters are acceptable except for the ‘quality of information’, which needed revision (Yusoff 2019b). The overall Kalpha value was 0.0178, while individually, literary presentation, illustration, legibility, and quality of information obtained were -0.0156, -0.0294, -0.0212, and -0.0178, respectively. Only the ‘materials are sufficiently specific and understandable’ was unable to obtain Kalpha value due to constant raw data. As the results of the Kalpha were less than 0.66, the face validation can be considered unacceptable (Hayes & Krippendorff 2007).

Table 3 shows the sociodemographic characteristics of the users that were recruited for face validation. More than 50% were parents and caretakers. Table 4 shows the users’ face validation results. The overall agreement percentage was 77.1%. Individually, quality scale, subjective quality, and perceived impact received were 82.3%, 62.0%, and 87%, respectively. The quality scale score was obtained by calculating the percentage agreement between engagement (81.6%), functionality (85.5%), aesthetic (82.0%), and information (80.0%). According to Yusoff (2019b), each section of face validation by the users was appropriate except for subjective quality, which needed revision. Meanwhile, the overall Kalpha value was -0.0047, with each section of quality ratings, subjective quality, and perceived impact being -0.0047, 0.2335, and

-0.0114, respectively. As the results of the Kalpha were less than 0.66, the face validation can be considered unacceptable (Hayes & Krippendorff 2007).

In this study, there was a contrast between the high CVI value in content validation and the high agreement percentage in face validation to the low Kalpha value. These results were discussed in Paun *et al.* (2022). According to Paun, reliability indicates the ability to distinguish between categories. However, when a disproportionate amount of data falls under one category, which leads to highly skewed data, the agreement between the raters is high; in this context, the – high CVI and agreement percentage values would produce a low-reliability coefficient, the – low Kalpha value. Hence, when this case occurs, Paun *et al.* (2022) suggested using the raw observed agreement, which in this study was CVI for content validation and percentage agreement in face validation.

CONCLUSION

In conclusion, this eHealth website focused on nutrition in early childhood for individuals from non-nutrition and nutrition backgrounds. As the website focuses on a small niche and acts as an interactive educational tool, the website could educate and engage with the end users of the website. The website had been content validated by professionals and face validated by both professionals and target users. In content

Table 3. Sociodemographic characteristics of target audiences (n=50)

Demographic characteristics	Frequency	Percentage
	n=50	(%)
Role		
Caregivers	16	32.0
Parents	21	42.0
Non-nutrition student	6	12.0
Nutrition student	7	14.0
Area of living		
Gombak	3	6.0
Hulu Langat	3	6.0
Klang	32	64.0
Kuala Lumpur	4	8.0
Petaling	4	8.0
Putrajaya	4	8.0
Participant age		
18–20	4	8.0
21–30	35	70.0
31–40	9	18.0
41–50	2	4.0
Race		
Chinese	1	2.0
Indian	1	2.0
Malay	47	94.0
Melanau	1	2.0
Child age group		
0–1	5	10.0
1–2	12	24.0
3–5	10	20.0
Not related to me	13	26.0
Two age groups of children	9	18.0
Three age groups of children	1	2.0
Education level		
SPM	6	12.0
Diploma	12	24.0
Degree	28	56.0
Master	4	8.0

Table 4. Face validation by target audiences for the eHealth website

Sections	Scale	Percent of agreement (%)	Kalpha value
Quality ratings		82.3	-0.0047
	Engagement	81.6	-0.0041
	Functionality	85.5	-0.102
	Aesthetic	82.0	-0.0034
	Information	80.0	-0.0118
Subjective quality		62.0	0.2335
Perceived impact		87.0	-0.0114
Overall		77.1	-0.0047

validation, the professionals agreed with all the measured parameters. While in face validation, the result from professionals was accepted; however, there is a need to improve the quality of information. The result of face validation by the target users was also acceptable, with the need to improve the subjective quality. Overall, the website may guide parents and caregivers to obtain fast and reliable information regarding child feeding practices. In addition, the website also highlights the latest research and findings in the area of nutrition and growth which may serve as a center for knowledge sharing and future research involving this area. The website will serve as a good start for intervening in long-term nutrition-related, as eating habits and food choices from young affect future health outcomes.

ACKNOWLEDGEMENT

The authors would like to thank all the content experts who were involved in the process of validating this website. The efforts and cooperation of all the other participants are also greatly appreciated.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Mother's Knowledge, Attitude and Practices and its Influence toward Nutritional Status of Children in Terengganu

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ABSTRACT

This cross-sectional study aimed to identify the nutritional status, Knowledge, Attitude and Practice (KAP) regarding stunting among mothers and its relationship with stunting among children below two years old in Terengganu. A total of 330 mother-child pairs from Terengganu were recruited through purposive sampling. Anthropometric measurement comprised weight and height. Information on socio-demographic, and a validated questionnaire on knowledge, attitude and practice of stunting were self-reported. Chi-square test was applied in this study with $p < 0.05$ considered significant outcome. The majority (61.2%) of the mothers aged 30–39 years old, with tertiary educational level (51.5%) and in the low income group (86.4%). The prevalence of stunting, wasting and underweight was 25.2%, 9.4% and 14.2% respectively for the children below two years old in Terengganu. KAP analysis revealed that 44.5% of mothers had moderate level of knowledge, while 68.8% and 92.7% had good level of attitude and practice, respectively. A significant association ($p < 0.05$) was found between knowledge of mothers with stunting among the children, while no significant association between attitudes and practice with stunting. The present study found that mothers' knowledge significantly impacted their child's growth status in relation to stunting. Future intervention programmes should incorporate nutrition education focusing on mothers' knowledge to prevent stunting among children.

Keywords: children, nutritional status, stunting

INTRODUCTION

Early nutrition is essential for children and the growth of adulthood. Inadequate nutrition during the first two years of life can cause morbidity and mortality in children. This period is critical for the growth and development of children; and prevention from malnutrition-related issues such as wasting, stunting and underweight (UNICEF 2017). Thus, subsequently reduce the child mortality rates. Worldwide reported that the prevalence of stunting, wasting and underweight are 21.3%, 7.3% and 13.4%, respectively (Dukhi 2020). Weight-for-Age Z-scores (WAZ), Length/Height-for-Age Z-scores (LAZ), and Weight-for-Length Z-scores (WLZ) were used to determine the child's nutritional status. Then children who have less than two standard deviations ($-2SD$) below the Child Growth Standard median guideline are considered undernutrition of underweight, stunting and wasting (WHO 2015).

Childhood stunting is the most significant sign of human development that is affecting globally to children under the age of five years

old that approximately 162 million (UNICEF/WHO/World Bank Group 2020). Therefore, it was estimated that 127 million children under five years old will continue to be stunted in 2025 if the development were to continue (De Onis *et al.* 2013). Usually, stunting occurs in countries with low and middle income. According to the World Bank data, Malaysia's rate of stunting among children under five years old was 20.7%, which was higher than other middle-income countries such as Ghana (18.8%), Mexico (12.4%) and Kazakhstan (8%) (UNICEF 2015).

In Malaysia, the prevalence of malnutrition in children has decreased over the years. A report by the National Health and Morbidity Survey (NHMS) 2019 stated that the prevalence of stunting, wasting and underweight was 21.8%, 9.4% and 14.1%, respectively, among Malaysia children under five years old (IPH 2019). In comparison with the local study, NHMS 2016 was reported that Kelantan had the highest stunting across the different states in Malaysia which is 34%, followed by Terengganu at 26.1% and with the lowest incidence in Kuala Lumpur at 10.5%

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(Received 10-08-2023; Revised 18-09-2023; Accepted 08-11-2023; Published 31-01-2024)

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(Baharudin *et al.* 2019). Malaysia has made no progress toward reducing the stunting rate as the prevalence of stunting in children under five years old in Malaysia has increased from 17.2% in 2006; 20.7% in 2016; to 21.8% in 2019 (Global Nutrition Report 2019). In Malaysia, under five years of mortality also increased from 2009 to 2020 (per 1,000 live births) (WHO 2021).

The most striking details in childhood stunting situations in Malaysia are significant problems regardless of factors such as household income, parental education, duration of breastfeeding, low birth weight, increase in child age, health status and history of children's recent illnesses, are among the variables of undernutrition (Gebre *et al.* 2019). Environmental factors such as drinking water sources, types of sanitation and household built-up materials were reported can also influence the nutritional status (Kassie & Workie 2020). Mothers with poor knowledge, attitude and practice may also lead to stunting. It shows that stunting in children of the first two years of life is impacted by the mother's lack of maternal knowledge, negative attitude and practice in the feeding process (West *et al.* 2018).

In addition, studies among the mothers and their knowledge, attitude and practice towards the nutritional status of their children is still scarce. Malaysia still had the highest stunting as can be seen in the East Coastal of Peninsular Malaysia like in Kelantan and Terengganu states. Therefore, this study was conducted to determine the association of mother's Knowledge, Attitude and Practice (KAP) towards the nutritional status of their children below two years old in Terengganu. Besides, it could be a reference and guide to other researchers for further investigation or the subsequent related study.

METHODS

Design, location, and time

This study is part of the larger study conducted with ethical approval obtained from UniSZA Human Research Ethics Committee (UHREC) with reference number UniSZA/UHREC/2022/391. A cross-sectional study was conducted from August 2022 until March 2023 to determine the nutritional status and knowledge, attitude and practice of stunting among mothers with children below two years old in Kuala Terengganu and Kuala Nerus. A list

of children aged two years and below and their mothers was obtained from District Development and Safety Committee (JPKK) in Kuala Nerus and Kuala Terengganu and Terengganu Family Development Foundation (YPKT) who meet the inclusion criteria and exclusion criteria of the study.

Sampling

A total of 330 mother-child pairs from Kuala Terengganu and Kuala Nerus were recruited through purposive sampling. The inclusion criteria of the study were as follows: 1) Female and/or male child that aged 0–24 months; 2) mothers of the children; 3) mothers who are able to read/write/understand Malay and ;4) district of Kuala Terengganu and Kuala Nerus. The exclusion criteria included children with physical disabilities and known diseases.

Data collection

Prior to the data collection, ethical approval was obtained from the UniSZA Human Research Ethics Committee (UHREC) with reference number UniSZA/UHREC/2022/391. The participants were then recruited according to the inclusion and exclusion criteria. A brief explanation was given to the participants, and written informed consent was obtained. The study was divided into three sections of socio-demographic, anthropometric measurements and KAP questionnaires. Anthropometric measurement was comprised of weight and height. Information on socio-demographic, and validated questionnaires on knowledge, attitude and stunting practice were self-reported.

Socio-demographic. This section includes age of the mother and children, sex of the children, race, date of birth, number of children, mother's educational level and estimated household income.

Anthropometric measurements. This section includes all measurements of children that were taken, procedures or measurements and also which growth indices to use (length-for-height). Weight was measured using the SECA 374 baby scale (SECA, Germany), whereby the children must remove all cloth and shoes to the nearest 0.1kg (Ruel-Bergeron *et al.* 2019). To measure the recumbent length of the children, SECA 374 baby scales (SECA, Germany) were used as the babies were lying with arms by sides and flat

feet. Measurements were taken to the nearest 0.1cm. Weight-for-Age Z-scores (WAZ), Length/Height-for-Age Z-scores (LAZ), and Weight-for-Length Z-scores (WLZ) were determined using WHO AnthroPlus software (version 3.2.2). The nutritional status of the children, namely underweight, wasting and stunting, was determined (Wolde *et al.* 2015).

Knowledge, attitude and practice (KAP) questionnaire. Questionnaire was validated by the expert teams in nutrition, dietitian, health education, lactation counsellor, nurses, paediatrician, psychologist and public health specialist using a validated questionnaire for content validation. The questionnaire includes three sections: C1 for knowledge (29 questions), C2 for attitude (10 questions) and C3 for practice (5 questions). The topics covered within this questionnaire are about stunting in general, mother, infant and young child feeding and WASH. To acquire their information, the responder must complete all the knowledge, attitude and practice questionnaires.

Data analysis

Each of the questions of knowledge and practice needs to answer either 'Yes', 'No' or 'Do not know'. One mark was given to a correct answer, zero for wrong and don't know option. In contrast, the attitude question was scaled from the level agreement ranging from 1 to 5 on a five-point Likert scale (1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree). This method measures respondents' attitudes, whether they are positive or negative. Total scores were then categorized into three classifications, 80% as good, 60–79% as moderate and less than 60% as poor (Jaqtap *et al.* 2017).

The findings were reported in the form of descriptive and inferential statistics. Data with a normal distribution were reported as mean, and SD was used for continuous data, whereas data with a skewed distribution was expressed as median and Interquartile Range (IQR). Numbers and percentages were used to represent categorical variables. Statistical significance is set at $p < 0.05$ with 95% Confidence Interval (CI). Inferential statistics such as Pearson's Chi-square test also were presented when all assumptions were fulfilled. Descriptive and Pearson's Chi-square tests were carried out according to the specific objective stated in this study.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the participants

The socio-demographic characteristics of the participants is provided in Table 1. The total samples included in this study were 330 participants, with 53.6% male and 46.4% female children. The majority (61.2%) of the mothers aged 30–39 years old, with tertiary educational level (51.5%) and in the low income group (86.4%). Families with less than three children per house are 76.7%, with more than one pregnancy (69.7%). The respondents that participated in this study were from several races, including Malay, with a significant population of 98.8%.

Prevalence of stunting, underweight and wasting

Table 2 depicts the prevalence of wasting, stunting and underweight among the children. A total of 25.2% of the children were stunted, 14.2% were underweight, and 9.4% were wasting. The prevalence of stunting in this study is quite similar to the stunting prevalence in Terengganu, which was reported by the National Health and Morbidity Survey (NHMS) (IPH 2016). Terengganu is recognized as the second highest state with stunting among children below two years old, after Kelantan, which reported the highest state for stunting cases at 34%. Hence, the prevalence of underweight and wasting is the same as Malaysia's prevalence of underweight and wasting reported by NHMS 2019, which are 14.1% and 9.1%, respectively.

Stunting, underweight, and wasting may occur in an early life that starts from conception until two years old. However, this nutritional status needs to be detected at an early age as early prevention can protect the child's growth from deteriorating. As stated by NHMS 2019, 21.8% of children in Malaysia are stunted. Stunting usually higher among older children. In this study, the majority of stunting the children occurred at the age of 13–24 months. This could be due to the situation that the children started to had solid food and become picky eater and subsequently doesn't get enough nutrition. Beside, most of the boys had a longer recovery times compared to female when sick (Thurstans *et al.* 2022). The prevalence of stunting among children aged 12–24 months was 17% compared to children

Table 1. Socio-demographic characteristics of participants (n=330)

Characteristics of participants	Frequency (n=330)	Percentage (%)
Children's gender		
Male	177	53.6
Female	153	46.4
Children's age (months)		
Below 6	64	19.4
6–12	90	27.3
13–24	176	53.3
Mother's age		
19	1	0.3
20–29	103	31.2
30–39	202	61.2
40–49	24	7.3
Number of children		
Less than 3	253	76.7
More than 3	77	23.3
First pregnancy		
Yes	100	30.3
No	230	69.7
Race		
Malay	326	98.8
Chinese	1	0.3
Others	3	0.9
Education level		
Not formal	3	0.9
Primary	7	2.1
Secondary	150	45.5
Tertiary	170	51.5
Household income		
Low income group	285	86.4
Middle income group	43	13.0
High income group	2	0.6

below six months old at 13.9% (Baharudin *et al.* 2019). Low birth weight might affect the stunting status of the children as they will increase the risk of malnutrition. Low birth-weight may cause children to have various infections, loss of appetite, and poor nutrition intake compared to their normal-weight counterparts (Raymond Leprince *et al.* 2020).

Underweight usually occurs among children aged 6–24 months. In this study, underweight children aged 6–24 months was 14.2%. In Malaysia, 65% of indigenous children (*Orang Asli*) had a higher prevalence of underweight compared to the general population

Table 2. Prevalence of stunting, underweight and wasting among children under two-year-old in Terengganu (n=330)

Nutritional status	Frequency (n=330)	Percentage (%)
LAZ		
Normal	247	74.8
Stunting	83	25.2
WAZ		
Normal	283	85.8
Underweight	47	14.2
WLZ		
Normal	299	90.6
Wasting	31	9.4

LAZ: Length/Height-for-Age Z-scores; WAZ: Weight-for-Age Z-scores; WLZ: Weight-for-Length Z-scores

(Chew *et al.* 2022). Poor socio-economic in East Coast Malaysia that led to poor diet, delayed complementary food and frequently sick are reasons for underweight among children. Most of the families cannot afford to buy nutritious food for their children due to poverty. Improving household socioeconomic status can prevent underweight issues for children below two years old in the population.

Children at the age of 11–19 months have the highest chance to have wasting compared to other ages (Lee *et al.* 2022). Boys had a higher chance of being wasted than girls (Lee *et al.* 2019). The findings of the present study is similar, where boys have higher prevalence of wasting compared to girls as their energy requirement are higher especially in terms of physical activity. In addition, the ability to absorb and retain nutrients may be limited with the limitations in eating the nutritious food. At this point, children who are underweight and wasting may have poor dietary intake that affect their growth as they tend to be a picky eater and start to know the taste and type of foods taken. Children that were limited in their variety of food intake will have short stature and have imbalanced diets that are leading to weight loss (Lee *et al.* 2019). Food intake needs to be adequate with macro and micronutrients that are needed by the body.

Knowledge, Attitude and Practice (KAP) of stunting among mothers

In this study, the total scores for knowledge, attitude and practice were determined based

on the questionnaires that were asked. Based on the results, the majority of the mothers had good attitudes and practice, which is 68.8% and 92.7%, respectively, while 44.5% of mothers had moderate knowledge, as shown in Table 3.

Mothers who have a good knowledge of nutrition will try to meet the child's nutrition needs. Even though their child is having a difficult time eating and needs to encourage them to eat beside picky eaters, mothers will make a variety of foods so that it will meet the nutrition needs of the child. However, in this study, 24.2% of mothers still had poor knowledge about stunting. A study by Fadare *et al.* (2019) reported that poor knowledge in mothers would cause negative outcomes for children. Adequate knowledge of mothers will give an adequate nutritional status to children.

In contrast, there are no poor scores for attitude, with 68.8% of the mothers have a good attitude. It can be said that a mother who had a good attitude will be able to reduce stunting among children below two years old. The mother's attitude is the key factors in ensuring the nutritional status of the children. Hygiene, safe and preparation storage and complementary feeding must be practised for their child as it will affect the food's health and the notion of enjoyment. Most of the mothers had a good attitude toward safe preparation and storage, and hygiene. Maternal education toward pregnant women in Malaysia was higher as it can change in attitude and behaviour are greatly influenced in level of educational. KAP study among 320 antenatal and postnatal mothers reported that maternal nutritional knowledge has significant relationship with attitude. Mothers with poor nutritional knowledge will have poor nutritional attitude towards their children (Ikhsan *et al.* 2018).

Furthermore, 92.7% of respondents get a good score in practice. Notable alterations in practice among mothers can reduce the stunting rate in the Terengganu population as they often practice hygiene. Cleanliness and safety are important for mothers to practice in their daily life, especially in handling food for their children. Most of the mothers had good practices regarding hygiene and cleanliness to prevent their child getting sick due to their own actions. Besides, mothers that had good practice in preparing a healthy meal for themselves were potentially

Table 3. Knowledge, attitude and practice (KAP) of stunting among mothers in Terengganu (n=330)

Variables	Poor n (%)	Moderate n (%)	Good n (%)
Knowledge	80 (24.2)	147 (44.5)	103 (31.2)
Attitude	-	103 (31.2)	227 (68.8)
Practice	24 (7.3)	-	306 (92.7)

preparing healthy and nutritious meals with essential micronutrients and macronutrients (Mondal *et al.* 2021). Thus, this could prevent their child from becoming stunting as well as reducing the prevalence of stunting

Relationship between Knowledge, Attitude and Practice (KAP) with stunting

There are significant associations between knowledge and stunting status ($p < 0.05$), while for attitude and practice with stunting, there are no significant associations, as shown in Table 4. This shows that the risk of stunting was reduced when mothers had adequate knowledge regarding stunting towards their children. Most of the studies concluded that good knowledge of mothers is able to reduce the stunting rates in their children. This statement was supported by the study by Hamlum *et al.* (2021) where mothers with a high level of knowledge will try to meet the nutritional status of their child and will complete the micronutrient and macronutrients of their child.

However, the mother's attitude was not affected by the stunting toward the child, as other factors need to be taken into account. As reported in several previous studies, mothers with positive attitudes will reduce stunting in children as mothers care for their child's feeding practices and nutritional status. As mentioned by Yeganesh *et al.* (2018), the attitude of mothers must come together with the improvement of household food security and the number of people living in one house.

Besides, a study by Nasution *et al.* (2019) concluded that children that had stunting are also with diseases that affected them like diarrhoea, fever or vomiting. When pain occurs, their desire to eat will decline and will eventually reduce their weight, even mothers feeding their children regularly. Besides, children at age below two years old are in the process of growth development. Thus, it is normal for them to lose appetite in eating. This is not because of the mother's

Table 4. Association between knowledge, attitude and practice (KAP) with stunting (n=330)

Variables	Stunting status (n=330) (n%)		X ² statistics (df)	p
	Normal	Stunting		
Knowledge				
Poor (n %)	51 (20.6)	29 (34.9)	6.915 (2)	0.032*
Moderate (n %)	115 (46.6)	32 (38.6)		
Good (n %)	81 (32.8)	22 (26.5)		
Attitude				
Poor (n %)	0 (0)	0 (0)	0.329 (1)	0.566
Moderate (n %)	75 (30.4)	28 (33.7)		
Good (n %)	172 (69.6)	55 (66.3)		
Practice				
Poor (n %)	18 (7.3)	6 (7.2)	0.00 (1)	0.986
Moderate (n %)	0 (0)	0 (0)		
Good (n %)	229 (92.7)	77 (92.8)		

*Chi-square for independence; *Pearson's Chi Square test, significant at p<0.05

negative attitude that causes their child to become stunted. So, it can be concluded that the attitude of the mothers is not the only factor in stunting.

Moreover, there is no significant association between the practice of the mothers and stunting. Studies regarding practice stated that mothers that have good nutritional practice would decrease the prevalence of stunting in children. Mother's education level is important to determine the practice level of mothers. Education levels is related to the maternal knowledge (Ikhsan *et al.* 2018), and thus the higher the mothers with good nutritional knowledge, the higher the minimum acceptable diet of the children (Pranita *et al.* 2023). Similarly, a study in the village of Kosona among 150 mothers, majority of them were older mothers who had low knowledge regarding stunting (Berisha *et al.* 2017). This will affect their practice in the right way, especially in complementary feeding of children where they can't meet the nutritional needs of children to the optimum. Besides, the age of the mothers also play an important role in applying the practice. Older mothers are unable to follow instructions and perform it well. When having limited access to food and with low household income, the cheaper and same food that contains limited nutrients was given to the child to avoid hunger. The mother's practice was not affected by stunting toward the child, as other factors need to be taken into consideration.

CONCLUSION

Prevalence of stunting among children below two years old in Terengganu is 25.2% that need to be decreased. The majority of the mothers have moderate and good knowledge, attitude and practice. However, there are 24.1% with poor knowledge, and 7.3% with poor practice. This study able to measure the level of knowledge, attitude and practice among mothers in Terengganu. There are significant association (p<0.05) between knowledge and stunting. This implies that maternal knowledge is the key determinant in ensuring the nutritional status of the children and thus preventing them from becoming stunting. Thus, more health awareness campaign on nutritional status of the infant need to be emphasized among the expectant mothers, or during the maternal's antenatal visit to the health facilities.

Future research needs to be conducted with more focus among children below two years old in East Coastal of Malaysia especially in Terengganu and rural area as to provide a deeper understanding on stunting since most studies focused on children below five years and above that are outside of Malaysia. Besides, more health campaign could be done by the public health specialist in order to create awareness among mothers and to increase their knowledge on monitoring their children's health in reducing

stunting at early stage. Thus, achieving healthy nation in the long run.

ACKNOWLEDGEMENT

The authors would like to thank all children and their mothers for participating in this study. We also appreciate the support from the District Development and Safety Committee (JPKK), Terengganu Family Development Foundation (YPKT), all researchers and the data collection team throughout this study.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Data Quality of Nutritional Status among Children Using WHO Anthro Application: A Quasi-Experimental Study

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ABSTRACT

This study aims to look at improving the quality of nutritional status data through WHO Anthro training in stunting focus areas. This study used a quasi-experimental quantitative method with a pretest-posttest equivalent repeated measures framework approach, using two groups. A total of 40 kindergarten teachers were sampled, divided equally into two groups. The control group was taught how to plot nutritional status using WHO charts and the intervention group was trained how to use the WHO Anthro application. Data was analyzed by non-parametrical means with a Friedman test to compare the pre-mid-post data in each group of different samples. The group trained by WHO Anthro showed that the data quality on nutritional status was significantly different, with a $p=0.000$. The evaluation conducted after two months of training proved to be significantly different in terms of information and data accuracy with $p=0.030$ and $p=0.040$, respectively. WHO Anthro is proven to be able to facilitate kindergarten teachers in determining the nutritional status of students, and the resulting nutritional status reports are of higher quality because they are more accurate and useful for early detection of stunting in each school.

Keywords: data quality, nutritional status, stunted, WHO anthro

INTRODUCTION

Nutrition in Indonesia is still a major issue, even becoming one of the targets of the Sustainable Development Goals (SDGs) related to reducing under-five mortality due to undernutrition and malnutrition (Mabuza 2020). The nutrition problem in Indonesia is called the triple burden, which consists of undernutrition and overnutrition for macronutrients, and undernutrition for micronutrients. These nutrition problems jeopardize the quality of Indonesia's future generations (Rah *et al.* 2021). Based on the Indonesian Nutritional Status Survey 2021, it was found that the prevalence of stunting was 24.4% (MoH RI 2021), while according to the Survei Demografi Kesehatan Indonesia 2018, it was found that the prevalence of stunting was as much as 19.3%, malnutrition as much as 3.9%, and obesity was as much as 8% (MoH RI 2018). The health profile of D.I Yogyakarta province found that the status of malnutrition and undernutrition was 8.3%. The incidence of stunting was 11.08%, while the incidence of overnutrition was 3.14 (Dinas Kesehatan Yogyakarta 2020).

The efforts that can be applied to prevent and overcome nutritional problems in preschool-

age children are screening and surveys. Screening consists of observing the growth and development of preschool-age children at various service sites, such as health centers, posyandu, and educational institutions (MoH RI 2020b). A monthly growth and development screening is carried out by taking the weight and height of the kids. Measurements of height using a microtoise and weight using digital scales were utilized in this growth and development detection study on kindergarten students in Semarang to identify nutritional issues in preschoolers (Tsani *et al.* 2022).

The problems that happened were the lack of teacher knowledge in terms of how to measure growth correctly, non-standard measuring instruments, and the lack of teacher knowledge in interpreting the measurement results. This is comparable to Wahyuntari's community service project, wherein she discovered that there was no charting on the Growth Chart (*Kartu Menuju Sehat*) during the cadres' execution of child growth observations, and consequently, no interpretation of the findings (Wahyuntari & Herfanda 2022). Data entry of growth measurements of body weight and height is essential for early

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(Received 10-08-2023; Revised 23-09-2023; Accepted 24-11-2023; Published 31-01-2024)

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detection of nutritional problems (Wahyuni 2018). According to research by Aditianti *et al.* (2019), cadres of posyandu have also observed children's growth; however, neither the results of the children's nutritional status nor the results of weight and height measurements have been plotted to observe growth.

In the development of technology, the World Health Organization (WHO) developed an application called WHO Anthro as one of the applications used to observe child growth and development by inputting measurement data consisting of weight, height, age, sex, measurement position (for height: standing or recumbent) of children. WHO Anthro is software to facilitate the implementation of motor growth and development observations in individuals and populations of children up to 5 years of age and children aged 5–19 years using WHO Anthro. Nutrition workers who effectively utilized WHO Anthro demonstrated noteworthy outcomes in which the application and training of WHO Anthro enhanced the quality and perception of nutritional status information (Rahmad & Sudargo 2016).

The purpose of this study is to compare the efficacy of WHO Anthro Software with the conventional approach for anthropometry evaluation. This study is interesting because it examines the role that schools play in the fight against malnutrition. Specifically, it looks at how kindergarten teachers might use the WHO Anthro Application to determine their students' nutritional status.

METHODS

Design, location, and time

This research was conducted using Quasi-Experimental study design. The framework of the approach used was a repeated equal pre- and post-test using two groups. It was conducted in January–March 2023 at 20 ABA Kapa–newon Gamping kindergartens.

Sampling

The population in this study was all ABA kindergarten teachers in the Kapenawon Gamping area, totaling 98 teachers. The sample of this study was 40 ABA kindergarten teachers who were divided evenly into two groups, namely the intervention group and the control group (each group consisted of 20 teachers) who taught at ABA

kindergartens in the working area of Puskesmas Gamping I and II. The inclusion criteria of this study are ABA kindergarten teachers who are active and registered in ABA kindergartens in the Gamping Health Center area, who are willing to become respondents and are proven by signing informed consent. The exclusion criteria of this study are teachers who did not attend the training and did not complete the data quality questionnaire for three repetitions. This study has obtained a research ethics eligibility letter from the ethics committee of 'Aisyiyah University Yogyakarta with number 2595/KEP-UNISA/II/2023.

Data collection

A questionnaire on respondent characteristics and the quality of the information in the nutritional status questionnaire data made up the study instrument. Data on the characteristics of ABA kindergarten teachers were taken directly during registration. Information about the nutritional state of ABA kindergarten students was gathered from questionnaires that assessed participants' understanding of the course materials and from observations made by instructors during evaluations that took place prior to, during, and two months following the training. The nutritional status data quality is assessed using these three criteria: correctness, informational value, and timely reporting. The research instruments used have reliability and validity ratings of 0.63 and 0.67, respectively.

The training was conducted over two days for two groups. The intervention group received training on the WHO Anthro and the control group received training on the application of WHO manual charts. To allow participants the chance to adopt anthropometric measurements and assess nutritional status in each kindergarten, there is a two-month delay between the mid-test and post-test data collection

Data analysis

Each group completed three tests. assessments given before, during, and after the test. Before teachers receive training materials, a pretest is carried out. After teachers receive the training materials, they take part in a midday test evaluation. The post-training assessment was carried out two months later. The Friedman test was used to analyze the three assessment results.

RESULTS AND DISCUSSION

Research subject characteristic

The characteristics of the study subjects consisted of the aspects of age and latest education, where each group, whether for intervention or for control, consisted of at least 20 people.

Table 1 provides information about the training subjects' demographics, including age and educational background. 90% of the subject in the intervention group held a diploma or bachelor's degree, and 75% of them were older than 55. 90% of participants in the control group were above the age of 55, and 85% of them held a diploma or bachelor's degree.

The data quality of nutritional status on WHO anthro training group

Data analysis consisting of normality and homogeneity tests on three aspects of data quality, namely data accuracy, informativeness, and timeliness of reporting in the group of teachers who received WHO Anthro training. Evaluation

of data quality showed that the average results improved before training, during training, and two months after training.

The assessment results of data quality from the aspects of informativeness, data accuracy, and timeliness of reporting in the WHO Anthro training group experienced a significant correlation after repeating the test three times with a p-value of 0.000. This is explained in Table 2.

The results obtained are in accordance with the research of Al Rahmad which states that training with WHO Anthro is effective in improving the quality of nutritional status information after one month of training (Al Rahmad 2020). Training is a program of planned activities to improve the quality of data. Training is a series of activities planned to improve the skills, knowledge, experience, or behavior of participants or trainees. Rini and Huriah's earlier study, which found that training in determining children's nutritional status to prevent stunting using applications with audio visual media

Table 1. Distribution of research subject characteristics by research group (n=40)

Variables	Groups			
	Intervention		Control	
	n	%	n	%
Age				
<55 years old	5	25%	6	30%
≥55 years old	15	75%	14	70%
Education				
Diploma/Bachelor	18	90%	17	85%
Junior High School	2	10%	3	15%

Table 2. Data quality assessment after WHO Anthro training

Aspects of data quality	Pre-test	Mid-test	Post-test	n	X ²
	Mean rank	Mean rank	Mean rank		
Informative	1.50	2.20	2.30	20 (19.000)	0.000*
Data accuracy	1.33	2.10	2.58	20 (22.750)	0.000*
Timely reporting	1.18	2.05	2.78	20 (32.094)	0.000*

Significant on CI:95%; p<0.05

was proven to be more effective in increasing respondents' competence and knowledge significantly with a p value of 0.000 (Rini 2020; Huriah *et al.* 2021). Training conducted for kindergarten teachers can optimize the role of teachers in preventing stunting in preschool children in Indonesia and in London (Andrew *et al.* 2019; Wahyuntari *et al.* 2022). The nutrition education app provides benefits in terms of ease of use and improved skills in observing children's nutritional status compared to conventional methods (Ernawati *et al.* 2021).

The data quality of nutritional status on WHO graph plotting training group

The results of the normality test on three aspects of data quality, namely data accuracy, informativeness, and timely reporting in the control group, are shown in Table 3 below. Data accuracy in the training group that determined nutritional status using WHO charts using traditional methods. The accuracy of interpreting the nutritional status determination based on Minister of Health Regulation No. 2 of 2020, which addresses determining nutritional status using 3 indicators (weight-for-age, height-for-age, body mass index-for-age), is used to examine the correctness of data. In the group of teachers trained on how to manually plot WHO Anthro graphs, it was found that data quality showed an increase in the average score.

Training on the utilization of WHO Anthro for kindergarten teachers is one of the efforts to prevent stunting in preschool children. WHO Anthro is used to easily determine the nutritional status of children because the interpretation of z-score measurements on each indicator appears automatically and is easy to understand. This application can also be used to determine nutritional status through the WHO manual

standard growth chart. The results of this study indicate an increase in the score on data quality after using the WHO Anthro standard manual growth chart, but there are still some obstacles using the manual growth chart. In the control group, 20% of teachers lacked the knowledge necessary to interpret their pupils' nutritional status. Therefore, they are only limited to measuring and plotting the graph. It is similar to the research conducted by Hadi, which showed that manual growth charts are easy to use. However, there are difficulties in reading the growth curve by gender and month (Hadi *et al.* 2018).

The recording of nutritional status manually can also be found at the Kasihan I Community Health Center (*Puskesmas*). Plotting nutritional status at *Puskesmas Kasihan I* uses the Growth Chart (*Kartu Menuju Sehat-KMS*) by observing the graph according to WHO standards. This resulted in some inaccuracies in the data reported, and the data was not utilized with a percentage of incomplete data reaching 9.75% in the 2019 nutrition data report (Rohman & Khairunnisa 2020). Despite some of the problems found in the study subjects, in Table 3 there are statistically significant differences between the three times measurement of data quality for each aspect of the data quality because the respondents in this study were still able to make nutritional status reports quite well. The result is evidenced by an increase in the mean rank. In the aspect of informative and accurate data, the pre-test to post-test mean rank increased from 1.40 to 2.33. In aspects of reporting on time, the mean rank from pre-test to post-test increased from 1.45 to 2.50 after receiving the training materials. This can be achieved because participants have high motivation and a great willingness to become nutrition surveillance agents, especially in

Table 3. The disparity in data quality assessment after plotting WHO's manual chart

Aspects of data quality	Pre-test	Mid-test	Post-test	n	X ²
	Mean rank	Mean rank	Mean rank	Chi ²	
Informative	1.40	2.28	2.33	20 (20.140)	0.000*
Data accuracy	1.45	2.23	2.33	20 (20.971)	0.000*
Timely reporting	1.45	2.05	2.50	20 (21.143)	0.000*

Significant on CI:95%; p<0.05

screening for nutritional problems in preschool children (Phan *et al.* 2021), where in the Gamping area is still included in the stunting focus location since 2021 (Dinas Kesehatan Sleman 2021).

One aspect of accuracy assessed in this study is the anthropometric measurement method. Anthropometric measurements for children must use standardized methods and equipment (MoH RI 2020a). The equipment that was used for anthropometric measurements in this study were digital scales and microtoise. Teachers are given training related to the procedures for measuring weight and height, where when measuring weight, it is recommended that students who are measured wear minimal clothing/footwear/hats/bags to avoid measurement bias (Ariati *et al.* 2020). The other accuracy in this study related to providing the data needed to measure nutritional status is the age of the child in months for children aged 0–72 months (MoH RI 2020a). Age is important in determining nutritional status. Inaccurate writing of a child's age in months will result in an incorrect interpretation of nutritional status (Septikasari 2018).

The disparity of data quality in each group can be concluded that there is a fairly large difference in the assessment of data quality in the aspect of timely reporting between the other 2 aspects with a value of $p=0.000$ ($p<0.05$). The nutrition team at the health center frequently reports nutritional status reports from each school late and in part. This is due to the incompleteness of the lack of interpretation of the given data about the nutritional status of pupils from each school. Timely nutritional status reports can assist government and health personnel in obtaining accurate and comprehensive data (Barnett *et al.* 2016).

In the anthropometric calculator feature, trainees are facilitated in determining the

category of children's nutritional status based on three indicators of nutritional status weight-for-age, height-for-age, body mass index-for-age. It is easier for participants to recognize them as they are displayed in different colors for each category. Thus, teachers can find out the nutritional status of their students easily. The individual assessment feature also helps participants to save the anthropometric measurement results of their students every month, which is very helpful for teachers to search for previous measurement results due to the good data integration for this program. The nutrition survey feature can also be used by kindergarten teachers in mapping the nutritional status of students based on location (Diab 2015). The benefits and accuracy of data after utilizing the WHO Anthro application were proven significant in a previous study, which showed that the Nutrition Service Workers (TPG) of Puskesmas in the Aceh region showed a percentage increase in the quality of nutritional status data information by 13.6% with a standard deviation of 5.623 with a 95% CI in the aspects of accuracy and benefits, each with a p -value=0.000, after carrying out one month of software-based WHO Anthro training (Rahmad & Sudargo 2016).

The effectiveness of training towards the data quality of nutritional status in preschool students who anthro training group

Based on the results, the WHO Anthro training provided to kindergarten teachers proved to be effectively beneficial and produced accurate data (Table 4). The benefits referred to here are not only limited to the results of the data report from WHO Anthro, but also to the improvement of kindergarten teachers' ability to use digital-based applications, with a p -value=0.001 ($p<0.05$). Previous research found that some teachers have a relatively low level of technological maturity,

Table 4. The effectiveness of WHO Anthro training towards the disparity of data quality

Aspects of data quality	Pre-test - Mid-test			Mid-test - Post-test		
	Mean difference	Standard error	<i>p</i>	Mean difference	Standard error	<i>p</i>
Informative	10.300	4.504	0.036	10.200	4.504	0.038
Data accuracy	11.250	3.559	0.007	-8.700	3.559	0.046
Timely reporting	21.200	5.626	0.001	-11.550	5.626	0.109*

*Insignificant on CI:95%; $p>0.05$

so it needs to be improved by holding training activities and innovations that are relevant to mastering digital technology (Astuti *et al.* 2021). The digitization capabilities of existing resources must be improved in order to take advantage of software-based information systems to record nutritional status (Khasanah *et al.* 2022). Based on this information, the research subjects included in the intervention group were able to adapt to the post-COVID-19 pandemic situation so that almost every teacher could benefit after utilizing the WHO Anthro Application.

The teachers in this group were able to see the interpretation of the nutritional status measurement results that had been unknown to the teachers. The training provided to teachers is an effort to screen for child nutrition problems and stunting conditions in children.

The nutritional status of students is not only known by teachers, but also anthropometric measurements will be sent to parents. The reporting aspect is timely because parents can find out information on their child's nutritional status so that they can routinely monitor their child's nutritional intake and growth and development. After knowing the nutritional status of children, it is hoped that parents or guardians can optimize their knowledge so that they can monitor children's nutritional intake by routinely reporting the results of children's growth and development (Nurmaliza & Herlina 2019).

WHO graph plotting training group

Based on the results of the post hoc "multiple comparisons" test using Tukey HSD on the aspects of data accuracy and informativeness, it was found that the average differences from pre-test to mid-test and from mid-test to post-test proved not to be significantly different. This is indicated by an asterisk (*) or p-value>0.05.

Regarding the timeliness of reporting, it is proven to be significantly different in the average of pre-test to mid-test and mid-test to post-test with a value of p=0.048 (p<0.05) (Table 5). Therefore, it can be concluded that the average score on the WHO Anthro plotting training has no significant difference on data quality products. The WHO Anthro plotting training has no significant difference in data quality. The WHO manual charting is not sufficient in producing accurate data, but it is still useful because the data produced can be used to provide information on the nutritional status of students to parents.

The research explained that the ABA kindergarten teachers involved in this study were not familiar with how to determine nutritional status using WHO Anthro. Evaluation conducted after two months of training proved to be significantly different in terms of information and data accuracy with p=0.030 and p=0.040. Before the training, the teachers were not able to interpret anthropometric measurement data. Therefore, the nutritional status of students was unknown. One of the services that *Pendidikan Anak Usia Dini (PAUD)* institutions should provide to help overcome child nutrition problems is counseling and training on early childhood health, growth, and nutrition (KEMENPPPA 2013).

CONCLUSION

Training on the WHO Anthro and WHO manual growth charts proved effective in improving data quality, in terms of data accuracy, informative aspects, and timely reporting aspects. Data quality from the aspect of timeliness of reporting was seen to be higher in teachers who received WHO Anthro training compared to teachers who received training on WHO standard manual growth charts. The recommendation from

Table 5. The effectiveness of training on WHO graph plotting towards the disparity of data quality

Aspects of data quality	Pre-test - Mid-test			Mid-test - Post-test		
	Mean difference	Standard error	p	Mean difference	Standard error	p
Informative	10.050	5.229	0.142*	-10.050	5.229	0.142*
Data accuracy	11.000	5.044	0.083*	-10.000	5.044	0.126*
Timely reporting	12.000	4.952	0.048	-12.000	4.952	0.048

*Insignificant on CI:95%; p>0.05

this study is that the use of WHO Anthro is useful to be implemented by kindergarten teachers in early detection of stunting in preschool children.

ACKNOWLEDGEMENT

We are grateful to those who helped with this research, especially the headmaster and the teachers of the kindergarten school. The author would like to thank The Research and Community Service Institute of 'Aisyah University for providing the research grant that made this study possible.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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Association between Sociodemographic Factors with Nutritional Status among Primary School Children in Setiu, Terengganu, Malaysia

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ABSTRACT

This study aims to determine the association between sociodemographic aspects and nutritional status among rural Setiu, Terengganu schoolchildren. A cross-sectional study using convenience sampling was conducted among 269 primary school children. Sociodemographic information was obtained from parents or guardians through face-to-face interviews, and standardized techniques and calibration were adopted for anthropometric measurements. The World Health Organization Anthro Plus was used to generate the z-scores for Weight-for-Age (WAZ), Height-for-Age (HAZ), and Body Mass Index-for-Age (BAZ) to indicate underweight, stunting, and obesity among the children. Chi-squared test was used to determine the association between sociodemographic factors and nutritional status. The children exhibited mean WAZ, HAZ, and BAZ scores of -0.66, -0.82, and -0.00, respectively. Approximately 13.8% of schoolchildren in this study were stunted, 16.7% were underweight, 8.9% were overweight, and 11.5% were obese. Age and the father's education level were significantly associated with WAZ ($p=0.02$ and $p=0.001$), household size was associated with HAZ ($p=0.029$), and BAZ was found to be associated with the father's income factor ($p=0.03$). This study discovered that the majority of results from the measurement of WAZ, HAZ and BAZ were in normal growth with 81 (79.4%), 230 (85.5%) and 196 (72.9%), respectively. In conclusion, this study indicates that most of the sociodemographic factors were not associated with nutritional status and the prevalence of malnutrition among primary school children in the rural areas of Setiu, Terengganu was lower than in the other rural areas.

Keywords: anthropometric, nutritional status, rural areas, school-aged children, sociodemographic

INTRODUCTION

Better strategies for enhancing early childhood nutrition may result from an understanding of early-life complementary feeding dietary patterns and their underlying causes. Sociodemographic and economic aspects have been linked to the nutritional condition of young children, including adolescent age, mother's age, income, parent's employment, and literacy level (Arage *et al.* 2019), specifically in rural areas (Hoang *et al.* 2018). There are several known risk factors for malnutrition, including nutritional status, poverty, ignorance, inappropriate feeding, parental separation, multiple pregnancies and the mother's health. (Shafqat *et al.* 2013). Previous studies have demonstrated gradients between food and socioeconomic status across all stages of human development, and that bad eating habits are substantially associated with lower socioeconomic status (WHO 2020). Malnutrition

trends among children older than 5 years old, nevertheless, are a problem that is being ignored. The World Health Organisation (WHO 2021) reported that 90% of the world's 1.8 billion children between the ages of 5 and 15, live in Low- and Middle-Income Countries (LMICs) and simultaneously the rates of childhood overweight and obesity are also rising.

In Malaysia, primary school children suffer from overnutrition and malnutrition (Poh *et al.* 2013). On the other hand, Malaysia has transitioned from relative undernutrition to overnutrition. The percentage of underweight children fell from 55% to 14% in just ten years. In Malaysian children aged 10 to 12, the prevalence of overweight and obesity was 16.3% and 17.4%, respectively. These rates were twice as high as those of undernutrition (7%) and stunting (7.8%) (IPH 2018). Primary school children (33.7%) had a higher prevalence of overnutrition than secondary school adolescents (28.5%) (Teo *et al.*

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(Received 13-08-2023; Revised 23-09-2023; Accepted 11-11-2023; Published 31-01-2024)

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2019). Along with socioeconomic and lifestyle changes, which are frequently attributed to a combination of globalization and urbanization, the obesity pandemic in Malaysia grew. Regardless of age, race, or social position, changes in eating habits and sedentary lifestyles have been linked to an increase in obesity (Wafa & Ghazalli 2020). Meanwhile, in children aged six months to 12 years, it appeared that overweight (9.8%) and obesity (11.8%) are more common than stunting (8.4%) and thinness (5.4%) (Poh *et al.* 2013). Children stunted at school age are likely to have been exposed to poor nutrition since early childhood. In Brazil, school-age boys had a much higher rate of stunting than school-age girls. It was indicated that 13% of school-age children were underweight and that 21% of them were stunted. As the research population aged, both nutritional status indices declined, notably in boys (Mwaniki & Makokha 2013). Malnutrition in rural areas mainly manifests as being underweight, while wasting is more common in urban areas. The problem affects different ages and socioeconomic statuses (Abdel Wahed *et al.* 2017). However, there needs to be more research and data on the nutritional status among school children aged 7 to 12 years old in Malaysia, particularly in rural areas in Terengganu. Many studies have reported that sociodemographic factors are associated with children's nutritional status in urban areas. Therefore, in this study, we aim to determine the nutritional status of school children in rural Setiu and its association with the sociodemographic condition.

METHODS

Design, location, and time

A cross-sectional study involving 269 schoolchildren aged 7 to 12 years old in rural areas of Setiu District, Terengganu, Malaysia. This study was conducted from 1st August 2022 until 18th February 2023. The interview was conducted at their houses to gather information for sociodemographic profiles using questionnaires and anthropometric measurements (height and weight).

The ethics with a study protocol (UniSZA/UHREC/2022/411) was granted by the UniSZA Human Research Ethics Committee (UHREC). Information sheets about the study and consent forms were disseminated to the school-aged

children and their parents or guardians who met the criteria before collecting data.

Sampling

Study participants were selected based on the inclusion and exclusion criteria at the point of data regardless of ethnicity. Participants must be Malaysian citizens and are literate in the Malay language. In Malaysia, rural areas are defined as areas with a population of less than 10,000 people, having agriculture and natural resources as the main population income and in which its population is either clustered, linear, or scattered. The Setiu district was chosen as its population density was 52 per km² (Terengganu Basic Data 2020). The villages were identified as rural areas based on the total population and the main jobs of residents were self-work and self-employed.

The sample size was calculated by using a single and two-proportion formula (5% margin of error, a 95% confidence level, and a 20% for non-response rate). A convenience sampling technique was used to choose the school children from six selected villages in the Setiu district. The study excluded schoolchildren with chronic diseases, non-Malaysian citizens, and living outside the selected area.

Data collection

A structured interviewer-administered questionnaire was used and adopted from Poh *et al.* (2019), considered the associated nutritional status factors and covered various sociodemographic characteristics. The interview session took about 20 minutes on average. The school-aged children's anthropometry (weight and height) was measured by a trained researcher using a well-calibrated SECA scale and a height measuring board of a stadiometer, respectively. Every measurement was made thrice, and the mean was recorded.

Anthropometric measurements of school aged children were converted to Weight-for-Age Z-Scores (WAZ), Height-for-Age Z-Scores (HAZ), and Body Mass Index-for-Age Z-Scores (BAZ) using the WHO AnthroPlus software (WHO 2009). The age- and sex-specified z-scores were then classified according to the WHO growth reference for school aged children and adolescents (de Onis *et al.* 2007). Underweight, stunting and thinness for school children were defined as WAZ, HAZ and BAZ < -2 Standard

Deviation (SD) whereas overweight for children were defined as BAZ>1 SD and obesity as BAZ>2 SD. For weight-for-age, only a sample of 102 school children aged 10 years and younger was analyzed, excluding 167 school children aged 11 years and above.

Data analysis

The data were analysed using IBM SPSS version 26.0 for Windows (IBM Corporation, New York, USA). Descriptive analysis was used to determine the sociodemographic patterns and nutritional status (WAZ, HAZ and BAZ) of school aged children. Normality tests were applied by using the Kolmogorov-Smirnov criterion. The Pearson Chi-square test and Fisher's Exact test were used to assess the significance of the association between sociodemographic factors and nutritional status among school aged children. Results from all statistical analyses were considered significant associations if the p-values were less than 0.05.

RESULTS AND DISCUSSION

Distribution of sociodemographic characteristics

The mean age was 10.0±1.57 years and the majority age was 10 to 12 years (68.4%) (Table 1). About 52.8% were boys and 47.2% were girls, with only one Malay ethnicity identified. The data from The Population and Housing Census of Malaysia (2020), reported that Malay was the main ethnic with 99.5% and others were 0.45%. Most respondents (97%) were living in a household with at least 4 members, 56.5% had 4 to 6 members in the household and 40.5% had a household size >7 members. Most of the parents of the respondents have received secondary education, which was 65.8% among fathers and 72.9% among mothers. This household income in Malaysian Ringgit (MYR) was divided into four groups, using criteria set forth in the Tenth Malaysia Plan. About 55.8% of respondents' fathers had an income <MYR1,500 while 71.0% of mothers had no income. So that, it was noted that most of them were in the category of very low income.

Nutritional status

Table 2 shows the anthropometric assessment with the mean height was 135.4±11.8

cm and the mean weight was 33.4±12.6 kg. The average values of WAZ, HAZ and BAZ were -0.66 and -0.82, and -0.00, respectively, all within the normal range of the WHO growth standard. The majority of respondents were normal in height (85.5%), body weight (79.4%) and BAZ (72.9%). However, about 13.8%, 16.7%, and 20.4% of the respondents were stunted, underweight and overweight/obese, which means that there is a double-burden malnutrition among the school aged children in this rural Setiu. These findings were differed from the national prevalence reported in the National Health Morbidity Survey 2019, where the prevalence of underweight, stunting, overweight and obesity among children aged 5 to 17 years in rural areas were 14.2%, 17.1%, 13.7% and 13.2%, respectively (IPH 2020). A study of fishermen's school children aged 7 to 11 years in Terengganu also showed varying prevalence of stunting (9.9%), overweight (12.9%) and obesity (2.0%) (Hashim *et al.* 2021).

Association between sociodemographic characteristics and nutritional status

Gender and nutritional status. This study, however, failed to demonstrate any significant association between gender and WAZ, HAZ and BAZ ($p<0.05$) (Table 3). Similar findings were observed in the nation-based surveys of children aged 6 to 17 years in Malaysia, in that secular changes in overweight and obesity did not differ significantly by gender (Mohamad *et al.* 2021). However, a local study conducted in seven districts in Terengganu revealed that female children aged 13 to 17 years had significantly higher BMI than male children, but did not show significant difference in BMI of children aged 10 to 12 years (Zulaily *et al.* 2017). Different finding was found in a rural setting in Fayoum Governorate, Egypt, where Abdel Wahed (2017) reported that male children (6 to 17 years) were significantly more obese than female children, but stunting and underweight did not differ significantly between gender. A plausible explanation for the inconsistent findings is that there may be gender and child nutritional status differences across regions and countries. Different socio-demographic backgrounds have different cultural influences on feeding and caregiving attitudes and practices due to power relations and social norms (Monterrosa *et al.* 2020).

Table 1. Socio-demographic pattern of school children aged 7 to 12 years at Rural Setiu, Terengganu (n=269)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	142	52.8
Female	127	47.2
Age (years)		
7–9	85	31.6
10–12	184	68.4
Household size		
1–3	8	3.0
4–6	152	56.5
>7	109	40.5
Father's education level		
No schooling	2	0.7
Primary school	53	19.7
Secondary school	177	65.8
Tertiary school I	23	8.6
Tertiary school II	14	5.2
Mother's education level		
No schooling	4	1.5
Primary school	31	11.5
Secondary school	196	72.9
Tertiary school I	38	14.1
Father's income (per month)		
No income	21	7.8
<MYR1,500	150	55.8
MYR1,500–RM2,299	65	24.2
MYR2,300–RM5,599	27	10.0
>MYR5,600	6	2.2
Mother's income (per month)		
No income	191	71.0
<MYR1,500.00	37	13.8
MYR1,500.–RM2,299	18	6.7
MYR2,300–MYR5,599	18	6.7
>MYR5,600	5	1.9

MYR: Malaysian Ringgit; MYR1.00=USD0.21

Tertiary school I represents Diploma and Degree

Tertiary school II represents Master and PhD Degree

Household income adopted from the fourth criteria, Tenth Malaysia Plan (Poh *et al.* 2019)

Table 2. Nutritional status among school children aged 7 to 12 years in rural Setiu, Terengganu

Nutritional status	Mean±SD	n (%)
Height (cm)	135.37±11.84	
Weight (kg)	33.37±12.55	
WAZ	-0.66±1.33	n=102
Severe underweight		2 (2.0)
Moderate underweight		15 (14.7)
Normal		81 (79.4)
Overweight		4 (3.9)
HAZ	-0.82±1.10	n=269
Severe stunting		4 (1.5)
Moderate stunting		33 (12.3)
Normal		230 (85.5)
Tall		2 (0.7)
BAZ	-0.00±1.46	n=269
Severe thinness		2 (0.7)
Moderate thinness		16 (5.9)
Normal		196 (72.9)
Overweight		24 (8.9)
Obesity		31 (11.5)

BAZ: Body Mass Index for Age (7 to 12 years); HAZ: Height for Age (7 to 12 years); WAZ: Weight for Age (7 to 10 years)

Age and nutritional status. Age was significantly associated with the WAZ ($p<0.05$); significantly more children aged 7 to 9 years were malnourished than those aged 10 to 12 years. This result is similar to a study in Palestinian by Al-Lahham *et al.* (2019) in which age (6 to 12 years) of being underweight was found to be significantly associated ($p<0.001$). A previous study reported that age was among the risk factors for being underweight. Stunting in school-age children may be linked to early exposure to poor nutrition, besides recent advances in maternal and child care practices may help to reduce the prevalence of stunting in younger children. The (IPH 2018) reported that the prevalence of overnutrition, among Malaysian children aged 10 to 12 years (overweight 16.3% and obesity 17.4%) was two times higher than undernutrition which is 6.7% and stunting 7.8%.

Sociodemographic factors and nutritional status of primary school children

Household size and nutritional status.

An association was found between household size and HAZ of children as depicted in Table 3. There were more malnourished children (56.4%) than normal children (37.8%) in households of >7 members. Similar findings were reported in school aged children in Ethiopia (Argaw *et al.* 2022; Berhanu *et al.* 2022) and Egypt (Abdel Wahed *et al.* 2017). Argaw *et al.* (2022) reported that children who had household members >5

were 2.1 times more likely to be stunted than those living in households of <5 members. More cases of stunting were seen in the big family members as compared to small family members. Household size has an impact on food scarcity, particularly in households of rural areas and with non-fixed income sources. As compared to smaller families with the same level of economic power, the larger family size would indicate less food being available for each family member,

Table 3. Association between sociodemographic characteristics and nutritional status (WAZ, HAZ and BAZ) among school-aged children in rural Setiu, Terengganu

Sociodemographic	WAZ (n=102)				HAZ (n=269)				BAZ (n=269)			
	Normal (n=81)	Others (n=21)	X ² /Fisher's exact test	P	Normal (n=230)	Others (n=39)	X ² /Fisher's exact test	P	Normal (n=196)	Others (n=73)	X ² /Fisher's exact test	P
Gender												
Male	41 (50.6)	11 (52.4)	0.021 ^a	0.885	120 (52.2)	22 (56.4)	0.240 ^a	0.624	110 (56.1)	32 (43.8)	3.222 ^a	0.073
Female	40 (49.4)	10 (47.6)			110 (47.8)	17 (43.6)			86 (43.9)	41 (56.2)		
Age												
7–9 years	63 (77.8)	21 (100.0)	— ^b	0.020 [*]	72 (31.3)	13 (33.3)	0.064 ^a	0.801	63 (32.1)	22 (30.1)	0.157 ^a	0.780
10–12 years	18 (22.2)	0 (0.0)			158 (68.7)	26 (66.7)			133 (67.9)	51 (69.9)		
Household size												
<7	47 (58.0)	9 (42.9)	1.549 ^a	0.213	143 (62.2)	17 (43.6)	4.778 ^a	0.029 [*]	118 (60.2)	42 (57.5)	0.314 ^a	0.575
≥7	34 (42.0)	12 (57.1)			87 (37.8)	22 (56.4)			78 (39.8)	31 (42.5)		
Father's educational level												
No to primary	22 (27.1)	3 (14.3)	13.427 ^a	0.001 ^{**}	49 (21.3)	6 (15.4)	1.160 ^a	0.560	45 (23.0)	10 (13.7)	4.400 ^a	0.111
Secondary education	53 (65.4)	10 (47.6)			151 (65.7)	26 (66.7)			128 (65.3)	49 (67.1)		
Tertiary education	6 (7.4)	8 (38.1)			30 (13.0)	7 (17.9)			23 (11.7)	14 (19.2)		
Mother's educational level												
No to primary n	9 (11.1)	2 (9.5)	3.504 ^b	0.196	28 (12.2)	7 (17.9)	0.992 ^a	0.609	27 (13.8)	8 (11.0)	0.322 ^a	0.516
Secondary education	65 (80.2)	14 (66.7)			169 (73.5)	27 (69.2)			144 (73.5)	52 (71.2)		
Tertiary education	7 (8.6)	5 (23.8)			33 (14.3)	5 (12.8)			25 (12.8)	13 (17.8)		
Father's income (per month)												
<MYR1,500	50 (61.7)	11 (52.4)	0.606 ^a	0.436	145 (63.0)	26 (66.7)	0.189 ^a	0.664	135 (68.9)	36 (49.3)	8.789 ^a	0.030 [*]
≥MYR1,500	31 (38.3)	10 (47.6)			85 (37.0)	13 (33.3)			61 (31.1)	37 (50.7)		
Mother's income (per month)												
<MYR1,500	70 (86.4)	17 (81.0)	— ^b	0.504	192 (83.5)	36 (93.3)	— ^b	0.227	168 (85.7)	60 (82.2)	0.511 ^a	0.475
≥MYR1,500	11 (13.6)	4 (19.0)			38 (16.5)	3 (7.7)			28 (14.3)	13 (17.8)		

^ap<0.05; ^{**} p<0.01; ^aPearson chi-square test; ^bFisher's Exact test

which can lead to stunting (Herrera-Cuenca *et al.* 2021).

In this study, even though children were from low-income families, they were normal in WAZ, HAZ, and BAZ. This was likely due to the nutritious food availability as some of the children participated in the Food Supplement Programme (*Rancangan Makanan Tambahan*) provided at the school canteen, financially supported by the Ministry of Education, Malaysia. However, this study also involved children from high and medium family income (21%) since the data collection method was collected from all available participants who met the study's criteria and was drawn by a convenience sampling size population.

Parental income and nutritional status.

It is observed that most children who came from the low father's income category (less than MYR1,500) were in normal growth (68.9%) whereas more malnourished children (50.7%) had higher fathers' income of >RM1,500 (Table 3). The study by Poh *et al.* (2019) that uses the Malaysian data from the South East Asian Nutrition Surveys (SEANUTS) revealed a similar result where about one-third of subjects were from low-income households (<MYR1,500 per month) and less than one-fifth were from high-income households (\geq MYR5,600 per month). Based on the study by Naidu *et al.* (2013), it is found that about 66% of the guardians of 7,749 children aged 7 to 12 years in Malaysia fall into the household income group income that is less than MYR2,000. Households with higher income showed a higher prevalence of overweight than households with lower income. Our study evidenced the association between parental income and nutritional status.

It was postulated that the educational level among the parents contributed as most of them (86%) received the highest education at the secondary level. The demographic of this rural Setiu District area is mainly related to the agricultural and tourism business. Some might have higher incomes and better salaries but with lower education levels. Due to the hustle and job commitment, they may prefer to have outside meals that are considered less healthy food choices. This study was in agreement with Ahmad *et al.* (2018), which highlighted the impact of gender, family factors, and socioeconomic factors on children's eating and physical activity habits. Family members, especially the parents,

have important equal roles in the provision of meals as well as shaping their children's eating and physical activity habits. However, further prospective studies should be conducted examining other risk factors to determine the real causes of this situation.

Parental education level and nutritional status. The father's education level was also associated with WAZ ($p < 0.001$). More normal weight children (65.4%) lived in households where fathers had received secondary education, while more malnourished children lived in households where fathers (38.1%) had at least tertiary education. Children's initial food experience begins with the parents' diet. This first exposure allows the child to be receptive to new flavours, thus increasing food acceptance for more variety. Thus, parents' education influences their early stages. A Lithuanian COSI study investigated the relationship between parental income, education level, and children's eating habits, and found that parents' higher education and income had a significant impact on their children's daily breakfast and fresh fruit consumption (Petrauskiene *et al.* 2015).

The WAZ results revealed that 79.4% children were normal, moderate underweight (14.7%), and 2.0% were severely underweight. The prevalence in this study was higher than the study by Zainuddin *et al.* (2013) in Malaysia, and the national prevalence of underweight among school children was 13.6%, and it was doubled in rural areas compared to urban areas. An observed outcome for HAZ demonstrates that in most of the children, 85.5% were normal, 12.3% had moderate stunting, 1.5% had severe stunting, and 0.7% were extreme tallness. The study by Tyagi *et al.* (2023), summarized that 1.4% of children (aged 6 to 15 years old) were found to be stunted.

The BAZ also revealed similar outcomes as most children having normal growth (72.9%), followed by obesity (11.5%), overweight (8.9%), moderate thinness (5.9%) and severe thinness (0.7%). This result was consistent with the study in Malaysia by Naidu *et al.* (2013). Even though they were in a rural area, a traditional fishing village, and the villagers lived in long-established ways, the access to processed food was easy. The children in rural areas potentially had higher risk factors for overweight and obesity due to the daily consumption of salty, dried, and snack food products such as artificial fish

and seafood crackers. The findings were in line with previous studies where most rural islanders had a high proportion of consuming fish or/and seafood due to engaging in traditional fishing activity (Farmery *et al.* 2020). A study by Ismail *et al.* (2022) in rural area in Kedah reported that the population lifestyle, availability of fast and processed food, sedentary or less physically active lifestyle, and consumption of an energy-rich but nutrient-poor diet, which results in a high number of obesities among them. As for nutrient components, excessive amounts of fat and sodium from recommendations were due to high consumption of cooking or purchasing more fried foods, coconut milk, and soy sauce dishes.

Children's mean daily energy increases were more prevalent when they ate salty snacks (Nurwanti *et al.* 2019). A report by Al-Lahham *et al.* (2019) reviewed that the age of students (6 to 12 years old) and the father's educational level were risk factors and was significantly associated with the WAZ ($p < 0.05$). The prevalence of being underweight is higher among children of less educated parents than children of highly educated backgrounds. However, the results show that parental educational level was not significantly associated with BAZ, and the result was in contrast with the studies conducted in Turkey and Malaysia which revealed that children with highly educated parents are more likely to be overweight. Additionally, studies in developed countries have strongly suggested the opposite association, where children of parents with poor levels of education showed an approximately higher risk of obesity by a factor of two to three. Parents with higher levels of education are more likely to be aware of potential health issues and are more likely to protect their children from an unhealthy lifestyle than those in rural areas (Syahrul *et al.* 2016). This study, however, failed to demonstrate any significant association between gender, age, and household size with BAZ as supported by Mohamad *et al.* (2021), as there was no significant association between overweight and obesity between males and females. This finding is also consistent with the study by Adetunji *et al.* (2019), whereby it stated an insignificant difference between the prevalence of overweight and obesity and school age. The present study demonstrates that stunting was higher in both low parental educational levels, with 13.4% and 14.3%, respectively, but had no

significant association. Other sociodemographic factors, such as age, gender, and parental income, were not significantly associated with HAZ.

This result was supported by a study by Yefri *et al.* (2022), which indicated no relationship between the parent's age, the father's education level, and the number of children with the risk of stunting. Though, the opposite results from the national survey done by Argaw *et al.* (2022) in Gedeo Zone, South Ethiopia, claimed that the children's stunted growth was significantly correlated with the educational status of mothers. Stunted children were twice as likely to be born to mothers who couldn't read as to mothers with a formal education. In this study, the father's income that was categorized as low income has a significant association with obesity as it was consistent with the result of Reis *et al.* (2020), which reported that children of lower-income families had been significantly affected by obesity. Lower income levels and Socioeconomic Status (SES) lead to low-income communities with substandard food and built environments and low affordability of healthy food. A similar study emphasized that children from low-income families are more likely to be obese for several reasons, including access to affordable and healthy food, participation in recreational activities, or a built environment that discourages physical activity, such as a lack of playgrounds or walkways (Anderson *et al.* 2021). It contrasted with the recent study of rural and urban primary school children's age, which found no significant association between parental income and overweight or obesity (Mesawa *et al.* 2020).

The findings could provide an overview to alert the authorities for future targeted intervention. A more comprehensive study can be explored to gain a deeper understanding of underweight, stunting and obesity among preschool children. However, it was noted that the present work has certain limitations. Since the present work focused on BMI, therefore this study did not report on other household factors that are associated with BMI such as the impact of dietary intake on nutritional status. Hence, the cross-sectional study was unable to assess the causal association between demographic characteristics and nutritional status. In addition to making a substantial contribution to accurate and reliable effect size estimation, the hierarchical

regression approach is important for investigating linked risk factors in the presence of interrelated components at various levels.

CONCLUSION

This study determined the association between sociodemographic factors (gender, age, household size, parent's education level, and income) and nutritional status (underweight, stunting and overweight/obesity) among rural Setiu, Terengganu primary schoolchildren. The majority of results from the measurement of WAZ, HAZ and BAZ were in normal growth. The underweight condition of the children was predominantly associated with the gender of the children and high paternal education levels among the children. This study identified only household size as a derived factor and significantly associated with stunting. A significant association between sociodemographic factors (father's educational level and income) was found with the BAZ. This study discovered that not every sociodemographic factor has a correlation with nutritional status. In conclusion, improvement and detailed research on parents' income, educational level and household size should be emphasized to reduce nutritional problems among primary school children.

ACKNOWLEDGEMENT

The authors would like to express our highest recognition and thankfulness to all parties directly or indirectly in this research. Enormous appreciation to the participants who willingly joined, very pleasurable, and good cooperation during data collection.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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