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Factors associated with poor appetite among residents at selected long-term care facilities in Selangor, Malaysia

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ABSTRACT

Introduction: Poor appetite is prevalent among older adults and may negatively impact on their overall health. This is especially true for institutionalised residents. Despite this, there is a paucity of research on appetite and its associated factors among institutionalised residents, which signified the present study. **Methods:** A cross-sectional study was conducted among elderly residents at long-term care facilities in the state of Selangor, Malaysia to ascertain their appetite status and its associated factors. **Results:** A total of 97 residents with mean age of 74.2±8.4 years old were recruited. They comprised 61.9% females and 38.1% males. More than 50% had poor appetite with early satiety. There were 63.0%, 82.4%, and 94.8% who had poor oral health, poor sleep quality, and depression, respectively. Ethnicity (*OR*=2.73; 95% *CI*=1.00-7.44; *p*=0.049) was the only factor that predicted poor appetite among older adults in long-term care facilities, with Malay residents having poorer appetite than their Chinese and Indian counterparts. **Conclusion:** The prevalence of poor appetite was high among residents staying at long-term care facilities in Selangor, Malaysia, especially among Malays. This issue deserves further studies to identify the specific underlying factors contributing to poor appetite among older adults from different ethnicities. Acknowledging the high prevalence of poor appetite among older adults and its possible unfavourable outcomes, appropriate nutrition interventions are therefore needed to address this issue among institutionalised elderly.

Keywords: appetite, depressive, institutionalised residents, older adults, sleep quality

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INTRODUCTION

Globally, there has been a growth in both population size and the proportion of older adults. With one billion older adults aged ≥60 years and above in 2019, this number is expected to increase to 1.4 billion and 2.1 billion by 2030 and 2050, respectively. Approximately 80% of the world's older adults will live in low- and middle-income nations by 2050 (WHO, 2019). Like other countries, Malaysia is experiencing significant population ageing, with the percentage of older adults aged 65 years and above in Malaysia having increased from 7.0% to 7.4%, within a year from 2020 to 2021 (Department of Statistics Malaysia, 2021).

Older adults are susceptible to malnutrition, which may be attributed to a variety of mechanisms (Norman, Haß & Pirlich, 2021); with higher risk of malnutrition among institutionalised older adults as compared to community dwellers (Pigłowska, Guligowska & Kostka, 2020) due to frailty, poor cognitive status, polypharmacy, poor dentition, and swallowing difficulties (Dominguez Castro *et al.*, 2021). Notwithstanding the increasingly recognised health concerns, studies on malnutrition among institutionalised older adults are scarce as compared to community dwellers (Streicher *et al.*, 2018) due to the challenges of conducting research in long-term care facilities.

Although malnutrition has often been associated with morbidity, mortality, and cost of care among older adults, it often remains unaddressed among institutionalised elderly (Norman *et al.*, 2021). As malnutrition in older adults, especially among institutionalised residents, is often associated with considerable personal, social and financial distress, thus identifying its contributors is necessary to allow the formulation of appropriate interventions. On the other hand, poor appetite is common in older adults leading to poor dietary quality (Nohan *et al.*, 2020) and represents a common predictor of malnutrition among older adults.

Aetiologies of poor appetite among older people can be multifaceted, including poor dentition and health status (Malafarina *et al.*, 2013), socio-demographic factors (Zukeran *et al.*, 2022), food preferences (van der Meij *et al.*, 2017), use of medications that suppress appetite, decreased taste sensation (Malafarina *et al.*, 2013), and depression (Suzana *et al.*, 2013). Nevertheless, most of the above studies were performed among community dwellers, which may limit their generalisation to institutionalised older adults. A better understanding of the factors associated with appetite in institutionalised older adults is therefore necessary to achieve early identification of declined food intake and mitigate its negative outcomes. Therefore, this study aimed to investigate the factors contributing to appetite among older adults in selected long-term care facilities.

MATERIALS AND METHODS

This cross-sectional study was conducted at five (5) selected long-term care facilities (LTCFs) in Selangor, Malaysia from 22 December 2020 till 16 August 2021. There are a total of 67 long-term care facilities distributed across the six districts in Selangor. Purposive sampling was applied for the selection of study location, with Petaling and Hulu Langat districts being selected due to the highest number of long-term care facilities located in these two districts. While study permissions were sought from all the long-term care facilities within Petaling and Hulu Langat districts, permissions were granted only from five long-term care facilities,

confirming the challenges of conducting studies in such setting, and this was especially true during the COVID-19 pandemic. Acknowledging the higher risk of severe course and mortality rate of COVID-19 among residents of long-term care facilities, the pandemic has also put unprecedented strain on long-term care facilities and restricted research engagement with residents.

In Malaysia, long-term care facilities are provided by public, private, non-governmental organisations (NGOs), as well as by churches and other religious groups. These long-term care facilities offer 24-hour room and board, as well as healthcare services, including basic and skilled nursing care, rehabilitation, and a full range of other therapies and treatments. The research was performed in accordance with the Declaration of Helsinki and the protocol was approved by the University Research Ethics Committee, Universiti Putra Malaysia (Ref: UPM/TNCPI/RMC/JKEUPM/1.4.18.2).

Data collection

Upon obtaining study permission from the institutions, arrangements were made with the respective institutions to obtain a list of residents that met the inclusion criteria. Study eligibility included residents aged ≥65 years, cognitively competent to consent, and able to self-feed. Residents who were fed enterally or parenterally on a modified texture diet and required assistance at mealtimes were excluded. Residents with cognitive impairment (scoring 5 or below on the abbreviated mental test) or communication problems were excluded. On the day of data collection, researchers approached potential residents either at the common area or at their dorms, depending on the setting of the institution and instructions given by the institution. Residents received a comprehensive participant information sheet with details of the study, their rights regarding participation and withdrawal at any stage, and assurance of complete anonymity. Eligible and interested residents provided individual written informed consent before their study enrolment.

Measurements

A face-to-face interview was conducted to collect all data at long-term care facilities. A pre-tested structured questionnaire was used to ascertain socio-demographic characteristics, appetite level, perceived meal satisfaction, depression, functional status, oral health status, and sleep quality of the residents, with details as below.

Assessment of appetite status

Appetite of the residents was ascertained using the 4-item Simplified Nutritional Appetite Questionnaire (SNAQ). Partially based on the Appetite, Hunger and Sensory Perception Questionnaire, the SNAQ was developed to objectively evaluate poor appetite in older adults and has been validated in older adults living in nursing homes (Wilson *et al.*, 2005). SNAQ has sensitivity and specificity values of 69.7% and 62.7%, respectively, besides an acceptable reliability as assessed using Cronbach's alpha (0.58). SNAQ comprises ordinal scales consisting of four domains: appetite, feeling of fullness, taste of food, and the number of meals per day. The score for each item on SNAQ ranged from 1 (very poor, I feel full after eating only a few mouthfuls, very bad, and less than one meal a day) to 5 (very good, I hardly ever feel full, very good, and more than three meals a day). With a total score ranging from 4 to 20 points, a score of <14 indicates poor appetite (Wilson *et al.*, 2005).

Assessment of meal satisfaction
Residents' self-perception of meal satisfaction was ascertained using the Mealtime Satisfaction Questionnaire (MSQ). The MSQ has high internal consistency (Cronbach's alpha 0.83) and test-retest reliability (intraclass coefficient = 0.91) (Pizzola *et al.*, 2013). The MSQ displayed moderate internal consistency (Cronbach's alpha = 0.75) in the present study.

Assessment of depression
The validated Malay version of Geriatric Depression Scale (M-GDS-14), a widely used screening tool for depression among older adults, was utilised in this study to assess depressive symptoms among the residents. The M-GDS-14 has good reliability (Cronbach's alpha = 0.84, test-retest reliability = 0.84) and validity (Spearman's rho = 0.68) in the Malaysian population.

Assessment of functional status
The validated Malay version of the Instrumental Activity Daily Living (IADL-MV) was used to determine functional status of the residents. With a Content Validity Index for four criteria ranging from 88.89 to 100.0 and a Cronbach's alpha coefficient for internal consistency of 0.84, the IADL-MV has outstanding reliability and validity for use with Malay speaking older persons in Malaysia. Cronbach's alpha for this study was 0.74.

Assessment of oral health status and medication use
Oral health status of the residents was determined using the Malay version of Geriatric Oral Health Assessment Index (GOHAI). The Malay version of GOHAI, which has acceptable validity and reliability with a Cronbach's alpha of 0.79, is an effective tool for measuring oral health-related quality of life among Malaysians. Medication use of the residents was self-reported by the residents and cross-checked with staff nurses at the institutions.

Assessment of sleep quality
Sleep quality of the residents in the past one month was ascertained using the Malay version of Pittsburgh Sleep Quality Index (PSQI) (Buysse *et al.*, 1989). This universally recognised tool comprises seven components, namely subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication use, and daytime dysfunction, with each component having a scale factor from 0 to 3, and collectively form a global score ranging from 0 to 21. A higher global PSQI score indicates lower sleep quality. A global PSQI score of ≤5 indicates satisfactory sleep quality, whereas a score of >6 indicates poor sleep quality. Cronbach's alpha for this index was 0.82, indicating that the instrument has acceptable internal consistency.

Statistical analysis
All data were analysed using IBM SPSS Statistics for Windows version 24.0 (IBM Corp., Armonk, New York, United States). Normality test was determined using the Kolmogrov-Smirnov and Shapiro-Wilk tests. Categorical and numerical data were presented as frequency (%) or mean±standard deviation (*SD*), respectively. Chi-square test was used to compare the proportion of variables accounted for by age groups. Chi-square tests were also used to determine the association between categorical variables and appetite status. Further analysis using multivariate logistic analysis was performed to identify the contributing factors towards appetite. All variables with a $p<0.25$ in the bivariate analyses were entered into the logistic regression model to delineate their contributions towards appetite status among older adults. For all analyses, a *p*-value of less

Table 1. Distribution of the respondents according to selected characteristics/factors and appetite status as stratified by age categories (*n*=97)

Characteristics	*n (%)*					
	Young-old (n=27)	*Old-old (n=41)*	*Oldest (n=29)*	*All (n=97)*	x^2	*p-value*
Sex					4.810[a]	0.090
Male	15 (55.6)	13 (31.7)	9 (31.0)	37 (38.1)		
Female	12 (44.4)	28 (68.3)	20 (69.0)	60 (61.9)		
Ethnicity					20.09[b]	<0.001*
Malay	22 (81.5)	28 (68.3)	11 (37.9)	61 (62.9)		
Chinese	2 (7.4)	6 (14.6)	16 (55.2)	24 (24.7)		
Indian	3 (11.1)	5 (12.2)	2 (6.9)	10 (10.3)		
Others	0 (0.0)	2 (2.1)	0 (0.0)	2 (2.1)		
Duration of stay					8.299[b]	0.075
1-5 years	22 (81.5)	26 (63.4)	15 (51.7)	63 (64.9)		
5-10 years	5 (18.5)	9 (22.0)	8 (27.6)	22 (22.7)		
10 years and more	0 (0.0)	6 (14.6)	6 (20.7)	12 (12.4)		
History of hospitalisation					1.006[a]	0.605
Yes	18 (66.7)	23 (56.1)	19 (65.5)	60 (61.9)		
No	9 (33.3)	18 (43.9)	10 (34.5)	37 (38.1)		
Number of chronic diseases					6.179[b]	0.360
None	10 (37.7)	11 (26.8)	7 (24.1)	28 (28.9)		
1-2 diseases	13 (48.1)	20 (48.8)	20 (69.0)	53 (54.6)		
3-4 diseases	3 (11.1)	9 (22.0)	2 (6.9)	14 (14.4)		
≥ 5 diseases	1 (3.7)	1 (2.4)	0 (0.0)	2 (2.1)		
Type of chronic diseases						
High blood pressure					2.685[a]	0.261
Yes	11 (40.7)	25 (61.0)	15 (51.7)	51 (52.6)		
No	16 (59.3)	16 (39.0)	14 (48.3)	46 (47.4)		
Diabetes mellitus					7.136[a]	0.028*
Yes	7 (25.9)	16 (39.0)	3 (10.3)	26 (26.8)		
No	20 (74.1)	25 (61.0)	26 (89.7)	71 (73.2)		
Hypercholesterolaemia					1.054[a]	0.590
Yes	5 (18.5)	12 (29.3)	8 (27.6)	25 (25.8)		
No	22 (81.1)	29 (70.7)	21 (72.4)	72 (74.2)		
Cardiovascular disease					1.000[b]	0.641
Yes	4 (14.8)	4 (9.8)	2 (6.9)	10 (10.3)		
No	23 (85.2)	37 (90.2)	27 (93.1)	87 (89.7)		
Arthritis					1.395[b]	0.555
Yes	1 (33.7)	5 (12.2)	3 (10.3)	3 (10.3)		
No	26 (96.3)	36 (87.8)	26 (89.7)	26 (89.7)		
Others					1.988[a]	0.738
Yes	4 (14.8)	3 (7.3)	2 (6.8)	9 (9.3)		
No	23 (85.2)	38 (92.7)	27 (93.1)	88 (90.7)		
Medication use					0.128[a]	0.897
<5 medications	25 (92.6)	37 (90.2)	27 (93.1)	89 (91.8)		
≥5 medications	2 (7.4)	4 (9.8)	2 (6.9)	8 (8.2)		
Depressive symptoms					0.459[a]	0.795
Normal	2 (7.4)	2 (4.9)	1 (3.4)	5 (5.2)		
Suggestive of depressive symptoms	25 (92.6)	39 (95.1)	28 (96.6)	92 (94.8)		
Functional status					9.721[a]	0.008
Normal	8 (29.6)	10 (24.4)	0 (0.0)	18 (18.6)		
Functional disabled	19 (70.4)	31 (75.5)	29 (100.0)	79 (81.4)		
Self-perceived oral health					3.796[a]	0.434
Poor	12 (44.4)	10 (24.4)	8 (27.6)	30 (30.9)		
Moderate	8 (29.6)	13 (31.7)	10 (34.5)	31 (32.0)		
Good	7 (25.9)	18 (43.9)	11 (37.9)	36 (37.1)		

Table 1. Distribution of the respondents according to selected characteristics/factors and appetite status as stratified by age categories (*n*=97) [*Cont'd*]

Characteristics	*n (%)*					
	Young-old (n =27)	*Old-old (n=41)*	*Oldest (n=29)*	*All (n=97)*	x^2	*p-value*
Sleep quality					0.344[a]	0.842
Poor	23 (85.2)	34 (82.9)	23 (79.3)	80 (82.5)		
Good	4 (23.5)	7 (17.1)	6 (20.7)	17 (17.5)		
Meal satisfaction						
Temperature					1.150[a]	0.563
High satisfaction	19 (70.4)	24 (58.5)	17 (58.6)	60 (61.9)		
Low satisfaction	8 (29.6)	17 (41.5)	12 (41.4)	37 (38.1)		
Colour contrast					0.240[a]	0.887
High satisfaction	11 (40.7)	16 (39.0)	13 (44.8)	40 (41.2)		
Low satisfaction	16 (59.3)	25 (61.0)	16 (55.2)	57 (58.8)		
Food choices					1.896[a]	0.388
High satisfaction	10 (37.0)	11 (26.8)	6 (20.7)	27 (27.8)		
Low Satisfaction	17 (63.0)	30 (73.3)	23 (79.3)	70 (72.2)		
Appetite status					1.341	0.512
Good	15 (55.6)	17 (41.5)	13 (44.8)	45 (46.4)		
Poor	12 (44.4)	24 (58.5)	16 (55.2)	52 (53.6)		

[a] Chi-square test of association
[b] Fisher's exact test
Age classification categories: young-old, ages 65 to 74 years; old-old, 75 to 84 years; and oldest, ≥85 years.

than 0.05 was considered statistically significant.

RESULTS

Table 1 shows the distribution of residents according to their socio-demographic characteristics, clinical characteristics, oral health status, sleep quality, depressive symptoms, functional status, use of medication, and meal satisfaction. Mean age of the respondents was 74.2±8.4 years, ranging from 60 to 95 years old. More than 40% of residents were in the old-old age group, with approximately 30% in the oldest and young-old age groups, respectively. The study was dominated by females (60%). The major ethnic group composition consisted of Malays (62.9%), followed by Chinese (24.7%), and Indians (10.3%), which is comparable with the ethnic composition of Malaysia. The mean duration of stay among the residents was 3.9±4.3 years, ranging from 0.10 to 30 years, with approximately 20% and 10% having stayed at the institutions for 5-10 years and more than 10 years, respectively. While no significant differences were found between other socio-demographic characteristics and age groups, the proportion of Chinese respondents was significantly higher in the oldest category than other ethnicities (x^2=20.09, p<0.001), which was attributed to the higher mean age of Chinese respondents (79.9±8.9 years old) compared to Malay (74.4±6.9 years old) and Indian (71.9±7.4 years old) respondents (data not shown).

Hospitalisation was common; six in ten residents had at least one hospitalisation in the past one year. The presence of non-communicable diseases was evident, with slightly more than half of the respondents having 1-2 diseases (54.6%) and hypertension was the most prevalent. An increase in age was associated with a lower risk of diabetes

mellitus (x^2 =7.136, p<0.05). However, no significant differences were found between the history of hospitalisation, number of diseases, type of disease, and age group of the respondents.

About 95% of the respondents were classified as suggestive of depressive symptoms, but there was no significant association between the presence of depressive symptoms and the age of the respondents. More than 80% of older adults had functional disability. All residents in the oldest age group were functionally disabled, while more than 75% and 70% of the old-old and young-old respondents, respectively, were functionally disabled, which explains the significant association between functional status and age group (x^2 =9.721, p<0.05). The prevalence of polypharmacy, defined as taking five or more types of medications, was 8.2%. The mean number of medication use among the residents was 0.9±1.0, ranging from 0 to 5 medications. Age did not influence the number of medications used by the residents (x^2 =0.218, p>0.05).

It is worth mentioning that more than 60% and 80% of the residents had poor oral health and were poor sleepers, respectively. A total of 61.9% of respondents were satisfied with the temperature of the foods served. Nevertheless, approximately 60% of the respondents were unsatisfied with the colour of the meals served, while more than 70% were unsatisfied with the food choices available at the institutions. There was no significant difference between meal satisfaction and age of the respondents.

Table 2. Distribution of respondents according to individual element of appetite assessment (n=97)

SNAQ items	*n* (%)
My appetite is:	
Very poor	1 (1.0)
Poor	6 (6.2)
Average	45 (46.4)
Good	31 (32.0)
Very good	14 (14.4)
When I eat	
I feel full after eating only a few mouthfuls	10 (10.3)
I feel full after eating about a third of a meal	11 (11.3)
I feel full after eating over half a meal	38 (39.2)
I feel full after eating most of the meal	37 (38.1)
I hardly ever feel full	1 (1.0)
Food tastes	
Very poor	1 (1.0)
Poor	8 (8.2)
Average	45 (46.4)
Good	39 (40.2)
Very good	4 (4.1)
Normally I eat	
Less than one meal a day	0 (0.0)
One meal a day	2 (2.1)
Two meals a day	18 (18.6)
Three meals a day	47 (48.5)
More than three meals a day	30 (30.9)

SNAQ: Simplified Nutritional Appetite Questionnaire

Appetite status

More than half of the residents had poor appetite, comprising 58.5% of the old-old, 55.2% of the oldest, and 44.4% of the young-old, respectively. There was no significant difference in appetite status between the age groups. Table 2 depicts the distribution of responses according to the elements of the appetite assessment. Of all the respondents, 46.4% perceived their appetite as average. While approximately 80% of the respondents had three or more meals per day, early satiety was common, with approximately 60% of the older adults unable to finish more than half of the meals served, which was accompanied by more than 50% feeling dissatisfied with the taste of the foods served.

Associations between appetite and selected factors

As depicted in Table 3, there were no significant associations between socio-demographic characteristics (age, sex, and duration of stay), clinical characteristics, medication use, meal satisfaction, functional status, presence of depressive symptoms, and perceived oral health among older adults with their appetite status. On the other hand, there was a significant association between ethnicity and appetite status, with older Malay adults having significantly poorer appetite than Chinese or Indian ethnicities (x^2=0.008, p<0.05). In addition, there was a significant association between sleep quality and appetite status (x^2=4.852, p<0.05), whereby respondents who had better sleep quality had better appetite.

Contribution of socio-demographic characteristics, clinical characteristics, depressive symptoms, and sleep quality towards appetite

Table 4 shows the predictive model for appetite status among residents. Variables with a p<0.25 in the bivariate analyses, namely ethnicity, sleep quality, history of hospitalisation, number of diseases, arthritis, hypercholesterolaemia, meal satisfaction (colour contrast), and depressive symptoms, were included in the logistic regression model. Ethnicity was the only variable that significantly contributed to appetite among older adults. Logistic regression model showed that the Malay ethnicity had 2.73 times the odds of having poor appetite compared to other ethnicity groups (β=1.005, *OR*=2.73, 95% *CI*=1.004, 7.444, p=0.049). The model explained 18.6% (Cox and Shell R-squared) and 24.8% (Nagelkerke R-squared) of the variance in appetite status.

DISCUSSION

The prevalence of poor appetite was evident in more than half of the older adults residing in long-term care facilities. Nevertheless, the prevalence was lower compared to previous local studies either among community dwellers (Suzana *et al.*, 2013; Syafinas *et al.*, 2018) or institutionalised older adults in Penang (Suzana & Charn, 2009). These discrepancies could be attributed to the lower mean age of the residents, shorter duration of stay at the institutions, and the use of different screening tools in the assessment of appetite across these studies. Notwithstanding, the prevalence of poor appetite was higher compared to community-dwelling older adults in other countries, including the United States (van der Meij *et al.*, 2017). The discrepancies between the present study findings and that of the above three studies were expected, as the earlier studies were conducted among community-dwelling older adults. The problem of appetite loss among the elderly at long-term care facilities cannot be disregarded; early identification of anorexia and correct nutritional

Table 3. Associations of selected characteristics/factors with appetite status among older adults (*n*=97)

Characteristics	*n (%)*		x^2	*p-value*
	Poor appetite	*Good appetite*		
Age (years)			1.341	0.512
60-69	12 (23.1)	15 (33.3)		
70-79	24 (46.2)	17 (37.8)		
>80	16 (30.8)	13 (28.9)		
Sex			0.592	0.442
Male	18 (34.6)	19 (42.2)		
Female	34 (65.4)	26 (57.8)		
Ethnicity			7.047	0.008*
Malay	39 (75.0)	22 (48.9)		
Non-Malay	13 (25.0)	23 (51.1)		
Duration of stay			1.616	0.446
1-5 years	33 (63.5)	30 (66.7)		
5-10 years	14 (26.9)	8 (17.8)		
>10 years	5 (9.6)	7 (15.6)		
History of hospitalisation			1.412	0.235
Yes	35 (67.3)	25 (55.6)		
No	17 (32.7)	20 (44.4)		
Number of diseases			1.829	0.176
None	12 (23.1)	16 (35.6)		
≥1 disease	40 (76.9)	29 (64.4)		
Medication use			0.281	0.596
<5 medications	47 (90.4)	42 (93.3)		
>5 medications	5 (9.6)	22 (48.9)		
Meal satisfaction			0.238	0.625
Temperature	31 (59.6)	29 (64.4)		
High satisfaction	21 (40.4)	16 (35.6)		
Low satisfaction				
Colour contrast			2.028	0.154
High satisfaction	18 (34.6)	22 (48.9)		
Low satisfaction	34 (65.4)	23 (51.1)		
Food choices			0.480	0.488
High satisfaction	16 (30.8)	11 (24.4)		
Low satisfaction	36 (69.2)	34 (75.6)		
Sleep quality			4.852	0.028*
Poor sleep quality	47 (90.4)	33 (73.3)		
Good sleep quality	5 (9.6)	12 (26.7)		
Functional status			0.116	0.734
Normal	9 (17.3)	9 (20.0)		
Functionally disabled	43 (82.7)	36 (80.0)		
Perception of oral health			0.939	0.645
Good	17 (32.7)	19 (42.2)		
Moderate and poor	35 (67.3)	26 (57.8)		
Depressive symptoms			1.476	0.224
Normal	4 (7.7)	1 (26.7)		
Depressive	48 (92.3)	44 (47.8)		

Table 4. Multiple logistic regression analysis for factors predicting appetite among older adults (*n*=97)

Variables	*B*	*SE*	*Wald*	*Df*	*Sig*	*Exp(B)*	*95% of CI For Exp(B)*
Constant	-0.081	0.473	0.029	1	0.864	0.922	
Ethnicity (Malay)	1.005	0.511	3.869	1	0.049	2.733	1.004, 7.444
History of hospitalisation	-0.347	0.489	0.503	1	0.478	0.707	0.271, 1.845
Number of diseases	-0.642	0.600	1.144	1	0.285	0.526	0.162, 1.707
Arthritis	1.270	0.831	2.335	1	0.126	3.560	0.699,18.148
Hypercholesterolaemia	-0.888	0.595	2.228	1	0.136	0.411	0.128, 1.321
Meal satisfaction (colour contrast)	0.464	0.522	0.790	1	0.374	1.590	0.571, 4.426
Sleep quality	1.046	0.649	2.596	1	0.107	2.844	0.798, 10.142
Depressive symptoms	-1.116	1.201	0.865	1	0.352	0.327	0.031, 3.444

intervention are critical for improving their health and quality of life.

The high prevalence of depressive symptoms among institutionalised older adults is a warning sign and consistent with a recent study conducted among Jordanians living in residential care facilities (Al-Amer *et al.*, 2019). The rate of depression was however higher compared to previous local studies (Suzana & Charn, 2009; Normala *et al.*, 2014), as well as institutionalised residents in Asia, including China (Wang *et al.*, 2021), Japan (Haseda *et al.*, 2018), and Thailand (Charoensakulchai *et al.*, 2019). The finding discrepancy could be due to differences in sampling methodologies, demographics, and the use of different measures of depression (Wang *et al.*, 2021).

While poor sleep quality was expected among institutionalised residents, the abnormally high prevalence was alarming and consistent with an earlier local study (Rashid, Ong & Wong, 2012), as well as studies in Spain (Valenza *et al.*, 2013) and China (Zhu *et al.*, 2020). Sleep quality among the residents appeared to be significantly associated with their appetite in the bivariate analysis of the present study, but this association was no longer significant in the logistic model. The lack of heterogeneity in this sample may partially explain why the present study failed to document significant contributions towards appetite. Our findings were not in line with an earlier study showing that appetite was significantly associated with increased sleep efficiency among older adults in Japan, whereby older adults with good appetite had better sleep quality (Yamamoto *et al.*, 2020). Serum leptin concentration, the *ob* gene product secreted by adipose tissue, declines gradually during ageing (Isidori *et al.*, 2000) and may lead to low-level expression of orexins, the appetite-stimulating peptides, which promote food intake in a dose-dependent manner (Sakurai *et al.*, 1998). Decrease of orexins with ageing has also been linked to reduced wakefulness and increased excessive daytime sleepiness, causing more nighttime arousals and awakenings, thus poor sleep quality (Lin, 2018). Figure 1 depicts the proposed putative mechanism between leptin, orexins, appetite and sleep. Notwithstanding the lack of significant contribution of sleep quality to appetite in this study, the co-existence of poor appetite and poor sleep quality among residents warrants more studies in these aspects.

Ethnicity was the only factor that predicted appetite among older adults in long-term care facilities in this study. Compared to Chinese and Indians, Malay residents had poorer appetite. Studies on the association between ethnicity and appetite are limited. A recent study conducted among community-

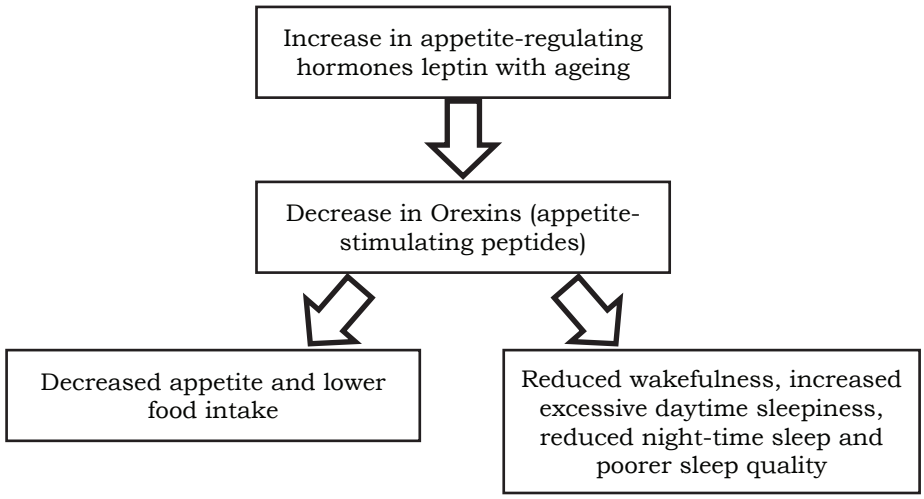

Figure 1. Proposed mechanisms of leptin, orexins, appetite, and sleep quality in older adults

dwelling older adults showed that non-white skin tone was independently and strongly correlated with poor appetite (Zukeran *et al.*, 2022). In Malaysia, limited studies have been conducted to determine the association between ethnicity and appetite regardless of age. Nevertheless, available local studies have consistently reported poorer diet quality among Malay respondents, be it young adults and children (Rezali *et al.*, 2015), middle-aged adults (Eng *et al.*, 2022) or community-dwelling older adults (Nohan *et al.*, 2020). The exact mechanism for this is unclear, with a past study suggesting distinct ethnic dietary pattern that may have been shaped by an individual's own socio-cultural entity in determining his/her food preferences (Nohan *et al.*, 2020). On the other hand, a recent study showed that in multicultural societies like Malaysia and Singapore, culture is often recreated and reconstructed as it interacts with different social elements that it is exposed to (Reddy & van Dam, 2020), narrowing food cultural differences and possibly the risk of poor appetite across different ethnicities. Acknowledging the finding discrepancies, future studies are needed to delineate the relationship between ethnicity and appetite.

There are several limitations throughout the implementation of this study that should be acknowledged. Firstly, the study design was cross-sectional, in which the causal and effect relationship of poor appetite and its associated factors could not be determined. Secondly, this study was conducted during the COVID-19 pandemic, which restricted movement and data collection in long-term care institutions. Despite movement restrictions, the research team tried to reach out to all the long-term care facilities located in Petaling and Hulu Langat via personal contacts and networking to ensure that the data collection process adhered completely with the standard operation procedures set by the institutions, which allowed the present study to achieve 90% study power. Finally, it is important to note that the mean age of the older adults in our study was lower than that in previous studies. Therefore, these findings should be interpreted with caution.

Further research is needed to fully understand the interaction between factors associated with poor appetite. To discover the causes of disease and to identify relevant risk factors and health outcomes, cohort studies with larger sample sizes are warranted. Moreover, future research should examine appetite status in older adults using different instruments, which are required in many contexts. In addition, appropriate intervention programmes with the assistance of dietitians and other relevant parties should be implemented to improve residents' appetite, including the availability of more food varieties for the residents, meal preparation training for cooks, and modification of the meal environment.

CONCLUSION

This study revealed a high prevalence of poor appetite among residents of long-term care facilities. Nutritional interventions, such as quality and varieties of meals served, are warranted to mitigate the risk of poor appetite among residents. The higher risk of poor appetite among the Malay residents deserves more work in future studies.

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Authors' contributions

Duaa A, contributed to data collection, data analysis and interpretation, responsible for data curation and drafted the original manuscript; Chan YM, involved in the conception and study design, supervised the work, responsible for data curation and drafted the original manuscript; Siti Nur Asyura A, involved in the conception and study design and supervised the work; Chin YS, Zalilah MS, Lim PY, Sazlina SG and Tanti IR; supervised the work; Lim PY, supervised the data interpretation. All authors reviewed and approved the final manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Association between nutritional status of Filipino preschool children and participation in government programmes at the household and individual levels

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ABSTRACT

Introduction: Health and nutrition interventions in developing countries have been linked to better thriving and survival of children. Identifying programmes with significant effect on the nutritional status of Filipino preschool children may aid in identifying impactful interventions in addressing malnutrition. This study evaluated the association between nutritional status of preschool children and government programme participation based on the 2018 Expanded National Nutrition Survey (ENNS) results. **Methods:** Secondary data analysis of 12,949 preschool children was performed from the 2018 ENNS. The selected data included socioeconomic, anthropometric, and self-reported household-level and individual-level government programme participation. Chi-square test for association and multiple logistic regression were conducted using Stata version 16. **Results:** Participation in immunisation programme, growth monitoring, household food production, and awareness and usage of iodised salt were negatively associated with at least one type of undernutrition. Consequently, participation in deworming programme was positively associated with both underweight and stunting. Regression analysis showed that preschool children who underwent growth monitoring were less likely to be stunted (*OR*=0.58), while those who underwent newborn screening were less likely to be underweight (*OR*=0.53) and stunted (*OR*=0.62). On the contrary, dewormed children were more likely to be stunted (*OR*=1.63) and those from 4Ps households were more likely to be wasted (*OR*=2.24). **Conclusion:** There is a need to re-evaluate programme strategies to maximise the benefits provided. Programmes showing significant associations with nutritional status including immunisation, growth monitoring, deworming, household food production, and awareness and usage of iodised salt should be continued and sustained with updated policies.

Keywords: government programmes, nutritional status, preschool children

INTRODUCTION

The national policies of most countries worldwide are geared towards implementation of nutrition-specific and -sensitive programmes, as well as strategies in line with the global nutrition and diet-related 2025 non-communicable disease (NCD) targets of the Sustainable Development Goals and the United Nations Decade of Action on Nutrition (WHO, 2018). However, despite all the efforts of including nutrition targets in the national policies

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and programmes in the government, malnutrition still persists in many countries. Undernutrition continues to cause nearly half of the deaths among children aged below 5 years old and impedes the achievement of their full economic, social, educational, and occupational potential (Yang *et al.*, 2020).

As part of the Philippine Development Plan, the Philippine Plan of Action for Nutrition (PPAN) provides the framework for improving the nutritional status of Filipinos. National and local government agencies are tasked to implement programmes and strategies to achieve set nutrition targets such as micronutrient supplementation, maternal and neonatal care, promotion of good nutrition and healthy lifestyle behaviours, home and community food production, livelihood and assistance programmes, provision of health insurance, and other services.

Results from the 2018 Expanded National Nutrition Survey (ENNS) conducted by the Food and Nutrition Research Institute (FNRI) showed that 19.1% of preschool children were underweight, 30.3% were stunted, and 4.0% were overweight (FNRI- DOST, 2020). The high prevalence of stunting and wasting among children under 5 years old and deficiencies in vitamin A, iron, and iodine are problems of public health significance.

The government programme participation (GP) component of the 2018 ENNS obtains information on the extent of participation of Filipino households and selected population groups in various food, nutrition, and health-related programmes implemented in the country. These include nutrition-specific programmes (national dietary supplementation, micronutrient supplementation, growth monitoring), health programmes (newborn screening, national immunisation programme, food labelling programme), and social protection programmes (*Pantawid Pamilyang Pilipino Programme*). The survey results document the knowledge, awareness, and participation of households and individuals in the different national programmes implemented across the regions in the Philippines (FNRI- DOST, 2020).

Community-based programmes play a key role in the substantial reduction of maternal and child mortality, as well as malnutrition reduction through access to health services, education, and livelihood income (Jamison *et al.*, 2006). The preschool age, 0-59 months, is a period wherein there is rapid physical growth and neurological development, which still encompasses the First 1000 days window of opportunity, the unique period of opportunity where the foundations of optimum health across the lifespan are established. Malnutrition weakens this foundation, which may lead to significant morbidities or early mortality if not addressed properly by well-timed interventions. Monitoring the citizens' participation in relevant government programmes is crucial in further strengthening existing interventions and developing new programmes (FNRI-DOST, 2020). This study evaluated the association between the nutrition outcomes of preschool children and their participation in individual- and household-level GP based on the 2018 ENNS results.

MATERIALS AND METHODS

Study design and participants

This study employed a cross-sectional design wherein a secondary analysis of the 2018 ENNS results was performed. The ENNS is a designated statistical activity that provides empirical data on the nutritional and health status of Filipinos for planning nutrition and health development programmes, and for timely policy decisions at the national and provincial levels.

The 2018 ENNS adopted the new 2013 master sample, developed by the

Philippine Statistics Authority, as its sampling design. It was a two-stage cluster sampling design wherein the first stage was the selection of primary sampling units composed of one barangay or a combination of contiguous barangays composed of 100-400 households, followed by the selection of secondary sampling units composed of housing units.

The ENNS information utilised in this study included socioeconomic, anthropometric, household, and children's participation in various government programmes. A total of 17,167 preschool children were included in the survey. Among these, 12,949 preschool children aged 0-59 months with complete information on sociodemographic profile, anthropometry, and GP data were included in the analysis.

Key components and relationships framework

The key components of this study were: 1) Nutritional status of preschool children, which was measured using weight-for-age, weight-for-height, and height-for-age indicators, 2) Participation in government health and nutrition programmes, and 3) Sociodemographic characteristics of the children and their households.

The relationships between these key components suggested that the nutritional status of preschool children, which was considered as the dependent variable, was influenced by their participation in government health and nutrition programmes, the independent variable. The sociodemographic characteristics of the household, such as the educational attainment and occupation of the household head, household size, place of residence, and wealth status, may also influence the participation of preschool children in government health and nutrition programmes.

Data collection

Outcome variables

Weights of the children were measured using Seca 874 digital weighing scales (Seca, Hamburg, Germany) with a 160kg capacity. Children below 2 years of age and those not able to stand independently were weighed together with their mother or caregiver, then used to subtract the weight of the mother/caregiver without the child to obtain the weight of the child. Weight was recorded to the nearest 0.1 kg.

The standing height of children 2 years and above was measured using a Seca 213 stadiometer (Seca, Hamburg, Germany), while the recumbent length of children less than 2 years was measured using a Seca 417 infantometer (Seca, Hamburg, Germany). Height and length were recorded to the nearest 0.1 cm.

The World Health Organization-Child Growth Standards (WHO-CGS) (WHO, 2006) was used to assess the nutritional status of children 0-5 years old (0-60 months), based on weight and height measurements.

Independent variables

The GP survey assessed the participation of households and members in selected government nutrition and related programmes. Face-to-face interviews were done using a pre-tested questionnaire lodged in an electronic data collection system. Other sources of information such as immunisation cards, birth certificates, and PhilHealth membership IDs were used to verify answers from respondents.

The GP component of the 8th ENNS was categorised into household- and individual- level programmes based on the selected programmes' target population. For household-level GP, the respondent was either the household head or any knowledgeable adult member of the household, while individual-level GP was assessed based on the specific age group the programme was intended for.

For household level, the government programmes were the following: household food production, *Pantawid Pamilyang* Pilipino Programme (4Ps), Family Development Session (FDS), Sustainable Livelihood Programme (SLP), and awareness and usage of iodised salt. The proportion of households/families who participated or were aware of these food, nutrition, and health programmes was obtained.

For individual level, government programmes were assessed by age groups. In this particular study, data on government programmes for preschool children, which included newborn screening (for 0-6 months old), immunisation (for 12-23 months old), vitamin A supplementation (for 0-60 months old), iron supplementation (for 0-60 months old), growth monitoring (for 0-60 months old), national dietary supplementation programme (for 6-60 months old), and deworming (for 12-60 months old) were obtained. Participation in these programmes was asked among mothers/caregivers of children 0-71 months of age. Information on the duration and/or frequency of participation during the last 12 months was obtained for growth monitoring programme, national dietary supplementation programme, vitamin A supplementation, and deworming, while duration and/or frequency of participation during the last 6 months were obtained for iron supplementation.

Statistical analysis

Descriptive statistics were used to describe the basic features of the data in this study, providing simple summaries of the sample and measures. These were particularly used in the tabulation of anthropometric results and proportion of the government programmes participated in.

Data subjected to analysis were the nutritional status of children based on weight-for-age, height-for-age and weight-for-height. The results generated proportion of households participating at the household-level (household food production, 4Ps, FDS, SLP, awareness and usage of iodised salt) and individual-level (newborn screening, immunisation, vitamin A supplementation, iron supplementation, growth monitoring, national dietary supplementation programme, and deworming) government programmes.

Chi-square test for association and multiple logistic regression were used to test the association between nutritional status and GP of preschool children's households. To determine the likelihood of having a normal nutritional status if one participated in government programmes, multiple logistic regression analysis was performed. All statistical analyses were done using STATA version 16 (StataCorp, Texas, USA).

Ethical review

The ENNS was evaluated and approved by the FNRI Institutional Review Committee (Protocol code: 2021-011). Respondents were given informed consent forms to confirm their voluntary participation in the survey and were allowed to withdraw from the study at any given time.

RESULTS

Profile of study children

A total of 12,949 preschool children aged 0-59 months and a total of 10,041 households were included in the study. There were 1,039 (8.0%) 0-5 months old, 1,125 (8.3%) 6-11 months old, 2,290 (17.7%) 12-23 months old, 2,386 (18.8%) 24-35 months old, 2,918 (22.4%) 36-47 months old, and 3,191 (24.7%) 48-59 months. Majority were males (51.8%), while 48.2% were females.

Based on the sociodemographic profile of the household heads (Table 1), majority were married (63.7%), the highest educational attainment was at least high school (40.3%), most were in the agricultural, forestry and fishery industry (24.3%), majority resided in

Table 1. Sociodemographic characteristics of preschool children

Sociodemographic characteristic	*n*	*%*	*95% CI*	
			Lower limit	*Upper limit*
Sex of preschool children				
Male	6675	51.8	50.9	52.8
Female	6274	48.2	47.2	49.1
Age group				
0-5 months	1039	8.0	7.2	8.9
6-11 months	1125	8.3	7.6	9.0
12-23 months	2290	17.7	16.2	19.3
24-35 months	2386	18.8	17.8	20.0
36-47 months	2918	22.4	21.6	23.2
48-59 months	3191	24.7	23.5	26.0
Sex of household head				
Male	8261	79.5	76.1	82.6
Female	1780	20.5	17.4	23.9
Civil status of household head				
Single	201	2.1	1.7	2.5
Married	6440	63.7	59.2	68.0
Widow/Widower	1026	10.5	9.8	11.3
Separated/Annulled/Divorced	258	2.4	2.1	2.8
Common-law/Live-in	2116	21.3	17.7	25.3
Educational attainment of household head				
No grade completed	264	2.1	1.3	3.4
At least elementary level	3823	34.3	30.4	38.5
At least high school Level	3817	40.3	37.5	43.1
At least college Level	2090	22.7	20.1	25.6
Others (Special Education, Alternative Learning System, Arabic Schooling)	47	0.5	0.2	1.3
Occupation of household head				
Armed forces occupations	18	0.1	0.1	0.2
Managers	224	2.2	1.7	2.9
Professionals	149	1.6	1.1	2.3
Technicians and associate professionals	214	2.3	1.8	3.0
Clerical support workers	169	1.9	1.4	2.6
Service and sales workers	1021	11.4	9.4	13.9
Skilled agricultural, forestry and fishery	3042	24.3	19.6	29.7
Craft and related trades workers	940	10.4	8.5	12.8
Plant and machine operators and assemble	1198	13.2	11.7	14.8
Elementary occupations	1511	15.0	13.1	17.0
Not classified	1555	17.5	15.9	19.4
Household size				
≤5	4880	49.7	46.5	53.0
>5	5161	50.3	47.0	53.5
Place of residence				
Rural	6788	55.3	39.2	70.3
Urban	3253	44.7	29.7	60.8
Wealth quintile				
Poorest	3464	28.4	23.4	33.9
Poor	2411	22.1	18.8	25.9
Middle	1796	19.6	17.4	22.0
Rich	1340	16.2	13.1	19.9
Richest	1030	13.6	11.2	16.5

rural areas (55.3%), and most were from the poorest wealth quintile (28.4%). In terms of household size, 50.3% of the preschool children belonged to households with more than five members, while the other half (49.7%) belonged to households with five or less members.

Nutritional status

Table 2 shows that 19.2% of all preschool children were underweight, with the 48-59 months old having the highest prevalence (22.4%). As for height-for-age, 30.1% of all preschool children were stunted, with the highest prevalence observed among the 12-23 months old children (36.1%). In terms of weight-for-height, only 5.6% of preschool children were wasted, with the highest prevalence manifested among the 0-5 months old age sub-group (9.4%).

Association between government programme participation and nutritional status

Table 3 shows that participation in household-level government programmes, namely household food production, awareness of iodised salt, and usage of iodised salt were associated with the nutritional status of preschool children in terms of both weight-for-age and height-for-age. On the other hand, nutritional status of preschool children in terms of weight-for-height was only associated with participation in household food production and awareness of iodised salt.

Table 4 presents the association between individual GP and the nutritional status of specific age sub-groups of preschool children. Results showed that the availing of newborn screening, participation in the national dietary supplementation programme, vitamin A supplementation, and iron supplementation were not associated with any of the nutritional status indicators. Participation in immunisation programme and growth monitoring

Table 2. Nutritional status of preschool children

Disaggregation	*Weight-for-age n (%)*			*Height-for-age n (%)*			*Weight-for-height n (%)*		
	UW	*Normal*	*AN*	*Stunted*	*Normal*	*AN*	*Wasted*	*Normal*	*OW*
Age group	2553 (19.2)	10188 (78.9)	208 (1.9)	4077 (30.1)	8714 (68.7)	156 (1.3)	770 (5.6)	11688 (90.1)	464 (4.0)
0-5 months	94 (8.7)	931 (89.9)	14 (1.4)	114 (11.9)	888 (85.3)	36 (2.9)	106 (9.4)	878 (84.6)	49 (5.2)
6-11 months	159 (13.3)	958 (86.1)	8 (0.6)	182 (15.7)	928 (83.1)	15 (1.2)	102 (8.8)	999 (88.6)	24 (2.5)
12-23 months	425 (18.5)	1836 (80.3)	29 (1.2)	832 (36.1)	1424 (62.3)	34 (1.6)	151 (5.8)	2071 (91.1)	67 (3.1)
24-35 months	500 (20.5)	1852 (78.3)	34 (1.2)	859 (34.8)	1507 (64.3)	20 (0.9)	118 (4.9)	2193 (92.3)	72 (2.6)
36-47 months	661 (21.1)	2202 (76.5)	55(2.5)	1066 (32.9)	1826 (66.1)	25 (1.0)	137 (4.2)	2645 (90.2)	127 (5.0)
48-59 months	714 (22.4)	2409 (74.7)	68(2.8)	1024 (30.4)	2141 (68.5)	26 (1.0)	156 (4.9)	2902 (89.7)	125 (4.9)

UW: Underweight; AN: Above Normal; OW: Overweight

Table 3. Association between participation in household government programmes with nutritional status of 0-59 months old preschool children

	Weight-for-age n (%)			*p-value*	*Height-for-age n (%)*			*p-value*	*Weight-for-height n (%)*			*p-value*
	UW	*Normal*	*AN*		*Stunted*	*Normal*	*AN*		*Wasted*	*Normal*	*OW*	
Household food production												
No=0	1105 (16.8)	4862(81.0)	128 (2.3)	<0.001*	1789 (27.6)	4223 (71.0)	80 (1.4)	0.015*	350 (5.0)	5459 (90.0)	269 (5.0)	0.003*
Yes=1	1451 (22.0)	5326(76.6)	80 (1.4)		2288 (32.9)	4491 (66.0)	76 (1.1)		420 (6.3)	6229 (90.7)	195 (2.9)	
Pantawid Pamilyang Pilipino Programme (4Ps)												
No=0	807 (30.9)	1978(68.3)	19 (0.8)	0.062	1209 (44.6)	1568 (54.6)	26 (0.9)	0.216	208 (7.2)	2536 (90.8)	50 (2.0)	0.117
Yes=1	551 (31.3)	1303(68.4)	8 (0.3)		866 (47.2)	978 (51.8)	18 (1.0)		146 (8.8)	1690 (90.3)	23 (0.9)	
Family development session (FDS)												
No=0	105 (34.4)	246 (65.5)	1 (0.2)	0.571	157 (46.1)	190 (52.9)	5 (1.0)	0.935	34 (11.1)	310 (87.2)	7 (1.7)	0.089
Yes=1	446 (30.5)	1057 (69.1)	7 (0.4)		709 (47.5)	788 (51.5)	13 (1.0)		112 (8.2)	1380 (91.2)	16 (0.7)	
Sustainable livelihood programme (SLP)												
No=0	1894 (26.8)	5504 (72.3)	56 (0.9)	0.513	2944 (40.2)	4430 (58.8)	79 (1.0)	0.622	527 (7.0)	6771(91.0)	138 (2.1)	0.411
Yes=1	66 (23.4)	234 (75.6)	3 (1.0)		116 (41.0)	186 (58.6)	1 (0.4)		13 (4.2)	281 (93.9)	8 (2.0)	
Awareness on iodised salt												
No=0	1165 (23.9)	3707 (74.8)	48 (1.3)	<0.001*	1806 (36.1)	3070 (62.9)	44 (1.1)	<0.001*	355 (6.5)	4434 (90.6)	124 (2.9)	0.002*
Yes=1	1388 (16.5)	6481 (81.3)	160 (2.2)		2271 (26.6)	5644 (72.0)	112(1.4)		415 (5.1)	7254 (90.2)	340 (4.7)	
Usage of iodised salt												
No=0	695 (18.4)	2941 (79.9)	59 (1.7)	0.013*	1127 (30.1)	2521 (68.7)	47 (1.3)	<0.001*	190 (5.0)	3366 (91.1)	134 (4.0)	0.224
Yes=1	691 (15.1)	3532 (82.4)	101 (2.6)		1139 (24.0)	3118 (74.6)	65 (1.4)		224 (5.2)	3879 (89.6)	206 (5.3)	

UW: Underweight; AN: Above Normal; OW: Overweight
*significant at 5% level of significance

Table 4. Association between participation in individual government programmes with nutritional status of preschool children

	Weight-for-age n (%)			*p-value*	*Height-for-age n (%)*			*p-value*	*Weight-for-height n (%)*			*p-value*
	UW	*Normal*	*AN*		*Stunted*	*Normal*	*AN*		*Wasted*	*Normal*	*OW*	
Newborn screening												
No=0	32 (12.4)	216 (86.2)	3 (1.4)	0.265	38 (16.5)	204 (79.9)	8 (3.6)	0.394	23 (8.1)	218 (89.8)	6 (2.1)	0.123
Yes=1	73 (7.6)	869 (90.9)	15 (1.5)		97 (11.5)	829 (86.1)	31 (2.5)		95 (9.2)	811 (84.5)	49 (6.3)	
With immunisation												
No=0	33 (26.8)	83 (71.3)	2 (1.9)	0.105	67 (62.5)	47 (35.0)	4 (2.5)	0.009*	16 (11.7)	96 (81.0)	5 (7.3)	0.140
Yes=1	392 (18.2)	1737 (80.6)	27(1.2)		757 (34.7)	1369 (63.7)	30 (1.5)		134 (5.6)	1960 (91.5)	62 (2.9)	
National ietary supplementation programme												
No=0	2140 (19.7)	8246 (78.5)	174 (1.8)	0.082	3519(31.8)	6931 (67.1)	109 (1.1)	0.614	580 (5.1)	9582 (91.0)	379 (4.0)	0.195
Yes=1	319 (24.4)	1011 (73.0)	20 (2.6)		444 (31.0)	895 (68.2)	11 (0.8)		84 (6.9)	1228 (89.5)	36 (3.7)	
Vitamin A supplementation												
No=0	687 (19.6)	2532 (77.9)	71 (2.5)	0.329	1140 (33.1)	2104 (65.4)	46 (1.5)	0.055	210 (5.7)	2931 (89.8)	137 (4.5)	0.316
Yes=1	1708(20.3)	6512 (78.1)	116 (1.6)		2736 (31.2)	5531 (68.0)	68 (0.8)		440 (5.2)	7621 (91.2)	267 (3.6)	
Iron supplementation												
No=0	2326 (20.1)	8850 (78.1)	185 (1.9)	0.605	3777 (31.8)	7472 (67.1)	111 (1.1)	0.506	631 (5.3)	10314 (90.8)	396 (3.9)	0.652
Yes=1	75 (22.5)	229 (75.2)	3 (2.2)		105 (27.3)	197 (71.3)	5 (1.4)		21 (6.6)	277 (90.3)	8 (3.2)	
Growth monitoring												
Checked weight												
No=0	793 (21.6)	2790 (76.7)	55 (1.8)	0.134	1288 (34.6)	2295 (63.7)	53 (1.7)	0.015*	242 (6.2)	3242 (89.6)	137 (4.2)	0.510
Yes=1	1760 (18.1)	7398 (80.0)	153 (1.9)		2789 (28.1)	6419 (70.9)	103 (1.0)		528 (5.3)	8446 (90.7)	327 (4.0)	
Checked height												
No=0	954 (20.8)	3451 (77.3)	73 (1.9)	0.227	1542 (33.0)	2865 (65.3)	69 (1.7)	0.023*	287 (5.9)	3996 (89.9)	176 (4.2)	0.582
Yes=1	1599 (18.2)	6737 (79.9)	135 (1.9)		2535 (28.3)	5849 (70.7)	87 (1.0)		483 (5.4)	7692 (90.7)	288 (3.9)	
Deworming												
No=0	1116 (18.9)	4291 (78.8)	106 (2.3)	0.023*	1847 (31.4)	3603 (67.4)	62 (1.2)	0.049*	300 (4.7)	4964 (90.4)	236 (4.9)	0.073
Yes= 1	1184 (23.2)	4008 (75.2)	80 (1.7)		1934 (35.6)	3295 (63.4)	43 (0.9)		262 (5.2)	4847 (91.8)	155 (3.0)	

UW: Underweight; AN: Above Normal; OW: Overweight
*significant at 5% level of significance

Table 5. Logistic regression analyses of government programme participation

Programmes	*Weight-for-age*			*Height-for-age*			*Weight-for-height*		
	OR adjusted	*95% CI*	*p-value*	*OR adjusted*	*95% CI*	*p-value*	*OR adjusted*	*95% CI*	*p-value*
Household food production	1.17	(0.98-1.41)	0.079	0.93	(0.75-1.16)	0.488	1.02	(0.65-1.62)	0.903
Pantawid Pamilyang Pilipino Programme	1.04	(0.61-1.78)	0.870	0.94	(0.64-1.38)	0.722	2.24	(1.11-4.53)	0.030*
Family development session	1.12	(0.62-2.03)	0.673	1.24	(0.75-2.04)	0.347	0.67	(0.37-1.20)	0.148
Sustainable livelihood programme	0.78	(0.51-1.19)	0.207	0.79	(0.51-1.21)	0.227	0.64	(0.23-1.73)	0.319
Usage of iodised salt	0.99	(0.85-1.16)	0.911	0.90	(0.82-0.98)	0.025	1.16	(0.85-1.58)	0.306
Newborn screening	0.53	(0.38-0.73)	0.002*	0.62	(0.47-0.82)	0.005*	0.80	(0.53-1.19)	0.222
Immunisation	1.22	(0.65-2.30)	0.487	0.73	(0.34-1.58)	0.370	0.91	(0.34-2.43)	0.824
National dietary supplementation programme	3.12	(0.87-11.27)	0.074	1.32	(0.50-3.51)	0.522	2.64	(0.73-9.53)	0.118
Vitamin A supplementation	1.17	(0.94-1.46)	0.134	1.11	(0.89-1.38)	0.310	0.72	(0.44-1.18)	0.162
Iron supplementation	1.63	(0.82-3.21)	0.135	0.96	(0.52-1.75)	0.868	1.35	(0.28-6.63)	0.669
Growth monitoring									
Check weight	0.71	(0.46-1.10)	0.108	0.58	(0.40-0.84)	0.010*	0.87	(0.34-2.23)	0.731
Check height	0.89	(0.49-1.64)	0.678	1.08	(0.86-1.35)	0.467	0.87	(0.41-1.84)	0.665
Deworming	0.96	(0.57-1.61)	0.849	1.63	(1.33-1.99)	0.001*	0.99	(0.47-2.11)	0.985

*significant at 5% level of significance

were associated with height-for-age only, while participation in deworming programme was associated with both weight-for-age and height-for-age.

Table 5 presents the results of the logistic regression analyses of government programmes. Results showed that 0-6 months old children who had undergone newborn screening were 47% and 38% less likely to be underweight and stunted, respectively. Among preschool children who had undergone growth monitoring, they were 42% less likely to be stunted. On the contrary, the odds of being stunted was 1.6 times higher among children who participated in deworming. Similarly, children who belonged to 4Ps households were 2.24 times more likely to be wasted.

DISCUSSION

Children in developing countries face a range of interrelated problems and child malnutrition; together with inadequate water and sanitation, consequent infections, and growth and development impairments, this remains to be an important public health problem. Poverty, food insecurity, and poor nutrition have serious detrimental impacts on health, development, and well-being of young children; and changes in child malnutrition prevalence are closely related to the countries' mortality trends (Pelletier & Frongillo, 2003). One of the most critical responsibilities of the government is to deliver and support quality healthcare to ensure optimal health among its people.

The Philippine Government created laws, programmes, and projects to ensure access to basic healthcare for Filipinos. The 1989 Philippine Constitution Article XV Section 3 and Article XIII Section 11 mandate the State to defend the right of children to assistance, including proper care and nutrition, and to make available an integrated and comprehensive approach to health development and other social services. The Philippine government acknowledges the challenges brought by health and nutrition problems, thus, consolidated efforts from the public and private sectors help provide plans and strategies to combat the health and nutrition problems of the country (National Nutrition Council, 2020).

Since improved health and nutrition in early childhood are strongly associated with long-term health and economic benefits, more interventions started to focus on the early life stages. Childhood malnutrition has its immediate, underlying, and basic determinants, which could be addressed through the implementation of health and nutrition programmes for young children and their families. These programmes also provide crucial contact with trained health workers who have been instrumental in improving health in developing countries through fostering behavioural change, supporting care practices, and improving access to health services (Ghodsi *et al.*, 2021).

Various factors could affect the impact of a nutrition or health programme on nutritional status. The success of government programmes depends on various factors, such as evidence-based innovation and interventions, rigorous monitoring and evaluation, partnerships with public and private-sector organisations, and timely information dissemination to the public, to effect behaviour change (Frieden, 2013). A systematic review on nutrition interventions in several countries showed that large-scale nutrition interventions positively impact child malnutrition in which the effectiveness depends on the context, needs of the community, and the situation at baseline. Significant differences in the rates of change in health and nutritional status between countries with and without interventions were observed (Allen & Gillespie, 2001). Social services were shown to have essentially eliminated almost all occurrences of child malnutrition, while

a programme providing an integrated approach to food and nutrition security and sustainable local food systems resulted in improved feeding practices and food security status among children (Sustainable Development Goals Fund, 2017).

In this study, household-level government programmes were identified to have an association with nutritional status were household food production and awareness and usage of iodised salt, while participation in the 4Ps demonstrated an increase in the likelihood of wasting. On the other hand, growth monitoring, immunisation, deworming, and newborn screening were the individual-level government programmes associated with nutritional status.

Household food production

Household food production programmes in the Philippines are designed to empower households to grow their own food in order to promote food security and self-sufficiency through backyard/ community gardening. The key benefits of home gardening include improved food security, increased food availability, better nutrition through food diversity, increased income and enhanced rural employment through additional or off-season production, environmental benefits from recycling water and waste nutrients, controlling shade, dust and erosion, and maintaining or increasing local biodiversity (Landon-Lane, 2011).

In this study, the benefit of household food production in the nutritional status of children was evidenced by its association to lower the prevalences of stunting, wasting, and underweight. Similar studies exhibited the potential benefit of home gardening when combined with other nutrition-specific programmes and revealed that home garden interventions can improve a child's nutritional status (Guzmán-Abril *et al.,* 2022; Petros *et al.,* 2018).

Iodised salt awareness and usage

A nutrition-specific programme associated with nutritional outcomes was the awareness and usage of iodised salt, showing an inverse relationship with the prevalences of underweight, stunting, and wasting. Iodine is an essential trace element required in the synthesis of thyroid hormones, which are necessary for normal growth and cognitive development. The use of iodised salt in the prevention of iodine deficiency disorder is recognised as efficient and cost-efficient. The Republic Act 8172 or the Act for Salt Iodisation Nationwide requires iodised salt to be sold/distributed in the Philippines, whether locally produced or imported, shall conform with the standards formulated by the Bureau of Food and Drugs.

A local study on the effect of iodine status and cognitive performance of Filipino school children showed that salt iodisation accompanied by adequate intake of energy, protein, thiamin, and riboflavin contributed to improved cognitive performance in children. The long-term factors identified which contributed to the improvement were normal iodine status and reduction in protein energy malnutrition (Amarra *et al.*, 2007). In this study, awareness of iodised salt was significantly associated with weight-for-age, height-for-age, and weight-for-height. Similarly, the usage of iodised salt was also significantly associated with weight-for-age and height-for-age.

Non-usage of adequately iodised salt among households was associated with a higher prevalence of child malnutrition and mortality in neonates, infants, and children under 5 years of age (Semba *et al.*, 2008). Education and raising awareness on iodised salt have a positive impact on iodised salt consumption among hard-to-reach, marginalised communities (Lowe *et al.*, 2015)

Pantawid Pamilyang Pilipino Programme (4Ps)

The 4Ps was developed by the national government to provide conditional cash grants among households/families with children aged 0-18 years and pregnant women to improve their health, nutrition, and education. In this study, the nutrition-sensitive programme was found to increase the likelihood of wasting, contrary to the study of Orbeta, Melad & Araos (2021), which found that participating in 4Ps had no significant impact on underweight and wasting as wasting is considered to be an acute illness, while underweight may possibly occur due to stunting or wasting. The increased odds of being wasted among children who belonged to 4Ps households may be attributed to the fact that households targeted by the 4Ps are those belonging to the poorest of the poor. Those who belong to the lower wealth quintile have limited access to resources, limited knowledge on health and nutrition, limited access to health care, and poor environmental conditions – all of which may have negative effects on nutritional status.

Growth monitoring

Child growth is considered an important indicator of the nutritional status and health of a population. For growth monitoring, only height-for-age was significantly associated with the regular monitoring of weight and height. The Operation Timbang Plus (OTP) is an annual weighing and height monitoring effort among infants and preschool children to provide information about their nutritional status.

Early detection of undernutrition also translates to early response of interventions. Growth monitoring can suggest an entry point to preventive and curative health care and serves as a constituent nutrition-specific programme in line with significant reductions in malnutrition and mortality (Irwanto, 2010). The proper recording and charting of a child's data on the growth chart allow for an appropriate comparison of the child's growth to the reference and this could aid in the early detection of growth faltering (Ashworth, Shrimpton & Jamil, 2008). The main aims of growth monitoring are to provide a diagnostic tool for health and nutrition surveillance, educate mothers, caregivers, and health workers on healthy food choices and care practices, provide regular contact with primary healthcare services, and encourage utilisation. Two major advantages of growth monitoring are frequent contact with health workers and a conduit to child health interventions (Ashworth *et al.*, 2008).

Growth monitoring is a strategy for the promotion of health, which creates awareness among mothers about growth or the lack of it in their children and serves as a guide to assure continued growth and optimal health. It is an efficient strategy to track physical growth and also serves as a measure to determine the efficacy of treatment and interventions (Kuwabara & Urakami, 2018). When addressing problems on the nutritional status of a child, health workers respond with targeted promotion activities based on growth trend, including the provision of nutritional supplements, treating underlying disease conditions, making referrals to health providers, and provision of nutrition counselling (Liu, Long & Garner, 2017).

Immunisation

One of the prevailing nutrition-sensitive measures to reduce child morbidity is immunisation, which is measured with reference to basic vaccination. The Philippine's expanded programme on immunisation aims to protect infants and children against diseases including tuberculosis, poliomyelitis, diphtheria, tetanus, pertussis, and measles through vaccination. Basic vaccination is considered "complete" if all eight basic vaccines [Bacillus Calmette–

Guérin (BCG), measles, polio 1-2-3, and Diphtheria-Tetanus-Pertussis (DTP) 1-2-3] have been received by a child. In this study, immunisation was found to be associated with height-for-age and the results were consistent with the Demographic and Health Surveys data showing that incomplete vaccination among children was associated with poor nutritional status. A significantly higher prevalence of underweight was found among children with incomplete vaccination schedules in seven countries, while wasting and stunting were frequently observed in under-vaccinated children in four countries (Solis-Soto, Deepak & Nicoli, 2020). Similarly, a recent study in Thailand showed that children with incomplete vaccination coverage were more likely to be stunted, wasted, and overweight (Shinsugi & Mizumoto, 2021). This suggests that immunisation not only helps prevent specific diseases, but also leads to overall improvements in health.

Deworming

Soil-transmitted helminth infections are among the most common infections in humans, caused by a group of parasites such as roundworms, whipworms, and hookworms. Those living in poverty are the most vulnerable to infection that can impair nutritional status by causing internal bleeding, which can lead to anaemia, intestinal inflammation and obstruction, diarrhoea, and impairment of nutrient absorption. Preventive chemotherapy or deworming done annually or biannually is an important strategy to prevent morbidity brought about by soil-transmitted helminths among at-risk population groups. However, the long-term solution to helminthic infections is addressing other factors such as water, sanitation, and hygiene (WHO, 2019).

Every month of January and July, mass deworming is carried out by the Department of Health in partnership with local government units, distributing anti-helminthic drugs to address the problems of intestinal parasites. Preschool-age children are at risk of having intestinal worms due to their daily activities and playtime, and improper handwashing techniques promotes the survival of these parasites. In this study, deworming showed a positive association with weight-for-age and height-for-age of children 12-60 months old, indicating improvement in their nutritional status. Conversely, deworming also resulted to higher odds of stunting. Mass deworming is proven effective to improve the weight and appetite of preschool-age children; however, it is ineffective for the height and cognitive abilities of preschool-age children (Welch *et al.*, 2017). On the contrary, deworming showed consistent association with reduced risk of stunting in another study (Lo *et al.*, 2018). In terms of anaemia, a decrease in prevalence was observed through deworming in partnership with regular hygiene and supplementation of iron and retinol (Girum & Wasie, 2018). In a study conducted in Nepal, it was found that undernutrition was linked less to hygiene-related risk factors and more to the low socioeconomic status of households and poor nutrition. The study results also showed that improved nutritional status of children was indirectly linked to water, sanitation, and hygiene practices as indicated by increased likelihood of children having parasitic infections and diarrhoea when there is poor sanitation and hygiene (Shrestha *et al.*, 2020). These results demonstrated that deworming, coupled with other nutrition and health interventions, helps in the improvement of the overall health and nutrition of a child.

Newborn screening

The Philippine National Comprehensive Newborn Screening System identifies development, genetic and metabolic conditions that can affect a child's long-term health or survival. This includes

blood, hearing, and heart screenings. Although newborn screening itself does not have a direct impact on nutritional status, it plays a crucial role in improving long-term nutritional outcomes through early detection of metabolic disorders, which demands special dietary recommendation and nutrition counselling. In this study, newborn screening programme decreased the likelihood of underweight and stunting. Similar findings were found wherein higher weight-for-age and height-for-age mean z-scores were observed among children who underwent newborn screening, thus improving nutritional outcomes in early childhood (Schütz *et al.*, 2022).

Nutrition programmes have indeed an important role in improving food and economic security, dietary intake, health, and child development. Results of this study could validate if our local policies and programmes on health and nutrition are indeed contributing significantly to the uplifting of the nutritional status of children during their crucial years of growth and development. Since government agencies have limited capacity and resources, it is crucial that they maximise limited resources by delivering effective programmes, which improve population-level health outcomes. All programmes should be backed-up with updated policies and closely monitored and evaluated to ensure that the health and nutrition services received by households and children are timely and appropriate. In the 4Ps, for instance, results of this study could possibly be used as science-based evidence in improving the existing modules used in Family Development Sessions by strengthening the focus on health and nutrition, and provide more nutrition-specific interventions to those identified with poor nutritional status. The same is true for the other programmes discussed in this study, which all have important roles in improving children's nutritional status. The results could be used by these programmes as a scientific basis for identifying the most vulnerable groups, increasing budget allocation to expand coverage and improve services, increasing the involvement of healthcare providers, and crafting policy recommendations to further support and sustain programme implementation.

CONCLUSION

For household-level programme participation, household food production, awareness of iodised salt, and usage of iodised salt were significantly associated with weight-for-age and height-for-age. Weight-for-height, on the other hand, was only associated with participation in household food production and awareness of iodised salt. As for individual-level GP, participation in immunisation programme and growth monitoring were associated with height-for-age only, while participation in deworming programmes was associated with nutritional status of preschool children in terms of both weight-for-age and height-for-age. For the strength of association, it was found that preschool children who underwent growth monitoring were less likely to be stunted. For preschool children who underwent newborn screening, they were less likely to be underweight and stunted. On the contrary, children who participated in deworming programmes were more likely to be stunted and children belonging to 4Ps households were more likely to be wasted.

There were several limitations to be taken into consideration in this study. Firstly, causal inference cannot be claimed from the results since data were obtained from a cross-sectional survey. The effects of confounding variables that may have influenced nutritional outcomes of preschool children cannot be ruled out despite adjusting for sex, wealth quintile, and urbanity. Another major limitation was that data on participation were mainly self-reported

by the respondents and their actual attendance or involvement was not verified. Future research is needed to further validate the results of this study and understand the impact of GP on the nutritional status of children. Other factors/variables not covered in this study should also be analysed.

Government programmes, whether nutrition-specific or nutrition-sensitive, are designed to improve the health and nutritional well-being of target populations. Understanding the association between nutritional status and government programme participation can serve as scientific basis in tailoring targeted intervention specifically in nutrition and health education, identifying vulnerable areas to be given prioritisation, increasing advocacy efforts and resource allocation, and fostering collaboration with more healthcare providers.

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Authors' contributions

Arias FPS, principal investigator, conceptualised and designed the study, prepared the draft of the manuscript and reviewed the manuscript; Ferrer EB, performed statistical data analysis and interpretation, reviewed the manuscript.

Conflict of interest

All authors declare no conflict of interest in the conduct of this secondary data analysis study as the survey is government funded.

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Eating behaviour and lifestyle changes among college students in Malaysia during the Movement Control Order (MCO)

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ABSTRACT

Introduction: COVID-19 lockdown has been linked to alterations in eating behaviour and a sedentary lifestyle. As human-to-human transmission rapidly increased, the Movement Control Order (MCO) was put in place as an attempt to minimise the risk of the virus spreading in the community. This study aimed to determine whether eating behaviour was associated with sleep quality and physical activity among college students in Malaysia during MCO. **Methods:** This was a cross-sectional study among Malaysian students aged between 20 to 34 years old. A simple random sampling method was applied and the participants had to complete an online survey consisting of a validated Dutch Eating Behaviour Questionnaire (DEBQ), Pittsburgh Sleep Quality Index (PSQI), and International Physical Activity Questionnaire–Short Form (IPAQ-SF), distributed via an online platform. **Results:** A total of 370 students participated, with 22.4% emotional eaters, 58.6% external eaters, and 23.0% restrained eaters. In addition, 64.3% had poor sleep quality, while 57.6% claimed to be physically active. However, no correlations were found between all eating behaviour subscales with sleep quality and physical activity. **Conclusion:** More than half of college students presented with external eating behaviours. Early screening and further investigations should be done, especially with the high rate of poor sleepers, to promote and sustain a healthy lifestyle during and beyond COVID-19.

Keywords: COVID-19, eating behaviour, lifestyle, movement control order

INTRODUCTION

The official term the World Health Organization (WHO) issued for the newly discovered respiratory disease was Coronavirus Disease 2019 (COVID-19). COVID-19 is a disease caused by a virus first found in Wuhan, Hubei Province, China, in late December 2019 (WHO, 2020). Since the disease's discovery, it has swiftly spread from China to the rest of the world and the pandemic has not been halted. WHO (2024) reported a cumulative of 61.2 million confirmed cases in South-East Asia from January 2020 to January 2024.

As human-to-human transmission was rapidly increasing and much about the virus remained unknown, on

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March 18, 2020, the Malaysian Prime Minister issued a Movement Control Order (MCO) to minimise virus spread in the community and to lift the burden and exhaustion of the country's health system. Lockdown restrictions were deemed required to halt the pathogen's spread. Throughout the observation period of MCO, outdoor activities were restricted and people were only allowed to go outside for essential purposes such as groceries shopping and medical-related care. Malaysians were also barred from going abroad. Likewise, foreigners were not permitted entry during MCO. Additionally, many sectors unlisted for operation were ordered to close; most employees were told to work from home and students were advised to adapt to online distance learning (ODL). With these sudden lifestyle changes, Malaysians responded with uncertainty when the MCO declaration was made (Azlan *et al.*, 2020).

The new norm amidst the COVID-19 outbreak has contributed to a transformation in everyone's lifestyle. Staying at home, working from home, online distance learning, limited outdoors and social contact, or working several hours under stressful conditions while handling the associated health hazards have substantially affected everyday functioning and sleeping. According to a study conducted in Spain, a combination of dietary changes, low physical activity, and more sedentary behaviour during quarantine was associated with poorer sleep quality (Martínez-de-Quel *et al.*, 2021). At the same time, Wang *et al.* (2020) identified many psychological effects of COVID-19 in China during the early wave of the pandemic, including elevated stress levels. Besides, among young Saudi women, stress has been linked to overeating, whereby many snacks and fast food intakes were significantly associated with higher stress levels (Al-Musharaf, 2020). In a global study of higher education students in Malaysia, it was concluded that poor sleep quality, poor diet, and physical inactivity were associated with stressful event and this affected students' health behaviours (Du *et al.,* 2021).

Eating behaviour is a broad term that includes food choice motives, dietary habits, and eating disorders (Viana & Sinde, 2008, as cited in LaCaille *et al.*, 2013). For example, Freitas *et al.* (2018) defined eating behaviour as psychosocial factors and attitudes associated with food selection. Psychological, societal, cultural, environmental, and economic variables can all be factors that impact or change eating behaviour, which can significantly influence an individual's health (LaCaille *et al.*, 2013). A study among college students in the United States by Son *et al.* (2020) stated that most (26%) reported that their food intake had increased because of COVID-19. The findings were consistent with a study among adults in Poland, where over 43.0% and nearly 52% reported eating and snacking more (Sidor & Rzymski, 2020). A similar trend was reported among Malaysian university students working remotely, whereby increased eating, snacking, cooking, and online food ordering were observed, leading to weight gain (Chen *et al.*, 2021).

Distant online classes owing to COVID-19 and lockdowns were one of the most regularly mentioned difficulties in studies among university students in Malaysia. The most pressing issue was poor internet connection, which interrupted online learning (Chakraborty *et al.*, 2020; Sundarasen *et al.*, 2020). It was particularly startling to learn that some students used their smartphones to attend online classes for six to eight hours daily, contributing to unmanageable stress and other health problems (Sundarasen *et al.*, 2020).

Excessive screen use, according to students, caused stress and disrupted sleep (Chakraborty *et al.*, 2020).

Since the COVID-19 outbreak is still new and ongoing in Malaysia, more research is needed, specifically on eating behaviour and lifestyle changes among Malaysian college students during MCO. Thus, this study was carried out to determine whether eating behaviour assessed with the Dutch Eating Behaviour Questionnaire (DEBQ) was associated with sleep quality and physical activity among the college student population in Malaysia during COVID-19.

MATERIALS AND METHODS

Study population

A quantitative-based cross-sectional study was conducted among college students in Malaysia on eating behaviour, sleep quality, and physical activity during the COVID-19 lockdown/ MCO. Data were collected from June to July 2021, when the COVID-19 outbreak was still ongoing. MCO in Malaysia began on March 18, 2020 and was halted on August 1, 2021. During this period, Malaysians underwent different phases of MCO and SOPs, such as minimal contact with other people and no interstate travelling allowed until full vaccination was implemented. This study involved a population of Malaysian young adults between 20 to 34 years old who were college students residing in Malaysia when the survey was conducted and had access to a smartphone and the internet. Those who practised food restrictions or had food allergies due to illness, such as celiac disease or Inborn Error of Metabolism (IEM), were excluded from this study. Statistics on the young adult population (age 15-64 years), retrieved from the official website of the Department of Statistics Malaysia, was 23.4 million individuals.

Sampling method

The sampling for this study was carried out using probability sampling through a simple random sampling method. A formula by Krejcie & Morgan (1970) was used to determine the sample size for this study. According to the formula, the sample size needed for this study was 384 participants.

Data collection method

Data were collected using a self-reported questionnaire via Google Forms and the link was shared on social media such as WhatsApp, Instagram, Snapchat, Twitter, and Facebook. Using social media platforms gave a higher chance of recruiting random participants as they were used by many, especially college students, who were practising new norms through online distance learning during the pandemic. The participants had to click on the link provided and would be navigated to the Google Form page directly. In addition, a short overview of the study's purpose, an informed consent form, and instructions on answering the questionnaire were provided. Only those who provided their digital consent were directed to the questionnaire. Participants were required to complete four questionnaire sections. Section A consisted of sociodemographic backgrounds such as age, weight, height, nationality, and college. Section B consisted of 33 questions regarding participants' eating behaviour, followed by sections C and D, with 19 questions on sleep quality and seven on physical activity during the COVID-19 lockdown, respectively.

Materials/Tools

The materials/tools used in this study were the English and Malay language versions of the Dutch Eating Behaviour Questionnaire (DEBQ) to assess the participants' eating behaviour, the

Pittsburgh Sleep Quality Index (PSQI) to assess participants' sleep quality, and the International Physical Activity Questionnaire–Short Form (IPAQ-SF) to assess participants' physical activity during COVID-19 lockdown.

Dutch Eating Behaviour Questionnaire (DEBQ)

Eating behaviour was assessed using the validated DEBQ (Subramaniam *et al.*, 2017). This instrument assessed three unhealthy eating behaviours: emotional eating, which is the tendency to cope with negative emotions; restrained eating, which is the tendency to restrict food intake in order to control body weight; and external eating, which refers to the extent to which external cues of food trigger eating episode. It comprised 33 items of a five-point Likert scale: 13 items on emotional eating and ten items each for external and restrained eating. The score ranged from "never" (score 1), "rarely" (score 2), "sometimes" (score 3), "often" (score 4), to "very often" (score 5). The score for each item was added together and further divided by the number of items in the subscale to get an overall score per subscale. Higher scores suggested a higher likelihood of displaying the subscale behaviour and a cut-off score of 3.25 was used to indicate potential emotional, external, or restrained eaters.

Pittsburgh Sleep Quality Index (PSQI)

The participants' sleep quality was assessed using the PSQI (Farah, Teh & Mohd Rasdi, 2019). PSQI collected data on participants' sleep quality from the previous month. It consisted of 19 items divided into seven subscales: one item for sleep quality, two items for sleep latency, one item for sleep duration, three items for sleep efficiency, nine items for sleep disturbance, one item for sleep medication, and two items for daytime dysfunction. In addition, four items were open-ended questions and the rest were scored through a four-point Likert scale with a range of 0 to 3, where 0 indicated no difficulty and 3 indicated severe difficulty. Finally, the scores for each subscale were added together to generate a PSQI score and poor sleepers were indicated by a cut-off score of more than five. For both healthy and clinical populations with mental and physical health conerns, this measure has shown high reliability and validity (Guo *et al.*, 2016).

International Physical Activity Questionnaire – Short Form (IPAQ-SF)

Physical activity was assessed using the validated IPAQ-SF (Craig *et al.,* 2003). This metric measured the types of physical activity people engaged in daily to calculate the total physical activity in metabolic equivalent (MET)-minutes/week. IPAQ-SF comprised seven open-ended questions requiring participants to recall their physical activity for the last seven days. IPAQ scores were divided into two categories: physically inactive and physically active. Individuals with low levels were categorised as physically inactive and those with moderate and vigorous levels were categorised as physically active. The categories for physically inactive and physically active were divided based on metabolic equivalent scores (MET-minutes/week), which were calculated based on the IPAQ-SF criteria (moderate level = at least 600 MET-minutes/week, vigorous level = at least 1500 MET-minutes/week). Those who did not meet the criteria were categorised as physically inactive. The MET-minutes/week was calculated as MET level x minutes of activity/day x days per week. IPAQ-SF was more feasible and did not put too much burden on the participants to recall their physical activities since it was self-administered.

Table 1. Baseline characteristics of the participants (*N*=370)

Baseline characteristic	*n (%)*			*Mean±SD*		
	Male (n=85)	*Female (n=285)*	*Total (N=370)*	*Male (n=85)*	*Female (n=285)*	*Total (N=370)*
Age (20-27)				21.8±1.3	21.9±1.2	21.9±1.2
Body mass index (kg/m^2)				24.5±7.4	21.6±4.6	22.2±5.5
Residency						
Urban	45 (52.9)	174 (61.1)	219 (59.2)			
Rural	40 (47.1)	111 (38.9)	151 (40.8)			
Living status						
Family	81 (95.3)	274 (96.1)	355 (95.9)			
Friends	0 (0.0)	1 (0.4)	1 (0.3)			
Alone	0 (0.0)	2 (0.7)	2 (0.5)			
Hostel	4 (4.7)	8 (2.8)	12 (3.2)			
Financial status						
Family	37 (43.5)	140 (49.1)	177 (47.8)			
Scholarship	13 (15.3)	28 (9.8)	41 (11.1)			
Loan	31 (36.5)	114 (40.0)	145 (39.2)			
Part-time job	1 (1.2)	3 (1.1)	4 (1.1)			
Full-time job	3 (3.5)	0 (0.0)	3 (0.8)			

Data analysis

Descriptive statistics were presented as frequency and percentage. Data on self-reported body weight and height were used to compute Body Mass Index (BMI). Meanwhile, continuous variables were presented as means and standard deviations. Pearson's Correlation Coefficient was used to analyse the correlations between the independent variable (eating behaviour) and dependent variables (sleep quality and physical activity). IBM SPSS Statistics for Windows Version 20.0 (IBM Corp., Armonk, New York, USA) was used to carry out all statistical analyses of this study. The significance level was set at a standard *p*-value of 0.05, two-tailed.

Ethical approval

Ethical approval for this study was granted by the Universiti Teknologi MARA Research Ethics Committee (UG/MR/567).

RESULTS

Participants' characteristics

A total of 370 participants returned complete forms. As shown in Table 1, 285 participants (77%) were females, while the remaining 85 participants (23%) were male college students, with an average age of 21.9 years and a BMI of 22.2 kg/m^2. The participants came from both urban and rural areas, with a majority of 219 participants (59.2%) and 151 participants (40.8%), respectively. Most of the students (355 participants, 95.9%) lived with their families and only one participant (0.3%) lived with friends. Mostly, their source of income came from their families (177 participants, 47.8%), and for three participants (0.8%) from a full-time job (see Table 1).

Participants' lifestyle

Table 2 presents the data for each questionnaire used. DEBQ concluded that most participants did not engage in

emotional eating (77.6%) and restrained eating behaviours (77.0%). However, more than half of the participants were external eaters (58.6%). PSQI indicated that 238 (64.3%) participants had poor sleep quality, with an average score of 8.24; the rest, 132 (35.7%) participants, reported good sleep quality, with an average score of 4.11 when a cut-off point of five was used. Finally, IPAQ-SF reported that 213 (57.6%) participants were deemed to be physically active, with an average MET score of 2722.7. The remaining 157 (42.4%) participants were physically inactive, with an average MET score of 183.3. Generally, the physically active and inactive participants seemed not to have a huge difference (see Table 2).

Correlations between eating behaviour with sleep quality and physical activity

In Table 3, the correlation between eating behaviour, which consisted of emotional eating, external eating, and restrained eating, with sleep quality had a *p*-value of 0.27, 0.39, and 0.93, respectively. For physical activity, *p*-values of 0.26, 0.32, and 0.23 were found, respectively. Both findings showed no significant associations ($p>0.05$). Pearson correlation analysis also presented a negligible correlation between eating behaviour and sleep quality (see Table 3).

Correlations between eating behaviour with sleep quality components

Table 4 shows the correlations of eating behaviour with sleep quality components. For the emotional eating subscale, only sleep latency ($p<0.001$), sleep disturbance ($p<0.05$), and sleep medication usage ($p<0.05$) components depicted significant results, but with weak correlations. However, other components showed negligible correlations. External eating presented only one significant finding – the sleep duration ($p<0.05$) component, nevertheless, the Pearson correlation showed a negative correlation. The

Table 2. Participants' eating behaviour, sleep quality, and physical activity level assessed by various questionnaires (*N*=370)

Variable	*n (%)*			*Mean±SD*
	Male (n=85)	*Female (n=285)*	*Total (n=370)*	
DEBQ subscales				
Emotional eating	22 (25.9)	61 (21.4)	83 (22.4)	3.81±0.05
Non-emotional eating	63 (74.1)	224 (78.6)	287 (77.6)	2.33±0.03
External eating	46 (54.1)	171 (60.0)	217 (58.6)	3.77±0.03
Non-external eating	39 (45.9)	114 (40.0)	153 (41.4)	2.84±0.03
Restrained eating	26 (30.6)	75 (26.3)	101 (27.3)	3.78±0.04
Non-restrained eating	59 (69.4)	210 (73.7)	269 (72.7)	2.32±0.04
PSQI				
Poor sleep quality (>5)	56 (65.9)	182 (63.9)	238 (64.3)	8.24±2.23
Good sleep quality (≤5)	29 (34.1)	103 (36.1)	132 (35.7)	4.11±1.05
IPAQ-SF				
Physically active	53 (62.4)	160 (56.1)	213 (57.6)	2722.7±2704.5
Physically inactive	32 (37.6)	125 (43.9)	157 (42.4)	183.3±193.2

DEBQ: Dutch Eating Behaviour Questionnaire; PSQI: Pittsburgh Sleep Quality Index; IPAQ-SF: International Physical Activity Questionnaire-Short form
IPAQ unit = MET minutes/week

Table 3. Correlations between eating behaviour subscales with sleep quality and physical activity (*N*=370)

Variable	*Sleep quality*	*Physical activity*
	r (p-value)	*r (p-value)*
Emotional eating	0.06 (0.27)	0.06 (0.26)
External eating	0.05 (0.39)	0.05 (0.32)
Restrained eating	-0.01 (0.93)	0.06 (0.23)

restrained eating subscale also revealed no significant results (see Table 4).

DISCUSSION

This study assessed the prevalence of Malaysian college students engaged with eating behaviour subscales, including emotional eating, external eating, restrained eating, sleep quality level, and physical activity during MCO of COVID-19. Generally, the DEBQ emotional eating subscale is widely used to define individuals with emotional eating, which measures an individual's urge to eat under unfavourable emotional states such as stress, boredom, and depression (Frayn & Knäuper, 2017). Emotional eating disorders have been more common during COVID-19 (Al-Musharaf, 2020). Still, the prevalence of emotional eating during COVID-19 among college students ranged from 4.5% to 52.7% in several studies conducted in central China (Sze *et al.*, 2021). The low range of emotional eaters might be due to the generalisation of the whole college student population in the country since only several provinces in central China were selected for the studies. However, another finding from Che Ladin & Chin (2021) reported a high prevalence of Malaysian adults who experienced emotional eating (54%). Similarly, this study revealed that almost half of the participants (45.7%) presented as emotional eaters. Therefore, the cases of emotional eating among college students in Malaysia were quite high during the COVID-19 lockdown.

Regarding sleep quality in Malaysia, the latest study in 2019 reported that about 45% of adults had poor sleep before the COVID-19 wave hit Malaysia (Farah *et al.*, 2019). The percentage of poor sleepers among adults was considered high even before the pandemic, almost

Table 4. Correlations between sleep quality components with eating behaviour subscales (*N*=370)

Variables	*Emotional eating*	*External eating*	*Restrained eating*
	r (p-value)	*r (p-value)*	*r (p-value)*
PSQI			
C1 (Subjective sleep quality)	-0.01 (0.86)	0.04 (0.46)	-0.09 (0.07)
C2 (Sleep latency)	0.17 (0.00)*	0.09 (0.08)	0.07 (0.21)
C3 (Sleep duration)	-0.09 (0.08)	-0.11 (0.04)*	-0.04 (0.40)
C4 (Sleep efficiency)	0.02 (0.67)	0.06 (0.27)	-0.02 (0.72)
C5 (Sleep disturbance)	0.11 (0.03)*	0.07 (0.21)	0.10 (0.07)
C6 (Use of sleep medication)	0.10 (0.05)*	0.04 (0.49)	0.07 (0.21)
C7 (Daytime dysfunction)	-0.03 (0.62)	0.04 (0.51)	-0.03 (0.55)

PSQI: Pittsburgh Sleep Quality Index
*$p \leq 0.05$

reaching half. In this study, Malaysian college students labelled as poor sleepers reached 65%, presenting no improvement in terms of sleep quality. In line with other studies, 44.5% of individuals were reportedly poor sleepers and this might be linked to higher levels of stress and anxiety during lockdown (Pérez-Rodrigo *et al.*, 2020; Stanton *et al.*, 2020; Voitsidis, Huang & Xhao, 2020, as cited in Celorio-Sardà *et al.*, 2021). Trabelsi *et al.* (2021) explained that the COVID-19 lockdown resulted in poor sleep quality as the percentage of those who had good sleep quality fell from 61% before the lockdown to 48% after the lockdown. Lifestyle changes during COVID-19, such as isolation and high usage of electronic devices, as well as stressors, such as uncertainty about one's health or financial consequences, have been shown to impact sleep patterns negatively and cause high rates of sleeplessness. Additionally, during the quarantine, participants (college students) spent more time on screens due to online learning, which is closely linked to increased sleep issues. This study on sleep quality showed that COVID-19 might contribute to a high percentage of poor sleepers among college students in Malaysia.

During the COVID-19 lockdown, engagement with physical exercise reduced significantly (Celorio-Sardà *et al.*, 2021; Trabelsi *et al.*, 2021). Nevertheless, this study's participants (57.1%) were physically active. The results were consistent with the latest report in Malaysia, whereby Malaysians were physically active during MCO (Syed Shiekh & Marathamuthu, 2021). In addition, these findings were consistent with the studies conducted in Italy and Spain, where individuals were reported to be more active during lockdown (Di Renzo *et al.*, 2020; López-Bueno *et al.*, 2020, as cited in Ingram, Maciejewski & Hand, 2020). Regardless, the difference between those physically active (57.1%) and inactive (42.9%) were insignificant in this study.

Shen *et al.* (2020) stated that higher levels of perceived stress are linked to a stronger inclination towards emotional eating. A correlation between emotional eating and sleep quality could exist because there is a link between stress with emotional eating and sleep quality. Negative emotions are linked to emotional eating, which may influence sleep quality. In a study by Geiker *et al.* (2017), as cited in Saleh-Ghadimi *et al.* (2019), a link between emotional stress and sleep was presented, which caused the participants with a high emotional eating score to be more prone to poor sleep quality. This was also supported by Dweck *et al.*'s (2014, as cited in Saleh-Ghadimi *et al.*, 2019) study among healthy women in the United States, where poor sleepers had a considerably higher emotional eating score.

To our knowledge, stress increased during the COVID-19 pandemic, which disrupted normal lifestyle. However, despite the evidence linking emotional eating and sleep quality, this study reported no causal relationship between these two variables, whereby the elevation of PSQI scores did not necessarily increase DEBQ scores. This might be due to the different questionnaires used to define emotional eaters compared to previous studies. Besides, when all seven components of sleep quality were analysed with emotional eating, only sleep latency, sleep disturbance, and sleep medication usage were significantly increased with the increasing score of emotional eating. Still, the components did not certainly represent a correlation with emotional eating, as no positive correlations within the range of 0.30 to 1.00 were observed in those three components.

This study's correlation between eating behaviour and physical activity

also revealed no causal relationship. It was likely that individuals in a negative mood experienced lower physical activity, which would match earlier findings of reduced physical activity when people are socially isolated (Robbins *et al.*, 2018; Werneck *et al.*, 2019, as cited in Ingram *et al.*, 2020). Nonetheless, existing research on the effects of stress on physical exercise presented inconsistent findings. This study's result was in line with a statement by Düz & Tuba Aytekeli (2020), in which DEBQ subscales and MET scores had no significant association.

Ingram *et al.* (2020) concluded that relaxing lockdown restrictions result in a rapid boost of positive mood. Here, no more alterations were shown after, as this might be due to the minor differences in lockdown regulations that occurred during the period. The participants were likely to have accommodated to the lockdown situation. Thus, stress due to the COVID-19 lockdown might not be a factor for poor sleep quality and lower physical activity. As a result, a link between eating behaviour, sleep quality, and physical activity was not found.

The strengths of this study would be the sufficient sample of young adult population, which provided a good influence to perform analyses. Besides, this study was also conducted to find the correlation between different variables that could assist in comprehending the existing links and further present us with the realistic situation in today's world. Not to mention, the proportion of participants from urban and rural areas was quite balanced, with minor differences in percentages, which conveyed the generalisation of the study population in Malaysia.

Nevertheless, this study had a couple of limitations to note. Firstly, response bias might have occurred since the survey was self-reported. Participants might have underreported or overreported the data based on their ability to recall. Moreover, the survey form might need to be clearer from the participant's point of view in terms of the instructions given or the format style set for the questions. Next, a longitudinal study would have provided better and more accurate insights than a cross-sectional study to determine the impact of MCO during COVID-19 on the changes in participants' lifestyles. Furthermore, as the study results were more inclined towards female participants, the sample may not be representative. Finally, since the study was conducted during the second half of 2021, whereby most college students had already adjusted to the new norms, the factors affecting participants' lifestyles might have lessen compared to the first half of 2020, when MCO had just started.

CONCLUSION

College students in Malaysia had poor sleep quality during the COVID-19 lockdown. Although there were no correlations between emotional eating with sleep quality and physical activity, findings are still at initial stages since only a few studies have been conducted to assess the relationship between emotional eating using DEBQ scores with PSQI and IPAQ-SF scores. In essence, early screening of college students' lifestyles should be initiated in Malaysia. This is to promote and sustain a healthy lifestyle among college students. Further investigations can help counter the core predictors of eating behaviour, sleep quality, and physical activity during and beyond COVID-19.

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Conflict of interest

The authors declare no conflict of interest in this study.

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Association between dietary diversity and complications during pregnancy in a South-West District of Bangladesh

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ABSTRACT

Introduction: Poor dietary diversity is one of the key factors that increases the rate of complications during pregnancy. Pregnancy complications significantly increase the risk of maternal mortality. The aim of this study was to explore the associated factors between dietary diversity and complications during pregnancy. **Method:** A cross-sectional study was conducted among 450 randomly selected pregnant women. Individual dietary diversity score (IDDS) was used to assess dietary diversity based on Food Frequency Questionnaire (FFQ). IDDS was derived from 24-hour recalls from nine food groups. **Results:** Most of the pregnant women (48.9%) included in this study were in their second trimester; 19.3% and 31.8% were in first trimester and third trimester, respectively. About 83.8% of respondents included in this study experienced pregnancy complications. According to IDDS, most participants (77.1%) consumed a medium-diversified diet. Only 4.4% and 18.4% of pregnant women had low and highly diversified dietary intakes, respectively. Mean IDDS was 5.62±0.93, which indicated medium diversity of dietary intake. Dietary diversity had a statistically significant correlation with age (p=0.003), monthly income (p=0.003), education level (p=0.001), and respondent's employment (p=0.004). The study exposed that pregnancy complications had a negative correlation with food diversity (r=-0.223), marriage age (r=-0.066), and education level (r=-0.163). **Conclusion:** The study concluded that pregnancy complications can be alleviated by improving dietary diversity practices during pregnancy.

Keywords: dietary diversity, maternal mortality, pregnancy complications

INTRODUCTION

Every year, over thirty thousand pregnant women die and 9.5 million women around the world suffer complications during and after pregnancy, resulting in serious socioeconomic difficulties (Hogan *et al.*, 2010; Islam & Sultana, 2019). The rate of pregnancy complications is increasing day by day all over the world because of poor dietary diversity (DD), nutritional and lifestyle practices, marriage age, number of meals consumed, occupation, and women's education (Nana & Zema, 2018; Gao *et al.*, 2013). In low- and middle-income countries, nutritional deficiencies are still a significant threat to public health, particularly for pregnant women (Desta *et al.*, 2019). The health problems that arise during pregnancy are to blame for almost two-thirds of maternal deaths (Say *et al.*, 2014).

Anaemia, hepatitis B, haemorrhage, preeclampsia, constipation, heart

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problems, liver disease, excessive vomiting, and visual impairment are considered common health problems among women during pregnancy (Gomes *et al.*, 2018). Moreover, palpitation, high fever, and pregnancy-related gestational diabetes are also concerns (Mahabub *et al.*, 2009). Pregnancy complications significantly raise the chances of maternal mortality and other long-lasting health problems (Gernand *et al.*, 2016).

Pregnancy is an important stage of a woman's life cycle. Proper DD during pregnancy is significant for both the mother and the foetus (Ding *et al.*, 2021). Maternal diet serves as a nutrient source for the rapid growth of the foetus and mother's health (Ahmed *et al.*, 2019). Women's nutritional needs are increased during pregnancy because of the increased demands placed on the mother and her growing foetus (Marangoni *et al.*, 2016). A humdrum diet impedes the availability of numerous nutrients, resulting in malnutrition and micronutrient deficiencies (Allen, 2008). During pregnancy, adequate DD increases the availability of macro- and micronutrients that improves the health status of women.

At both the individual and household levels, DD can be evaluated. Household dietary diversity (HDD) is a substitute indicator of access to food in the home. On the other hand, individual dietary diversity (IDD) reflects the diet's sufficiency for nutrients (Kennedy *et al.*, 2013). In comparison to other developing nations, Bangladesh has a higher rate of undernutrition among pregnant women because of their food group choice behaviours or lack of proper knowledge about dietary intake (Osmani & Sen, 2003; Kundu *et al.*, 2021). Low financial stability indexes, a lack of schooling, and unemployment are the main factors that cause lower DD in Bangladesh (Kundu *et al.*, 2021). Pregnancy complications are the main reason for 99% of maternal deaths in developing or low-income nations (Hossain *et al.*, 2014). In developing nations, women who live in rural areas have higher rates of maternal mortality than in urban areas (Castillo *et al.*, 2017). According to a study, 194 maternal deaths occur for every 10,000 pregnant women in Bangladesh (Hossain *et al.*, 2014).

The leading reasons for maternal deaths in Bangladesh are pregnancy haemorrhage (29%), eclampsia (24%), obstructed labour (10%), and abortion (5%) (Mayén *et al.*, 2014). Pregnancy complications and maternal mortality rates can be minimised by DD, improvement of women's socioeconomic status, increased birth space, and increased education level among women (Mahabub *et al.*, 2019). According to studies, there has been little change worldwide in the past 30 years in the mortality rate of pregnant women due to inadequate diet or malnutrition during pregnancy (Smith *et al.*, 2017). By addressing information and reducing adherence obstacles, the condition of pregnant women's food diversity would need to be responsibly enhanced. However, Bangladesh does not currently have any research in the relevant field.

Eating disorders and inadequate dietary habits are common during the pregnancy period. Several research findings that have looked at how eating disorders or poor DD affected pregnancy complications and neonatal outcomes have reported pregnancy complications or deaths (Stewart *et al.*, 2017). Waugh & Bulik (2019) conducted interviews with ten pregnant women who were currently or in the past had eating disorders, as well as ten comparison women and their offsprings. Their results found that babies born to eating-disordered mothers had considerably lower birth weights and lengths than babies born to comparison women. Proper DD and maternal nutrition can indeed provide greater benefits to minimise pregnancy complications

and maternal mortality rate (MMR) (Lee *et al.*, 2013). It is important to concentrate on the risk variables for pregnancy complications and reducing MMR to 70 for every 10,000 pregnant women, in fulfilment of the Sustainable Development Goals (SDGs) (Hossain *et al.*, 2023).

Understanding the factors that contribute to pregnancy complications and related deaths in Bangladesh is therefore essential for reducing maternal mortality rate. The health of the mother and her newborn are closely related; proper DD may reduce pregnancy complications and result in lower maternal and neonatal mortality rates. Unfortunately, there has been little research on DD and its associated complications during pregnancy in Bangladesh. So, it is important to concentrate in this area of work so that a plan can be created to lower maternal and child mortality in order to meet the SDGs. Therefore, the main goal of the study was to explore DD and the complications associated with pregnancy in the Jashore district of Bangladesh.

MATERIALS AND METHODS

Study design and setting

A community-based cross-sectional study was designed to determine the association between DD and the complications among pregnant women in Jashore district, Bangladesh. The study was conducted among pregnant women from October 2022 to January 2023. A convenient random sampling method was applied to collect data from pregnant women. Data were collected from pregnant women through direct face-to-face interviews. Relevant data were gathered from community clinics and other health facility disciplines in the Jashore district where pregnant women attended and were being treated during pregnancy. Data were collected only from pregnant women who were willing to be part of the study. Both urban and rural participants were included in this study. Pregnant women and those who were capable of communicating easily were the main target respondents for the study.

Questionnaire development and explanatory variables

The research team performed direct face-to-face interviews during pre-testing of the questionnaire to verify the flow of the questions, its accuracy, skip trends, add/drop some questions or answer options. The field research observation was shared among members of the team and the valued supervisor to significantly adapt the questionnaire. The questionnaire was divided into three parts: I) socio-demographics information, II) DD, and III) pregnancy complications. A paper-based, pre-tested questionnaire was used and the socio-demographic variables taken into account were: respondent's residence (rural, urban, and slum), age in years (≤20, 21-30, 31-40, and ≥41), frequency of pregnancy (1, 2-3, and >3), trimester (first, second, and third), family members (≤3, 4-5, and ≥6), monthly income (BDT<10000, 10001-20000, and >20000; 1 US dollar = 99.0482 BDT)(October 3, 2022), pregnant women's education level (illiterate, secondary, higher secondary, and above higher secondary), pregnant women's husband's education level (illiterate, secondary, higher secondary, and above higher secondary), respondent's employment (housewife, non-government job, government job, business), family earning number (1, 2, and ≥3), marriage age in years (<20, 20-30, and >30), pregnancy complications (yes and no). DD included nine major food groups. Different types of pregnancy complications experienced by the women during their pregnancy were considered, namely anaemia (iron deficiency anaemia), hepatitis B, heart disease, breathing problem, liver problem, oedema, excessive vomiting (hyperemesis gravidarum), palpitation,

abdominal pain, visual impairment, haemorrhage, preeclampsia, constipation, and gestational diabetes (gestational diabetes mellitus) (Hossain *et al.*, 2023). The accuracy of the data was verified against their medical cards or family members prior to data collection.

Sample size

The study population consisted of pregnant women. A community-based, cross-sectional study was designed among selected pregnant women. Due to the inadequate number of studies on this subject, the sample size was determined using a 95% response rate, a 95% confidence level, and a 5% margin of error. Based on this, 500 pregnant women were initially chosen for interviews from a list of pregnant women at a nearby community clinic. However, some of them who opted to participate in the study provided no information. Consequently, a total of 450 pregnant women were chosen in this study after those without information were removed. Face-to-face interviews were conducted in order to obtain accurate information from the Jashore district's rural and urban areas.

Data collection procedures and quality control

A self-designed, paper-based affirmed questionnaire was applied to gather data from pregnant women. The questionnaire was divided into three sections: socio-demographic variables, DD, and pregnancy complications. Participant's consent was asked before conducting the interview. All interviewers who were selected for data collection were students from the Nutrition and Food Technology department. All interviewers had past experience collecting data from public health surveys. Interviewers attended a training session before recruiting data (technique, consideration, tools, and data collection).

A pre-selected interview schedule was given to every pregnant woman. The time allotted for responses to each question was sufficient for the respondents. Initial versions of the paper-based survey questionnaire were written in English. In the prior interview, all questions were translated into the participant's native language (Bengali) to reduce bias and misconstrued interpretations. The interviewer assured respondents that the data collected were only used for this study and that their contact location or name would not be revealed publicly. An opportunity was given to the respondents to ask any questions regarding this study and they could leave or stop the interview at any moment they wished. The sample size for the pre-tested questionnaire was 40 pregnant women. After each day's field work, the completed questionnaires were double-checked. If any mistakes were found, the data were then corrected.

Pregnant women 24-hour individual dietary diversity score (IDDS) measurement

Using a paper-based, structured questionnaire, pregnant women were questioned individually about their eating habits or DD for the last 24 hours. Nine main food groups were examined, namely cereals, eggs, dairy, meat or fish, dark green vegetables, pulses or nuts, vitamin-A-rich fruits, organ meat, and other fruits and vegetables (Ahmed *et al*,.2019; Kennedy *et al.*, 2013). Every food group conferred 1 (one) point. IDDS was determined using the respondents' total responses to different dietary groups available for consumption in the last 24 hours. Individual pregnant woman could output a maximum of 9 (nine) points if they reportedly ate all food groups within the reference time. Dietary intake from <4 food groups was considered a low dietary diversity score. On the other hand, 4-6 food groups intake and >6 food groups intake were

considered moderate and high dietary diversity scores, respectively (Ahmed *et al.*, 2019; Kundu *et al.*, 2021).

Ethical approval and consent to participate

The Ethical Review Committee, Faculty of Biological Science and Technology, Jashore University of Science and Technology, Jashore-7408, Bangladesh provided the ethical approval to conduct this study. The study participants were reassured by the researchers that their names would not be recorded or mentioned in this study. Written informed consent from each participant was obtained before data collection by explaining the purpose and methods of the study, as well as the risks and benefits of participation in the study.

Data entry and analysis

Data from the final checked questionnaire were entered into IBM SPSS Statistics for Windows version 25.0 software (IBM Corp., Armonk, NY, USA), and data entry was carefully done to avoid errors. To explore the relationship across potential associated factors with socio-demographic information, DD, and pregnancy complications, frequency, percentage, mean, median, standard deviation, frequency distribution, Chi-square test, Pearson linear correlation, and Spearman's correlation were used. The confidence interval level was 95% and statistical significance was set at p-value <0.05.

RESULTS

Table 1 describes the socio-demographic characteristics of pregnant women in the study. A total of 450 pregnant women were included in this study. Results showed that 45.6% (n=205) and 46.7% (n=210) pregnant women were from rural and urban areas, respectively. Only 7.8% (n=35) pregnant women were found to live in the slum. Most of the pregnant women (48.2%, n=217) were in the 21–30 years age group. Only 30.4% (n=137) of pregnant women reported being pregnant for the first time. It was found that most of the respondents (48.9%, n=220) were in their second trimester; 19.3% (n=87) and 31.8% (n=143) were found to be in their first and third trimesters, respectively. Only 29.1% (n=131) of respondents were found to live in a joint family with more than six family members. Most of the respondents (40.4%, n=182) reported having a monthly family income greater than 20,000 taka. It was found that most of the pregnant women (42.4%, n=191) and their husbands (36.6%, n=166) were illiterate. Only 17.9% (n=80) pregnant women had a higher secondary education level. More than half of the pregnant women were found to be housewives (65.1%, n=293). The other respondents were from other occupations such as non-government job (3.8%, n=17), government job (25.6%, n=115), and business (5.5%, n=25). More than half of the respondents (56.7%, n=255) were found to have two earning members in their families. It was found that about 42.9% (n=193) of respondents married during their adolescent period and about 48.4% (n=218) got married when they were between 20 and 30 years old. Only 8.7% (n=39) pregnant women were found to be married at the age of above 30 years. It was also found that most of the pregnant women (83.8%, n=377) experienced complications during their pregnancy. Only 16.2% (n=73) of respondents were found to have had no complications during pregnancy.

Figure 1 depicts that the mean IDDS value obtained by all respondents was 5.62±0.93, indicating a medium-diversity diet in terms of DD. The median, or 50th percentile, of IDDS was 6. The median value indicated that about half of the pregnant women consumed food from six or fewer food groups. Among the nine different food groups, it was found that the maximum and minimum number of food groups taken by any

Table 1. Socio-demographic characteristics of pregnant women in the Jashore district

Characteristics	*Frequency (n)*	*Percentage (%)*
Living area		
Rural	205	45.6
Urban	210	46.7
Slum	35	7.8
Age of respondent (years)		
≤20	105	23.3
21-30	217	48.2
31-40	96	21.3
≥41	32	7.1
Frequency of pregnancy		
1	137	30.4
2-3	186	41.3
>3	127	28.3
Trimester		
First	87	19.3
Second	220	48.9
Third	143	31.8
Family members		
≤3	96	21.3
4-5	223	49.6
≥6	131	29.1
Monthly family income (BDT)		
<10000	112	24.9
10001-20000	156	34.7
>20000	182	40.4
Education level (Respondent)		
Illiterate	191	42.4
Secondary	92	20.4
Higher secondary	87	19.3
Above higher secondary	80	17.9
Education level (Respondent's husband)		
Illiterate	166	36.9
Secondary	102	22.7
Higher secondary	52	11.7
Above higher secondary	130	28.9
Respondent's employment		
Housewife	293	65.1
Non-government job	17	3.8
Government job	115	25.6
Business	25	5.5
Number of family members with income		
1	137	30.4
2	255	56.7
≥3	58	12.9
Marriage age (years)		
<20	193	42.9
20-30	218	48.4
>30	39	8.7
Pregnancy complications		
Yes	377	83.8
No	73	16.2

BDT= Bangladeshi Taka; USD 1 = BDT 99.0482 (October 3, 2022)

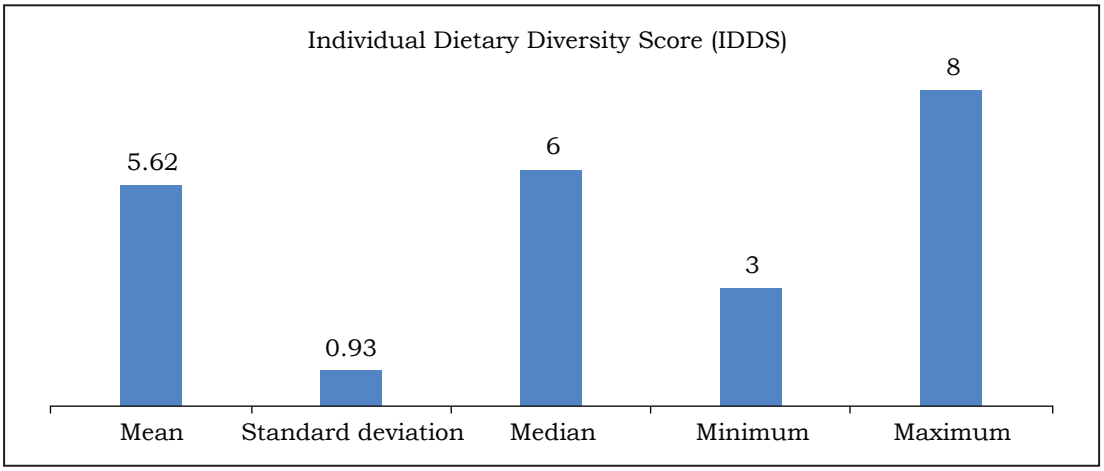

Figure 1. Mean, standard deviation, median, minimum, and maximum Individual Dietary Diversity Score (IDDS) values of pregnant women

individual pregnant woman were 8 and 3, respectively. The results showed that most of the pregnant women (77.1%, *n*=347) had a medium-diversity dietary intake, indicating that they consumed from four to six diverse food groups. In contrast, only 4.4% (*n*=20) of pregnant women had low-diversity dietary intake as they consumed from less than four different food groups. On the other hand, about 18.4% (*n*=83) of respondents consumed food from more than six different food groups, which was referred to as high-diversity dietary intake.

Table 2 shows the effect of socio-demographic characteristics on the DD of pregnant women (*N*=450). It was revealed that respondents living in rural (82.9%, *n*=170), urban (76.7%, *n*=166), and slum (45.7%, *n*=16) areas mostly consumed a medium-diverse diet. The age of the respondent was found to be associated with DD (p=0.003). Pregnant women of different age groups were found to consume a moderately diverse diet. The percentages of pregnant women who consumed a moderately diverse diet were 73.3% (*n*=77), 82.5% (*n*=179), 67.7% (*n*=65), and 81.25% (*n*=26) for age groups ≤20 years, 21–30 years, 31–40 years, and ≥41 years, respectively. Majority of pregnant women (78.1%, *n*=107) were found to consume a medium-diversified diet during their first pregnancy. On the other hand, 72.6% (*n*=135) and 83.5% (*n*=106) of pregnant women were found to consume diets with medium DD. It was found that respondents from different trimesters had mostly taken a medium-diverse diet. The percentages of pregnant women who consumed a moderately diverse diet in their first, second, and third trimesters were 67.8% (*n*=59), 77.3% (*n*=170), and 82.5% (*n*=118), respectively. There was no association between the number of family members among the respondents and DD. All the respondents, irrespective of their family members, consumed a moderately diverse diet. However, monthly family income, education level, and employment status of respondents were found to be associated with DD (p<0.05). Accordingly, 76.8% (*n*=86), 76.3% (*n*=119), and 78.1% (*n*=142) of pregnant women with monthly family income of <10,000 taka, 10,001-20,000 taka, and >20,000 taka were found to consume a diet with medium diversity. It was found that pregnant

Table 2. Effect of socio-demographic characteristics on dietary diversity of pregnant women

Characteristics	*Number of pregnant women n (%)*			*p-value*	*Mean±SD*
	Low (<4 food groups)	*Medium (4 to 6 food groups)*	*High (> 6 food groups)*		
Living area				0.521	
Rural	8 (3.9)	170 (82.9)	27 (13.2)		68.33±10.13
Urban	0 (0.0)	161 (76.7)	49 (23.3)		70.34±9.64
Slum	12 (34.3)	16 (45.7)	7 (20.0)		69.51±12.21
Age of respondent (years)				0.003***	
≤20	8 (7.6)	77 (73.3)	20 (19.1)		70.62±9.43
21-30	2 (0.9)	179 (82.5)	36 (16.6)		71.19±11.72
31-40	9 (9.37)	65 (67.7)	22 (22.9)		68.82±13.11
≥41	1 (3.1)	26 (81.25)	5 (15.6)		70.96±8.37
Frequency of pregnancy				0.679	
1	7 (5.1)	107 (78.1)	23(16.8)		69.55±12.10
2-3	8 (12.4)	135 (72.6)	43 (23.1)		68.43±10.09
>3	5 (3.9)	106 (83.5)	17 (13.4)		70.56±8.13
Trimester				0.872	
First	7 (8.1)	59 (67.8)	21 (24.1)		74.18±7.56
Second	11 (5)	170 (77.3)	39 (17.7)		73.51±6.12
Third	2 (1.4)	118 (82.5)	23 (16.1)		72.34±8.78
Family members				0.470	
≤3	0 (0.0)	55 (57.3)	41 (42.7)		71.10±9.72
4-5	6 (2.7)	195 (87.5)	22 (9.8)		78.16±12.89
≥6	14 (10.7)	97 (74.1)	20(15.2)		76.50±11.3
Monthly family income (BDT)				0.003***	
<10000	13 (11.6)	86 (76.8)	13 (11.6)		76.52±11.32
10001-20000	6 (3.8)	119 (76.3)	31 (19.9)		65.13±9.71
>20000	1 (0.5)	142 (78.1)	39 (21.4)		71.50±11.32
Education level (Respondent)				0.001***	
Illiterate	13 (6.8)	171 (89.5)	7 (3.7)		69.87±70.80
Secondary	5 (5.4)	69 (75.0)	18 (19.6)		68.56±13.37
Higher secondary	2 (2.3)	63(72.4)	22 (25.3)		73.20±13.72
Above higher secondary	0 (0.0)	44 (55.0)	36 (45.0)		70.10±11.94
Respondent's employment				0.004***	
Housewife	14 (4.8)	268 (91.5)	11 (3.8)		81.67±12.73
Non-government job	4 (23.5)	5 (29.4)	8 (47.1)		73.30±9.12
Government job	0 (0.0)	61 (53.1)	54 (46.9)		70.12±13.78
Business	2 (8.0)	13 (52.0)	10 (40.0)		66.35±9.07
Number of family members with income				0.872	
1	12 (8.8)	112 (81.8)	13 (9.4)		71.50±7.90
2	6 (2.5)	219 (85.9)	30 (11.7)		66.83±9.97
≥3	2 (3.4)	16 (27.6)	40 (69.0)		68.66±11.32
Marriage age (years)				0.921	
<20	13(6.7)	148 (76.7)	32 (16.6)		65.59±10.01
20-30	5 (2.3)	163 (74.8)	50 (22.9)		70.52±9.71
>30	2 (5.1)	36 (92.3)	1(2.6)		71.62±13.13
Have any pregnancy complications				0.734	
Yes	18 (4.8)	336 (89.1)	23 (6.1)		79.68±13.11
No	2 (2.7)	11 (15.1)	60 (82.2)		76.42±11.94

Chi-square test was used to measure *p*-value; $p<0.05$ is statistically significant
***indicates 1% significance level ($p<0.01$)

women with different education levels mostly consumed a medium-diversified diet. Most of the respondents who were housewives (91.5%, *n*=268) reported consuming a moderately diversified diet. Respondents working in non-government jobs (47.1%, *n*=8) were found to consume a highly diversified diet. On the other hand, pregnant women with government jobs (53.1%, *n*=61) and pregnant women with business (52%, *n*=13) were found to consume a diet with medium diversity. This study found that 81.8% (*n*=112) and 85.9% (*n*=219) of pregnant women who consumed a moderately diverse diet had only one or two earning members in their families, respectively. However, about 69% (*n*=40) of respondents were found to have high DD and had three earning members in their families. It was found that there was no association between the age of marriage and DD. Most of the respondents had medium dietary diversity. The percentages of medium DD were 76.7% (*n*=148), 74.8% (*n*=163), and 92.3% (*n*=36) for respondents who married at the ages of less than 20 years, 20–30 years, and above 30 years, respectively. Most of the pregnant women who answered affirmatively about complications during pregnancy were found to have medium DD. On the other hand, it was found that 82.2% (*n*=60) of pregnant women had high DD and reported that they had no complications during pregnancy.

Table 3 displays the complications during pregnancy suffered by pregnant women in the first, second, and third trimesters of their pregnancy. Mean values of pregnancy complications among pregnant women were distributed according to low, medium, and high IDDS. Mean value for prevalence of anaemia among pregnant women was higher in the low DD group than in the medium and high DD groups. Heart disease and liver disease were more prevalent in low-DD pregnant women than in the medium- and high-DD groups. Consequently, pregnant women in the lower DD group had higher rates of constipation, preeclampsia, oedema, haemorrhage, visual impairment, and palpitation compared to the higher DD and medium DD groups. Interestingly, in this study, no respondents had gestational diabetes, though they were from low-DD group. Overall, the mean values of pregnancy complications among pregnant women were higher in the low-DD group than in the medium- and high-DD groups.

The links between food diversity score, various socio-demographic factors, and pregnancy complications are shown in Table 4. Pregnant women's food diversity was found to be positively correlated with education level (r=0.275^{b**}), family members (r=0.218^{b**}), and number of pregnancy (r=0.030^{b}). Food diversity exhibited a negative correlation with respondent's occupation (r=-0.182^{b*}). Pregnancy complications exhibited a negative relationship with food diversity (r=-0.223^{a**}), marriage age (r=-0.066^{b}), and education level (r=-0.163^{b*}). Pregnant women's occupation had a positive and significant (r=.001^{a*}) correlation with pregnancy complications, whereas the number of pregnancy had no relationship with complications during pregnancy. However, food diversity was negatively connected with pregnancy complications, so it is reasonable to assume that increasing food diversity among pregnant women will decrease pregnancy complications.

DISCUSSION

A balanced diet plan should adhere to the dietary recommendations for eating a wide range of foods to obtain vitamins, minerals, carbohydrates, protein, and fat from multiple sources. A variety of cereals, nuts, whole grains, dark green leafy vegetables, organ meats

Table 3. Relationship between pregnancy complications and dietary diversity of pregnant women

Complication	*Dietary diversity*	*Number of participants*	*Mean±SD*	*p-value*
Anaemia	Low	11	0.98±0.13	0.062
	Medium	106	0.76±0.12	
	High	3	0.58±0.21	
Hepatitis B	Low	9	0.73±0.10	0.182
	Medium	66	0.70±0.08	
	High	4	0.62±0.21	
Heart disease	Low	3	0.78±0.11	0.056
	Medium	45	0.67±0.20	
	High	7	0.49±0.10	
Breathing problem	Low	5	0.87±0.13	0.070
	Medium	41	0.78±0.17	
	High	3	0.65±0.13	
Liver disease	Low	0	0.00±0.00	0.213
	Medium	30	0.78±0.23	
	High	8	0.70±0.25	
Oedema	Low	9	0.78±0.17	0.319
	Medium	123	0.74±0.16	
	High	15	0.70±0.23	
Excessive vomiting	Low	7	0.85±0.35	0.227
	Medium	191	0.79±0.27	
	High	15	0.71±0.26	
Palpitation	Low	5	0.73±0.16	0.720
	Medium	61	0.72±0.10	
	High	21	0.61±0.18	
Lower abdominal pain	Low	13	0.78±0.21	0.328
	Medium	72	0.74±0.25	
	High	22	0.59±0.19	
Visual impairment	Low	6	1.69±0.52	0.082
	Medium	50	1.35±0.61	
	High	17	1.10±0.55	
Haemorrhage	Low	3	0.70±0.18	0.057
	Medium	39	0.61±0.11	
	High	15	0.51±0.12	
Preeclampsia	Low	8	0.71±0.24	0.612
	Medium	24	0.66±0.30	
	High	7	0.50±0.29	
Constipation	Low	11	0.69±0.10	0.054
	Medium	120	0.58±0.14	
	High	29	0.49±0.10	
Gestational diabetes	Low	0	0.00±0.00	0.328
	Medium	64	0.95±0.29	
	High	17	0.59±0.19	

Frequency distribution analysis was used to measure p-value; $p<0.05$ is statistically significant

Table 4. Associations between demographic factors with food diversity score and pregnancy complications

Variables	*Age*	*Occupation*	*EL*	*NP*	*FM*	*MA*	*FD*	*PC*
Age	1[b]							
Occupation	-0.149[b*]	1[b]						
EL	-0.072[b]	-0.274[b**]	1[b]					
NP	0.654[b**]	-0.096[b]	-0.057[b]	1[b]				
FM	-0.033[b]	-0.017[b]	-0.089[b]	0.030[b]	1[b]			
MA	0.029[b]	-0.129[b]	-0.019[b]	0.010[b]	0.031[b]	1[b]		
FD	0.038[b]	-0.182[b*]	0.275[b**]	0.030[b]	0.218[b**]	0.021[b]	1[a]	
PC	-0.063[b*]	0.001[a*]	-0.163[b*]	0.000[b]	0.023[b]	-0.066[b]	-0.223[a**]	1[a]

EL: Education level; NP: Number of pregnancy; FM: Family member; MA: Marriage Age; FD: Food diversity; PC: Pregnancy complication

[a]Pearson linear correlation; [b]Spearman's correlation; significant at $p<0.05$ (2-tailed), significant at $p<0.01$ (2-tailed)

or fish, dairy or dairy products, and their substitutes have been found to be strongly linked to a reduced risk among all causes of death and significantly improve health conditions (Sharma *et al.*, 2021). The findings of this study demonstrated that during pregnancy, most pregnant women failed to maintain their DD guidelines. This study's results showed that only 18.4% of the total respondents consumed more than six food groups (> 6), which revealed that they practised high IDD and this percentage was very low. On the other hand, about 81.5% of the total pregnant women in this study did not receive adequate DD. This prevalence is similar to another local study in Bangladesh (Nguyen *et al.*, 2017), but higher than a study in Ethiopia (74.6%) (Desta *et al.*, 2019). Different DD could be attributed to these findings. All of the respondents in this study consumed cereals (whole grains, starchy foods, etc.). On the other hand, participants consumed fewer eggs (54.9%), dairy and dairy products (65.6%), meat or fish (63.1%), nuts and seeds (32%), and fruits and vegetables (60%) in the previous 24 hours. The findings of this study were almost the same as previous findings in Bangladesh (Nguyen *et al.*, 2017) and Tanzania (Desta *et al.*, 2019). This could be reasons for society's culture, lifestyle, low level of animal product access to families, or low family income to afford animal products. These findings suggest that pregnant women who ate fewer animal products (meat, poultry, lean meat, and dairy products) may experience greater pregnancy complications. Therefore, avoiding animal products may result in lower IDD scores, which increases the risk of pregnancy complications in women. Moreover, pregnancy complications are not only associated with this; they are also influenced by many other factors. Women who have low IDDS during pregnancy tend to be exposed to more pregnancy complications during pregnancy than those who have high IDDS. A similar finding was found in Ethiopia (Delil *et al.*, 2018). This could be because the pregnancy period serves as the most essential DD demanding period in a mother's life. Therefore, women are highly recommended for dietary diversification to meet their nutritional requirements during the pregnancy period.

The education level of pregnant women is the single most important determinant of sufficient IDD. It was found that, in comparison to the level

of education, increasing educational status was strongly associated with adequate DD. This finding is consistent with a similar study in Bangladesh (Islam & Sultana, 2019; Hossain *et al.*, 2023). The reason for this could be that pregnant mothers with higher level of education are more likely to obtain knowledge about individual dietary needs and can easily comprehend educational messages spread through various media. For this reason, it is anticipated that the proportion of pregnant women consuming an adequate variety of foods will increase as education levels rise (Mayén *et al.*, 2021). According to this study, the likelihood of consuming a sufficient variety of dietary items increased along with increased household income. Pregnant women with higher incomes per month tend to have higher IDD compared to low-income pregnant women or the jobless. This could be explained by the fact that pregnant women with relatively high monthly incomes have more buying power and may be capable of paying for a variety of foods as compared to lower-income pregnant women. A similar result was found in another study in Bangladesh (Hossain *et al.*, 2023).

This research resembled a study carried out in Kenya (Kiboi *et al.*, 2017). About half of the Bangladeshi women marry before they turn 18 years old (Islam & Sultana, 2019) and the prevalence of teenage pregnancies is rising as a result of early marriages. According to this study, pregnant women who gave birth at a young age (under 18 years) experienced more pregnancy-related difficulties. Additionally, women who were having their first child experienced more pregnancy complications. A similar report was found in another study in Bangladesh (Akhter *et al.*, 2015).

The food groups that participants had consumed over the previous 24 hours were used to determine the IDDS in this study. To investigate the caliber of pregnant women's diets, IDDS was used. The IDDS in this study was found to be 5.62±0.93, which indicated medium DD among respondents. A similar study was conducted in Bangladesh (Tiwari *et al.*, 2013) and the IDDS was found to be 4.02±1.28. In this study, the maximum level of IDDS among respondents was 8 and the minimum score was 3. A similar study conducted in Bangladesh found minimum and maximum IDDS of 4 and 7, respectively (Ahmed *et al.*, 2019).

The prevalence of complications during pregnancy among women is a serious public health issue. Pregnancy complications among pregnant women in the Jashore district were significantly correlated with women's education level, monthly income, occupation, prenatal health education, and IDD. Additionally, there is a need to increase dietary variety and raise awareness of its nutritional benefits, particularly with regard to pregnancy complications and pregnancy outcomes.

The prime strength of the study was the lack of literature regarding the association between DD and complications during pregnancy. However, due to pregnancy, some respondents were reluctant to give information about some questions. A representative sample of the population was also ensured due to the situation. A larger sample could have been included if funding was available during the study. The food consumption data were collected only once through recall method, which could have been improved if multiple recalls were executed in consecutive weeks.

CONCLUSION

This study demonstrated that a significant portion of pregnant women included in this study who suffered from various pregnancy complications

did not follow the necessary dietary recommendations. Additionally, the DD of pregnant women in the Jashore district was not satisfactory. In this study, it was found that pregnant women residing in the Jashore district mostly consumed a medium-diversified diet. The study also revealed that pregnant women with a low-diversified diet experienced various complications during pregnancy, such as higher prevalences of constipation, preeclampsia, oedema, haemorrhage, visual impairment, and palpitation than those who consumed a high- and medium-diversified diet. The findings of this study highlighted that food diversity, marriage age, and education level, were significantly correlated. Thus, the study concluded that the maintenance of an adequate, diversified diet can help reduce the risk of complications during pregnancy. However, emphasis should also be given to improve the education level of women. Data from this investigation will be used to create guidelines and policies that would make a significant contribution in ensuring pregnant women's DD and minimising pregnancy complications.

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Authors' contributions

Zaman S, conceptualised and designed the study, performed data analysis, wrote and reviewed the paper; Ahammed T, principal investigator, conceptualised and designed the study, analysed and interpreted the data, supervised the entire study, prepared the manuscript, reviewed and edited the paper; Bashar Ma, curated the data and drafted the manuscript.

Conflict of interest

No conflict of interest exists between the authors.

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Socio-demographic factors and parental feeding practices predicted body mass index of Malaysian children with learning disabilities

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ABSTRACT

Introduction: Overweight and obesity have emerged as significant global health concerns among children. Previous studies have provided evidence that children with intellectual and learning disabilities (LD) are at a higher risk of obesity compared to their peers without disabilities. **Methods:** This study aimed to predict body weight status of children with LD who attended Special Education Integration Program in Kelantan, located on East Coast of Peninsular Malaysia. Parents completed a self-administered questionnaire in Malay language, which included "Screening Tool of Feeding Problems" children's version (STEP-CHILD) and Comprehensive Feeding Practice Questionnaire (CFPQ). The children's body weight and height were measured to determine body mass index (BMI). Research hypothesis was tested through stepwise multiple linear regression analysis. **Results:** This study recruited 245 subjects with mean age of 10.5±1.7 years and mean BMI of 18.5±4.9 kg/m^2. Prevalence of underweight, thinness and severe thinness was 12.2%, while overweight and obesity was 29.0%. Male children with LD (β=0.109, p<0.044), older age (β=0.226, p<0.001), higher child birth weight (β=0.119, p<0.029), lack of parental modelling (β=-0.170, p=0.004), lower parental pressure (β=-0.266, p<0.001), and higher restriction for weight control (β=0.361, p<0.001) were found to predict higher BMI values. **Conclusion:** Positive parental feeding practices during mealtime are crucial for addressing the poor nutritional status of children with LD.

Keywords: BMI, children, learning disabilities, parental feeding practices

INTRODUCTION

According to the European Association for the Study of Obesity (EASO, 2023), overweight and obesity rank as the fifth leading cause of global deaths. The World Health Organization (WHO) estimated that nearly 18.4% of children and adolescents aged 5 to 19 years were overweight and 6.8% were obese worldwide in 2016, compared to 14.8% overweight and 4.9% obese in 2010. Meanwhile, the prevalence of thinness among this age group slightly decreased from 11.0% in 2010 to 10.5% in 2016. The increasing prevalence of overweight and obesity among children has become a significant global health concern, as it outpaces the rate of underweight children (WHO, 2021).

As anticipated, Malaysia has also witnessed an alarming upward trend in the prevalence of overweight and obesity

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among children and adolescents. The Global Nutritional Report (2022) stated that in 2019, the prevalence of overweight and obesity among Malaysian children and adolescents aged 5 to 19 years were 30.0% and 14.8%, respectively, compared to 26.8% and 12.9% in 2016. However, the prevalence of thinness decreased from 7.5% in 2016 to 7.1% in 2019. Additionally, the National Health & Morbidity Survey (NHMS) indicated a rise in the national prevalence of thinness and obesity among children aged 5 to 17 years, with thinness increasing from 7.8% in 2015 to 10.0% in 2019 and obesity rising from 11.9% in 2015 to 14.8% in 2019 (IPH, 2015; IPH, 2020). While several previous studies in Malaysia have examined unhealthy body weight status among typically developing children (Rahim, Chin & Sulaiman, 2019; Tay *et al.*, 2016), there is limited research conducted on children with learning disabilities (LD) in Malaysia (Chen *et al.*, 2015; Hashim *et al.,* 2017). This vulnerable group is struggling to get the right nutrition they need to avoid malnutrition and prevent infectious diseases.

The Malaysian Department of Social Welfare has defined LD as disorders in learning, cognition, and intelligence that deviate from an individual's chronological age. National surveys conducted in the United States, such as National Health and Nutrition Examination Survey (NHANES), covering the period from 2005 to 2012 have revealed that children and youth with intellectual and LD were 35.0% more likely to be obese compared to their peers without disabilities. Furthermore, data from the 2011 National Survey of Children's Health (NSCH), which was conducted in the United States and the District of Columbia targeting individuals aged 10 to 17 years indicated that children and youth with disabilities showed a 27.0% higher likelihood of experiencing obesity compared to those without disabilities (Bandini *et al.*, 2015).

Previous research findings consistently indicate that children with disabilities have a higher prevalence of underweight, overweight, and obesity compared to children without disabilities (Bandini *et al.*, 2015; Sayin & Ilik, 2017). Currently, there is a dearth of research dedicated to LD in Malaysia. A recent study, which had a limited scope, only included a small sample of children with LD in Kelantan and did not accurately represent the broader Malaysian population. The study reported a prevalence of 22.5% for underweight and 22.1% for overweight/obesity among the participants (Chen *et al.*, 2015). Despite extensive prior research conducted in various countries and among different disability groups, there remains a significant knowledge gap regarding the prevalence of different body weight status among children with disabilities in Malaysia.

Previous research has indicated that several factors contribute to unhealthy body weight status among children and adolescents with LD. These factors include age, gender, socioeconomic status, feeding difficulties, high consumption of energy-dense foods, co-morbidities, genetic disorders, and parental feeding practices (Chen *et al.,* 2015; Wang *et al.*, 2018; Eow *et al.*, 2021). Parents play a critical role in determining a child's nutritional status, as they are the ones responsible for choosing foods that can influence the child's taste preferences, eating habits, dietary intake, and eventual weight status. Families with disabled children face additional financial costs and often encounter financial difficulties due to the need for specialised healthcare, medications, specific foods, and disability-specific aids. The financial

burden can influence food choices, leading to a range of nutrition-related disorders and diseases. Additionally, unhealthy body weight status among this vulnerable group imposes an extra burden on family healthcare costs (Pushpalatha, 2020). Hence, it is crucial to investigate potential factors, such as parental factors, that may contribute to unhealthy weight status in children and subsequently lead to adverse health consequences, particularly non-communicable diseases.

The objective of this study was to explore the predictive factors associated with body weight status among children with LD. This vulnerable group often has limited knowledge and understanding to make informed dietary choices. Additionally, they encounter difficulties in feeding themselves and frequently experience unmet healthcare needs in terms of dietary services (Tan, 2015).

MATERIALS AND METHODS

Study design and data collection

This cross-sectional study was conducted in primary schools located in different districts with varying socioeconomic statuses in Kelantan. Stratified random sampling was employed to ensure representation from urban and rural areas. The minimum sample size was calculated using Daniel's (1999) single proportion formula. Consequently, nine primary schools with the Special Education Integration Program (SEIP) were randomly chosen. The study protocol received ethical approval from the Human Research Ethics Committee USM (Reference no. USM/JEPeM/19110827). In addition, approval was also obtained from the Ministry of Education and the State Department of Education. The researchers obtained approval from school principals and communicated the dates of data collection. Subsequently, class teachers assisted in distributing the invitation letters to parents or primary caregivers for their attendance during the data collection sessions.

All parents/caregivers and their children with LD between the ages of 7 and 14 years from the selected schools were invited to participate in the study. The inclusion criteria consisted of children with LD who were attending the Special Education Integration Program (SEIP), regardless of the aetiology of their disability, and who were capable of standing straight and still during anthropometric measurements without assistance. Additionally, parents/caregivers needed to be willing to participate. The exclusion criteria were children with LD who were following a special diet for medical reasons, as well as those with oedema or physical deformities in their limbs and spine that could interfere with anthropometric measurements. Prior to administering the questionnaire, written informed consent was obtained from parents/caregivers. Every respondent received an honorarium for their participation.

Children with LD underwent measurements of body weight and height, while their parents/caregivers were required to complete a set of questionnaires. Data collection took place between the years 2020 and 2021, during the Movement Control Order (MCO) period implemented due to the COVID-19 pandemic. To ensure adherence to the standard operating procedures published by the National Security Council and the School Management and Operations New Norm Guidelines 2.0 by the Ministry of Education Malaysia at that time, adjustments were made to the data collection procedure. Researchers briefed parents on the research objectives and provided them with the necessary instruments. The research instruments had undergone pre-testing for reliability and validity at a community-based rehabilitation centre in Kelantan prior

to data collection. Parents completed the self-administered questionnaire at home and returned it to the school the following day, minimising face-to-face interaction. Researchers then thoroughly reviewed the completed questionnaires, seeking clarification from participants when necessary. The response rate was 82.8%, resulting in 245 participants who successfully completed the study and were included in the final data analysis.

Measurements

Demographic and socioeconomic background

Parents of children with LD were asked to self-report their education level, monthly household income, and household size. The monthly household income in Kelantan was categorised according to the survey report by Department of Statistics Malaysia (2020). Additionally, parents provided information about the child, including their date of birth, gender, ethnicity, birth weight, gestational age at delivery, and any co-morbidities the child may have.

Feeding problems

Feeding problems were evaluated using the "Screening Tool of Feeding Problems" children's version (STEP-CHILD) (Tareq *et al.*, 2019; Seiverling, Hendy & Williams, 2011). STEP-CHILD was employed to assess the occurrence of feeding problems among disabled children, consisting of 15 items with six subscales: chewing problems, rapid eating, food refusal, food selectivity, vomiting, and stealing food. Participants rated the frequency on a 3-point Likert scale: "0" indicated no occurrence of the behaviour, "1" denoted the behaviour occurring between 1 and 10 times per month, and "2" represented the behaviour happening more than ten times per month. The total feeding problem score was determined by summing the responses from the 15 items, with scores ranging from 0 to 30. A higher score indicated more severe feeding problems (Tareq *et al.*, 2019). The study's internal consistency reliability was found to be good, with a Cronbach's alpha coefficient of 0.850.

Parental feeding practices

Parental feeding practices were assessed using the Malay version of the Comprehensive Feeding Practice Questionnaire (CFPQ) (Shohaimi, Wei & Shariff, 2014). The CFPQ comprised 39 items organised into 12 subscales, which are as follows:

1. Monitoring: Parents keep track of the child's intake of less healthy foods.
2. Child control: Parents allow the child to control their eating behaviours.
3. Emotion regulation: Parents use food to regulate the child's emotional states.
4. Encourage dietary balance and variety: Parents promote balanced food intake.
5. Environment: Parents make healthy foods available in the home.
6. Food as a reward: Parents use food as a reward for the child's behaviour.
7. Involvement: Parents encourage the child's involvement in meal planning and preparation.
8. Modelling: Parents actively demonstrate healthy eating for the child.
9. Pressure: Parents pressure the child to consume more food at meals.
10. Restriction for health: Parents control the child's food intake with the purpose of limiting less healthy foods and sweets.
11. Restriction for weight control: Parents control the child's food intake with the purpose of decreasing or maintaining the child's weight.

12. Teaching about nutrition: Parents provide nutrition knowledge to the children during meals.

Each item within each subscale was rated by the parents using a five-point scale. The scores for each item were then summed to calculate a total score for each subscale. A higher total score on a subscale indicated a higher intensity of the specific parental feeding practice. This study demonstrated good internal consistency reliability, with a Cronbach's alpha coefficient of 0.856.

Anthropometric measurements

Children's height was measured using a SECA 206 Body Meter (SECA, Germany) to the nearest 0.1 cm, while their body weight was measured with a SECA Robusta 813 digital weighing scale (SECA, Germany) to the nearest 0.1 kg. To determine the *z*-score for body mass index, expressed as BMI-for-age, the WHO AnthroPlus Version 1.0.4 software was utilised.

Body weight status of all children was categorised into four groups based on the WHO Growth Reference (WHO, 2007), except for children with Down Syndrome (DS). Children with a BMI below the 5th percentile were classified as underweight; normal weight was defined as a BMI within the range of the 5th percentile to less than the 85th percentile; overweight individuals were those with a BMI falling between the 85th and less than the 95th percentiles; and obesity was identified when BMI was at or above the 95th percentile. Meanwhile, a specific growth chart was applied for children with DS (Zemel *et al.*, 2015) as recommended by the Centers for Disease Control and Prevention, CDC.

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics for Windows version 26.0 (IBM Corp, Armonk, New York, USA). The normality of the data was tested using the Kolmogorov-Smirnov test. Descriptive data for categorical variables were presented in frequencies and percentages, while continuous variables were summarised as means and standard deviations for comparison by employing independent sample *t*-test. To predict body weight status of children with LD, a stepwise multiple linear regression was performed. The independent variables included in the regression model were selected based on simple linear regression results, with a significance level of $p<0.25$. The level of statistical significance for the overall analysis was set at $p<0.05$.

RESULTS

Table 1 presents the data on a total of 245 children with LD, with 68.2% males and 31.8% females, and a mean age of 10.5±1.7 years. Majority of the children (62.9%) were categorised as having intellectual disability. Regarding parental education, more than half of the fathers (57.9%) and mothers (56.8%) had completed secondary school. The majority of families (84.3%) fell under the B40 category, with a monthly household income of less than RM3,030, while only 3.7% belonged to the T20 category with a monthly income of more than RM6,620. The mean household size was 5.60±1.81 persons, with 54.7% of families having five to seven members living in the house.

In terms of birth-related factors, the majority of children (80.9%) had a normal birth weight and 77.4% were delivered full-term, between 37 to 41 weeks. Regarding co-morbidities, 18.1% participants reported that their children had additional health conditions, with the most common being epilepsy, asthma, and cardiovascular diseases, each reported by 4.2% of the participants. This study observed that a significant number of participants reported that their children frequently displayed rapid eating (1.98±1.31), food refusal (1.48±1.34), and food selectivity (1.27±1.13) during the past six months.

Table 1. Characteristics of children with learning disabilities and parental factors (*N*=245)

Characteristic	*n (%)*	*Mean±SD*
Children		
Type of disabilities		
Intellectual disability	154 (62.9)	
Autism	32 (13.1)	
Down syndrome	27 (11.0)	
Attention deficit hyperactivity disorder	16 (6.5)	
Dyslexia	16 (6.5)	
Sex		
Male	167 (68.2)	
Female	78 (31.8)	
Age (years)		10.5±1.7
7-9	57 (23.3)	
10-12	152 (62.0)	
13-14	36 (14.7)	
Ethnicity		
Malay	240 (98.0)	
Chinese	4 (1.6)	
Indian	1 (0.4)	
Birth weight (kg) (*n*=245)		2.9±0.6
Very low birth weight (<1.49)	4 (1.6)	
Low birth weight (<2.50)	43 (17.6)	
Normal birth weight (≥2.50)	198 (80.8)	
Gestational age (weeks) (*n*=234)		37.8 ±2.7
<37	49 (20.0)	
37–41	182 (77.8)	
≥42	3 (1.2)	
Co-morbidities		
Yes	47 (19.2)	
No	198 (80.8)	
Parents		
Father's education level (*n*=240)		
PhD/Master/Bachelor	18 (7.5)	
STPM/Diploma/A-Level	35 (14.6)	
Secondary school (PMR/SPM/O-Level)	139 (57.9)	
Primary school (UPSR)	36 (15.0)	
No formal education	12 (5.0)	
Mother's education level (n=243)		
PhD/Master/Bachelor	33 (13.6)	
STPM/Diploma/A-Level	36 (14.8)	
Secondary school (PMR/SPM/O-Level)	138 (56.8)	
Primary school (UPSR)	27 (11.1)	
No formal education	9 (3.7)	

Table 1. Characteristics of children with learning disabilities and parental factors (*N*=245) (*cont.)*

Characteristic	*n (%)*	*Mean±SD*
Monthly household income (RM) (*n*=242)†		
B40 (<RM3,030)	204 (84.3)	
M40 (RM3,030 – RM6,619)	29 (12.0)	
T20 (>RM6,620)	9 (3.7)	
Household size (persons)		5.60±1.81
<5	73 (29.8)	
5-7	134 (54.7)	
>8	38 (15.5)	
Feeding problems (maximum score)		
Chewing problem (6)		0.84±1.16
Rapid eating (6)		1.98±1.31
Food refusal (6)		1.48±1.34
Food selectivity (4)		1.27±1.13
Vomiting (4)		0.42±0.88
Stealing food (4)		0.70±0.98
Parental feeding practices (maximum score)		
Monitoring (20)		13.35±3.20
Child control (20)		11.25±2.62
Emotional regulation (15)		6.34±2.65
Encourage dietary balance and variety (15)		12.01±2.03
Environment (10)		8.17±1.56
Involvement (15)		11.37±2.45
Food as reward (10)		6.33±2.14
Restriction for health (10)		7.68±2.28
Teaching about nutrition (10)		7.95±2.00
Restriction for weight control (35)		23.76±7.08
Pressure (15)		8.75±3.24
Modelling (20)		16.57±3.41

UPSR: *Ujian Penilaian Sekolah Rendah* (Primary School Assessment Test); PMR: *Penilaian Menengah Rendah* (Lower secondary Assessment); SPM: *Sijil Pelajaran Malaysia* (Malaysian Certificate of Education); STPM: *Sijil Tinggi Pelajaran Malaysia* (Malaysian Higher Certificate of Education); PhD: Doctor of Philosophy; RM: *Ringgit Malaysia*; B40: Bottom 40%; M40: Middlle 40%; T20: Top 20%

†Classification was based on monthly household income by household group and state

Table 2 displays the mean weight of the children, which was 34.3±13.5 kg, and the mean height, which was 134.2±12.2 cm. The average BMI of all children was 18.5±4.9 kg/m^2. It was observed that the mean BMI for males (18.8±4.8 kg/m^2) was significantly higher compared to females (17.5±4.8 kg/m^2; t=2.165, p=0.031). The overall prevalence of underweight / thinness/ among the children was 12.2%, while 58.8% were categorised as having a normal weight and 29.0% were classified as overweight/obese.

Table 3 presents the results of the stepwise multiple linear regression analysis, which identified six significant predictors of BMI among children with LD. The results indicated that being male (β=0.109, p=0.044), higher age

Table 2. Body weight status of children with learning disabilities by gender (*N*=245)

Anthropometric measurements	*All*	*Male (n=167)*	*Female (n=78)*	*p-value*¶
Weight (kg), mean±*SD*	34.3±13.5	35.4±13.6	31.9±13.1	0.057
Height (cm), mean±*SD*	134.2±12.2	134.8±11.9	132.8±12.8	0.224
BMI (kg/m^2), mean±*SD*	18.5±4.9	18.9±4.8	17.5±4.9	0.031*
BMI classification, *n* (%)				
Underweight‡/Thinness†	30 (12.2)	18 (10.8)	12 (15.4)	
Normal‡,†	144 (58.8)	88 (52.7)	56 (71.8)	
Overweight†/Obesity†,‡	71 (29.0)	61 (36.5)	10 (12.8)	
Total	245 (100.0)			

‡Zemel *et al.* (2015) for children with DS, †WHO (2007) for all other children, ¶Independent sample *t*-test
*Significant at $p<0.05$

(β=0.226, $p<0.001$), and higher birth weight (β=0.119, p=0.029) significantly predicted higher BMI values in children with LD. In terms of parental feeding practices, the regression analysis revealed that a lower mean score of parental modelling (β=-0.170, p=0.004), a lower mean score of pressure (β=-0.266, $p<0.001$), and a higher mean score of restriction for weight control (β=0.361, $p<0.001$) were significant predictors of higher BMI values among children with LD. Notably, restriction for weight control demonstrated the largest beta coefficient, indicating that it was the strongest predictor for BMI value. Overall, this prediction model was statistically significant, $F(5,238)=18.907$, $p<0.001$, and accounted for approximately 30.6% of the variance in BMI (adjusted R^2=0.306).

DISCUSSION

This present study observed a high prevalence of overweight and obesity among children with LD. They are at a higher risk of experiencing poor nutritional status than typical children due to limited ability to comprehend and assess information about nutrition, which leads to challenges in maintaining a healthy diet. The current study highlighted that the double burden

Table 3. Significant predictors for body mass index of children with learning disabilities (*n*=223)

Variables	*B*	*β*	*95% CI*		*p-value*
			Lower bound	*Upper bound*	
Age	0.641	0.226	0.339	0.944	<0.001
Sex					
Male	1.138	0.109	0.032	2.244	0.044
Birth weight	0.985	0.119	0.104	1.866	0.029
Parental feeding practice					
Modelling	-0.244	-0.170	-0.411	-0.077	0.004
Pressure	-0.401	-0.266	-0.564	-0.237	<0.001
Restriction for weight control	0.250	0.361	0.170	0.330	<0.001

Multiple linear regression model: R=0.568, R^2=0.323, Adjusted R^2=0.306; $F(6, 238)=18.907$, $p<0.001$; associations are significant at $p<0.05$.

of malnutrition (undernutrition and overnutrition) not only occurs among typical children, but is also prevalent among children with LD. This study found that more males were overweight or obese than females. Being male was identified as a predictive factor for higher BMI, which aligns with a recent study in Malaysia showing higher BMI for males than females (Eow *et al.,* 2021). However, the relationship between gender and BMI in disabled children remains inconsistent, as previous studies in Chile and South Korea reported that females had higher BMI than males (Barria *et al.*, 2018; Joo *et al.*, 2019). Previous evidence suggested that gender differences become more pronounced during pubertal maturation, as males and females have different body compositions. Girls who experience delayed puberty are negatively associated with obesity, body fat percentage, fat mass, and fat-free mass (He *et al.,* 2017).

Meanwhile, studies conducted among Japanese children with intellectual disabilities have also revealed that the onset of obesity among boys is more likely to occur at early ages, whereas for girls, it tends to appear later, specifically during the period of pubertal maturation (Haga & Aihara, 2015). Interestingly, despite previous studies suggesting that female children with LD are at a greater risk of overweight and obesity (Barria *et al.*, 2018; Joo *et al.*, 2019), this does not seem to be the case among children with LD in the current findings. However, caution should be exercised when making a direct comparison, as these differences could be attributed to other possible factors such as variations in reference standards used, socio-demographic factors, dietary patterns, lifestyle, and cultural practices in different countries.

The present study observed that increased age predicted higher BMI values in children with LD. This finding aligns with previous studies conducted in Asian countries (Eow *et al.*, 2021; Wang *et al.*, 2018), which reported a positive correlation between BMI and age in disabled children. It has been suggested that BMI increases in conjunction with age during puberty. Our study supports this idea, as almost three-quarters of the children aged 10 years and older were predominantly boys. Boys tend to gain more fat-free and skeletal mass during puberty, which contributes to their weight gain, while females tend to accumulate a significantly higher amount of fat mass during this stage of development. On the other hand, lower physical activity levels as children with LD age and spending more time in sedentary activities could be another contributing factor to the observed increase in BMI. Previous research has found that lower physical activity levels, resulting from poor social interaction and motor functioning, were associated with weight gain among disabled children (Wouters, Evenhuis & Hilgenkamp, 2019). Thus, the relationship between physical activity and BMI among children with LD warrants further investigation in future studies.

Additionally, this study also found that higher birth weight predicted higher BMI among children with LD. This finding is consistent with a previous study (Chen *et al.*, 2015), but contradicts another study (Chen *et al.*, 2019) that reported low birth weight as being correlated with an increased risk of severe obesity, as well as thinness. The variation in these findings may be elucidated by the fact that children with low birth weight exhibit catch-up growth in accordance with their genetic factors, subsequently experiencing a relatively rapid increase in body weight as they grow (Baran *et al.*, 2019). However, it is important to note that not all children with low birth weight follow a regular catch-up development trend, as different growth patterns may exist (Chen *et al.*, 2019). Given these discrepancies, it becomes

crucial to consider these various factors when developing interventions to address childhood overweight and obesity among children with LD. However, it is worth mentioning that there is still limited evidence specifically focusing on children with LD, and further prospective studies are warranted to investigate the temporal relationship between birth weight and BMI in this population.

This study highlighted that children with LD frequently exhibited rapid eating, food refusal, and food selectivity during the past six months. These findings align with a study conducted by Leader *et al.* (2020), who reported that disabled children experiencing these feeding problems had a higher prevalence of gastrointestinal symptoms compared to those who did not. Children with gastrointestinal problems were found to be susceptible to conditions such as constipation, diarrhoea, and abdominal pain, which could potentially lead to unhealthy body weight due to poor nutrient absorption (Eow *et al.*, 2021).

Regarding parental feeding practices, higher restriction for weight control was found to be associated with higher BMI among children with LD. This could be explained by the fact that parents may encourage their children to eat less, provide smaller portions at meals, skip meals, and limit them to certain foods, under the perception that it would prevent them from becoming overweight. When parents believe their children are gaining weight, they intentionally restrict their food consumption, which aligns with the concept that restrictive parental feeding behaviours are linked to a child's weight status (Freitas *et al.*, 2019). Parents may believe that severely restricting a child's food intake will positively influence his/her eating habits. However, higher restriction for weight control may have a negative impact, as this may cause children to experience stress and lead to increased food consumption as a means to relieve tension, ultimately resulting in a higher BMI (Joo *et al.*, 2019). Restricting food intake in children with LD often makes them crave it more. They keep thinking about the food they cannot have, which can lead to strong cravings and obsessions. This makes it harder for children to control themselves when they finally get to eat what they have been missing out on. Also, restricting their food intake can make them turn to eating for comfort when they are feeling stressed or deprived, which weakens their self-control even more. Consequently, such parental restrictive practices might not effectively promote moderation in food consumption, but instead encourage children to consume more and weaken their self-control concerning food.

Furthermore, the higher restriction for weight control could also explain the lower instances of pressure to eat. This study revealed that a lower practice of pressuring children to eat was associated with higher BMI in children with LD, while higher pressure to eat was more commonly observed among children with a lower BMI. A similar study conducted in Malaysia found that parents exerted less pressure on disabled children who were overweight and obese (Eow *et al.*, 2021). The possible explanation for this behaviour is that parents are aware of their children's weight gain, leading them to apply less pressure and avoid forcing them to eat more when they are not hungry or have not finished their meals. This finding demonstrated that Malaysian parents are concerned about their children's weight issues, which aligns with the higher prevalence of overweight and obesity among children with LD, as observed in the current study. However, it should be noted that parents tended to underestimate their children's weight status (Warkentin *et al.*, 2018). Consequently, children's eating behaviours might not be effectively controlled until they have already become overweight or obese.

This study revealed that lower

parental modelling of healthy eating practices predicted higher BMI in children with LD. A significant number of parents in this study were less likely to serve as role models for their children in terms of consuming healthy foods and showed less enthusiasm for practising healthy eating habits themselves. The manner in which parents model healthy eating in front of their children, including their eating habits and food preferences, can greatly influence the development of healthy eating behaviours in children, directly impacting their diet quality and nutritional status. It is important to note that this study was conducted during the COVID-19 lockdown period, known as MCO, which significantly affected lifestyle behaviours. This context highlighted the crucial role of parental modelling and feeding practices as parents and children spent most of their time together at home due to lockdown restrictions.

The current findings underscore the importance of parental role modelling as a critical factor in children's body weight status, indicating its potential as a target for future interventions. Given the lower scores of parental modelling observed in our study, it is evident that efforts should be directed towards parents to enhance their feeding practices. By doing so, we can implement a valuable strategy to improve children's health behaviours and BMI. However, it is essential to consider the findings of Russell *et al.* (2018), who suggested that although modelling feeding practices are crucial for promoting children's healthy weight, this approach may be less effective in detecting changes in children's eating behaviours, mainly because most parents tend to report following best practices in their daily lives.

There are several limitations in this study. Firstly, the cross-sectional study design only allowed for the examination of correlations between variables and not establishing causal relationships between them. Secondly, the study relied on self-reported questionnaires to gather information on demographic and socioeconomic backgrounds, feeding problems, and parental feeding practices. Self-reporting introduces a high risk of under- or over-report responses, potentially affecting the accuracy of the data. Additionally, the instruments used to assess parental feeding practices were not validated specifically among children with LD, even though they have been validated and commonly used in local studies involving children with typical development. Therefore, it is essential for future research on children with LD to explore the validity and reliability of LD-specific questionnaires related to feeding problems and parental feeding practices, as neither of these questionnaires have been validated among Malaysian children with LD. This step will enhance the accuracy and applicability of findings in this population. The main limitation of this study was the absence of information on the physical activity levels of children with LD. Physical activity is a crucial factor that should have been assessed to establish a correlation with obesity/overweight among this vulnerable group.

Despite these limitations, this study successfully investigated the relationship between demographic and socioeconomic factors, feeding problems, and parental feeding practices with the BMI of children with LD in Malaysia, a topic that has not been extensively explored. As a result, it contributes to a better understanding of BMI and its predictive factors within this vulnerable group. The study's findings, particularly concerning parental feeding practices, emphasised the crucial role of parents in preventing unhealthy weight status among children with LD. This insight could potentially inform interventions and support strategies aimed at promoting better health outcomes in children population with LD.

CONCLUSION

This study revealed a concerning prevalence of overweight and obesity among children with LD in Kelantan, with almost one-third of them falling into this category. Additionally, approximately one out of ten children were classified as underweight, thin, or severely thin. The study also highlighted the prevalence of rapid eating, food refusal, and food selectivity among these children during the past six months. Through multivariate analysis, several factors were identified as predictors of higher BMI among children with LD, including being male, older age, higher birth weight, negative parental modelling, lower pressure to eat, and higher restriction for weight control. Given the potential long-term health consequences associated with being overweight or obese, these findings underscore the importance of addressing weight issues in children with LD. Moreover, the study emphasises the critical role of positive parental feeding practices in combating body weight problems within this vulnerable group. Effective interventions and support strategies should be implemented to promote healthy weight management and overall well-being in children with LD.

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Authors' contributions

Siti FM, conducted the data collection, data analysis and interpretation, prepared the initial draft of the manuscript and reviewed subsequent versions; Soo KL, served as the principal investigator and collaborated with Siti FM in conceptualising and formulating the research plan, also provided guidance on data analysis and interpretation, and made revisions to the final draft of the manuscript; Divya V, assisted with data analysis and also reviewed the manuscript. All authors participated in reading and approving the final version of the manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest.

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Development and validation of the Salt Intake-Related Knowledge, Attitude, and Practice Questionnaire for Malaysian adults

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ABSTRACT

Introduction: Malaysian adults consume excessive amounts of salt daily, which could lead to hypertension. Understanding knowledge, attitudes, and practices (KAP) surrounding salt intake is crucial for designing effective interventions to reduce excessive consumption and its associated health risks. Therefore, this study aimed to adapt an existing salt intake-related KAP questionnaire that was previously employed in a local population-based survey and to validate and test its reliability. **Methods:** This cross-sectional study comprised two phases: (1) adaptation, content validation (CV), and face validation (FV); (2) pilot testing and reliability testing. CV and FV involved a total of seven experts and ten Malaysian adults from the Klang Valley, respectively. Pilot testing involved 139 Malaysian adults to determine the questionnaire's reliability. Content validity index (CVI) and Face validity index (FVI) values were calculated to analyse CV and FV. Reliability of each domain was analysed by obtaining Cronbach's alpha (α) values. **Results:** A self-administered questionnaire comprising six items each for knowledge, attitude, and practice was developed. The questionnaire demonstrated acceptable item-level CVI (I-CVI) and item-level FVI (I-FVI) values of at least 0.83, indicating that the items were relevant, clear, non-ambiguous, and simple. Reliability test showed acceptable α values of at least 0.70 for each domain, suggesting that the questionnaire was reliable. **Conclusion:** This tool could be considered valid and reliable for assessing the level of KAP towards salt intake among adults in Malaysia.

Keywords: adults, awareness, questionnaire, salt intake, validation

INTRODUCTION

The Institute for Public Health (IPH, 2019a) previously reported in the local Population-Based Salt Intake Survey to Support the National Salt Reduction Programme for Malaysia, also known as the Malaysian Community Salt Survey (MyCoSS), that Malaysians consume around 7.9 g/day of salt. This amount exceeds the maximum recommended intake by the World Health Organization (WHO, 2012) of 5g/day. Excessive salt intake has been linked to hypertension (Choe *et al.,* 2015), which is one of the strongest risk factors for various cardiovascular complications (Kjeldsen, 2018). Moreover, the prevalence of hypertension among adults in Malaysia in 2019 was 30% (IPH, 2019b), consistent with the previous prevalence

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of 30.3% reported in 2015 (Ministry of Health Malaysia, 2015). These statistics indicate that one in three Malaysians suffers from hypertension—a significant concern given that cardiovascular complications account for 34.8% of mortality (IPH, 2017). Therefore, reducing dietary salt intake is a cost-effective method to prevent and reduce non-communicable diseases, such as hypertension, and consequently, cardiovascular complications (Ministry of Health Malaysia, 2015).

An individual's salt intake is influenced by his/her knowledge, attitude, and practices regarding dietary habits (Mahat *et al.,* 2017). Hence, targeting personal attitude is an important component of behavioural change (Bettinghaus, 1986). Despite the reported high levels of salt intake and high prevalence of hypertension, most Malaysians are actually aware of their high dietary salt intake and its impact on health (IPH, 2019a). However, only a little more than half (55.4%) controlled their salt intake regularly through seven types of dietary practices, such as avoiding processed foods and reading food labels. A majority (72.9%) consistently added salt while cooking and nearly half (47.7%) added salt, sauces, and condiments to their food at the table. These statistics suggest a disconnect between awareness and actual dietary practices or behaviours.

In Malaysia, only a handful of knowledge, attitudes and practices (KAP) studies have focused on dietary salt intake. These comprised studies that either adopted (Ismail *et al.,* 2021; Ahmad, Taha & Harith, 2020; Tee, Singh & Cheng, 2020) or adapted (Haron, 2022; Haron *et al.,* 2021; Dahalim & Jusoh, 2020) a questionnaire that was validated by IPH and first used in the MySalt 2015 study (IPH, 2016). This study involved only staff from the Ministry of Health (MOH) Malaysia and the questionnaire was used again during the MyCoSS. Similar to MyCoSS (IPH, 2019a), a study found that only 50.0% of the staffs in a local private university regularly engaged in practices to control their dietary salt intake, despite majority of them knowing the association between high salt intake and health problems, and that salt reduction is important (Tee, Singh & Cheng, 2020). In contrast, two other studies (Ahmad *et al.*, 2020; Ismail *et al.,* 2021) conducted among non-academic staffs and undergraduate students of two local universities, respectively, found that the awareness seemed to be reflected through the respondents' behaviours or practices. As for studies that adapted the MyCoSS questionnaire, two studies that incorporated a scoring classification reported that the practice of controlled dietary salt intake was inadequate, although the awareness was considered good (Haron, 2022; Haron *et al.,* 2021). In a study by Dahalim & Jusoh (2020) who added a knowledge-related question on recommended daily salt intake, reported that majority of the respondents, comprising of staffs from a local private university, did not have the knowledge. Furthermore, only half of the staffs controlled their salt intake despite being aware of the health effects of high salt intake.

While it is challenging to fully explain the discrepancy between awareness and actual dietary practices, the questionnaire used in the MyCoSS and the studies that adapted the questionnaire may have had some limitations that prevented a comprehensive assessment of the respondents' knowledge, attitudes, and practices. For instance, the questionnaire had an unequal number of items for each domain, in which only two items were for knowledge (K), two for attitude (A), and four for practice (P). Aside from that, there is concern that the questionnaire may not have captured comprehensive information on KAP among respondents due to its limited number of items. Furthermore, responses in the MyCoSS questionnaire were also only presented at a descriptive level, unlike studies that

reported their findings based on a scoring classification (Haron, 2022; Haron *et al.,* 2021). Although recent studies that have adapted the questionnaire have included new items that addressed other areas related to the KAP (Haron, 2022; Haron *et al.,* 2021; Dahalim & Jusoh, 2020), a detailed procedure on the validation and reliability testing of these adapted questionnaires was not described. Therefore, this study aimed to develop a Salt Intake-Related Knowledge, Attitude, and Practice Questionnaire (SI-KAP) by adapting an existing questionnaire used in the MyCoSS, validate it and test its reliability to assess the KAP level among Malaysian adults concerning salt intake.

MATERIALS AND METHODS

Study design

This cross-sectional study design was conducted in two phases among adults in Klang Valley, Malaysia (Figure 1): Phase I – adaptation, content validation, and face validation of the questionnaire, and Phase II – pilot testing and reliability testing of the questionnaire. The Research Ethics Committee of the Universiti Kebangsaan Malaysia approved this study, with the reference number UKM PPI/111/8/JEP-2020-433. This study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2008.

Study instrument

To suit the Malaysian context, IPH has adapted the questionnaire from the World Health Organization/Pan American Health Organization protocol for population-level sodium monitoring (WHO/PAHO, 2010), which was translated into the Malay language, validated through back-translation, and the final version established for content validity through expert panel consensus. It was pre-tested among the Malaysian adult population. The questionnaire was first utilised in the MySalt study (IPH, 2016) among staffs of MOH and subsequently in MyCoSS (IPH, 2019a) with the broader Malaysian population.

The questionnaire consisted of eight items divided into three domains: knowledge, attitude, and practice. The knowledge domain included two items covering the area of health problems related to high salt intake. The attitude domain also comprised two items addressing the following: (i) the importance of reducing salt consumption and (ii) perceptions of the amount of salt consumed. Four items in the practice domain covered these aspects: (i) one item on methods of reducing salt intake during cooking; (ii) one item on methods of reducing salt intake at the table; and (iii) two items on methods of reducing salt intake regularly.

The responses in the questionnaire were close-ended. The knowledge and practice domains offered 'yes', 'no', 'don't know', and 'refuses to answer' as response options. Meanwhile, the attitude domain provided 'very important', 'somewhat important', 'not at all important', 'far too little', 'too little', 'just the right amount', 'too much', 'far too much', 'don't know', and 'refuses to answer' as response options.

Phase I

Items adaptation

Literature search using journal databases such as Science Direct, Scopus, PubMed, Cochrane Database, and Medline was conducted to identify local and international studies related to salt intake KAP. The keywords used included "salt intake", "salt intake awareness", "KAP towards salt intake", and "consumption of salt by Malaysians". The questionnaires from the identified studies were reviewed and compared with the MyCoSS questionnaire. The assessment, in collaboration with a group of experts in the salt reduction project, aimed to incorporate significant new information from existing questionnaires, identify

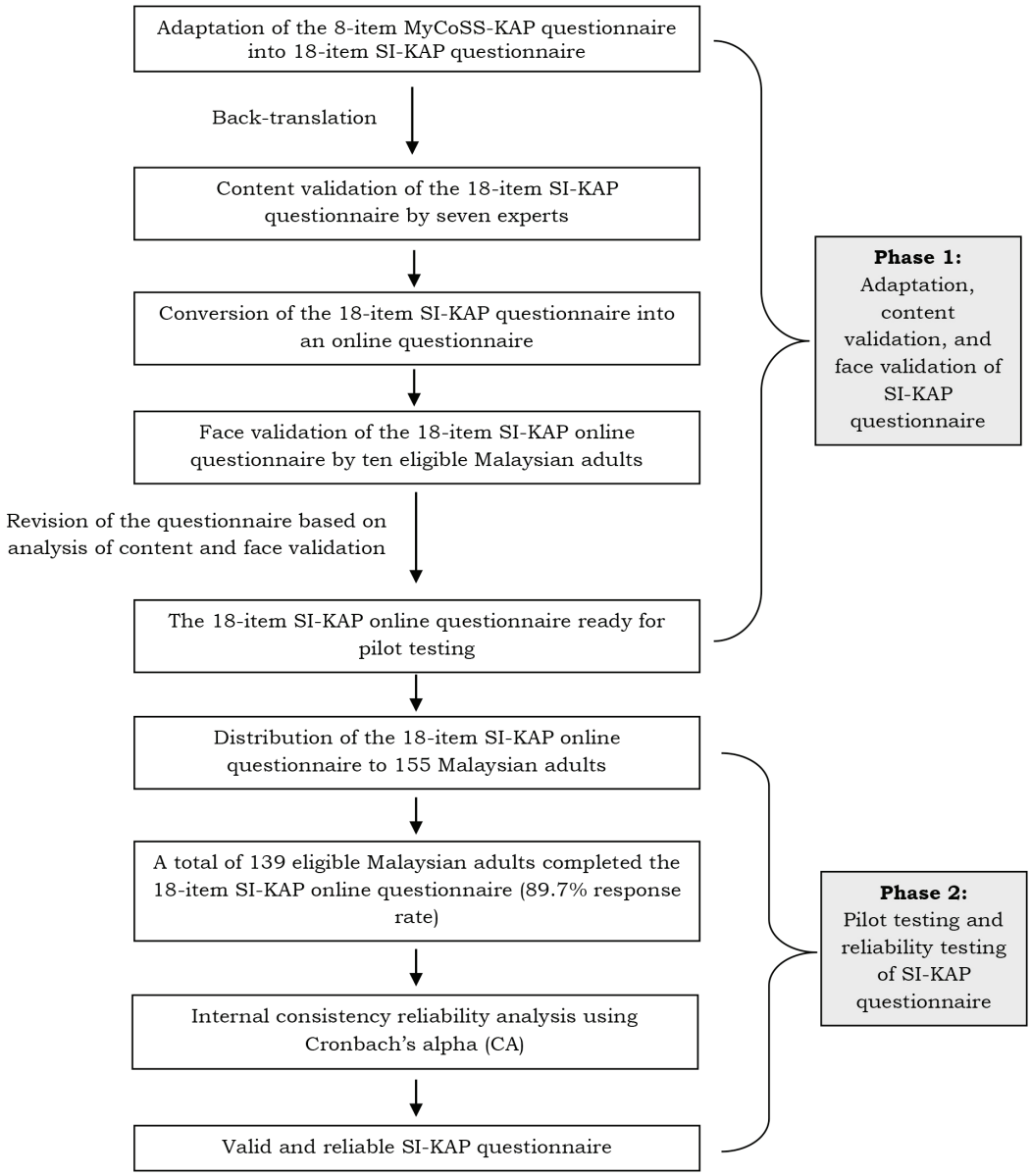

Figure 1. Phases of adaptation, validation, and reliability testing of Salt Intake-Related Knowledge, Attitude, and Practice (SI-KAP) Questionnaire

gaps in the gathered information, and eliminate redundant and irrelevant details based on the reviewers' extensive experience and expertise (Dyrbye *et al.,* 2010). It was also determined whether the number of items in the MyCoSS questionnaire sufficiently represented the domains and if the content from non-local studies was relevant to the Malaysian context.

In the SI-KAP questionnaire, four items were added to the knowledge domain to cover the following new areas: (i) recommended daily salt intake; (ii) main

sources of salt in the Malaysian diet; (iii) permissible amount of salt consumption; and (iv) relationship between salt and sodium. Two items from the MyCoSS questionnaire that addressed health problems related to high salt intake were retained. In the attitude domain, five new items addressed: (i) the importance of identifying foods high in salt; (ii) beliefs about minimising salt consumption; (iii) beliefs about the impact of reduced salt intake on hypertension risk; (iv) beliefs regarding flavour enhancement of adding salt to food; and (v) the importance of checking food labels for salt content. One item from the original questionnaire addressing the importance of reducing salt consumption was retained, while another concerning the perceived amount of salt consumed was moved to the practice domain. In the practice domain, an item was added to discuss practices of reducing salt intake when eating out. Two items from the original questionnaire, pertaining to the practices of reducing salt intake during cooking and at the table, were modified in wording. Two items focusing on the regular practice of reducing salt intake were retained.

Responses adaptation

The responses in the SI-KAP questionnaire remained close-ended. Minor modifications were made to the response options. In the knowledge domain, the 'refused to answer' option was removed from one of the retained items. For another retained item, the options 'stroke', 'heart disease', 'all of the above', and 'refused to answer' were eliminated. In the attitude domain, 'important' and 'less important' options were introduced, complementing the existing 'very important' and 'not important' options. In the practice domain, 'limit the consumption of salty snacks' was included as one of the options for an item addressing the practices of reducing salt intake on a regular basis.

Scoring and classification

In contrast to the MyCoSS questionnaire, the SI-KAP questionnaire incorporated a scoring system to facilitate the interpretation of comparisons between domains. Every option for all items across the three domains was assigned a score, with the most appropriate response receiving the highest score. After summing the highest scores of all items within that domain, the maximum scores were 24 for knowledge, 24 for attitude, and 26 for practice. Participant's score for each domain was converted into a percentage to reflect their level of knowledge, attitude, and practice towards salt intake. Additionally, an overall awareness score was calculated by adding the scores from all three domains, with the maximum possible score being 74 (24+24+26=74). These percentage scores were then interpreted as follows (Bakarman, Kurashi & Hanif, 1996):

(i) Knowledge: Unsatisfactory (< 60%), moderate (60%-70%), good (> 70%).
(ii) Attitude: Negative (< 60%), neutral (60%-70%), positive (> 70%).
(iii) Practice: Inadequate (< 60%), adequate (60%-70%), good (> 70%).
(iv) Overall awareness: Unsatisfactory (< 60%), moderate (60%-70%), good (> 70%).

Language validation

The MyCoSS questionnaire is available in both English and the Malay language (IPH, 2019a). Since the experts involved in the adaptation process were native English speakers, the adaptation was first carried out using the English version of the questionnaire. Similarly, the SI-KAP questionnaire is available in both languages. To produce the Malay version, the English version was first translated by four independent translators proficient in both languages. This Malay version was then back-translated into English to resolve any discrepancies and inaccuracies. The translation and

back-translation processes were applied only to the new and modified items. For the retained items, their existing Malay version were used.

Content validation

Content validation of the SI-KAP questionnaire was conducted by seven experts, including five nutritionists and two dietitians. Each expert completed an informed consent form to confirm their understanding and agreement to participate in the task, as well as a content validation form to critically review the domains and items before scoring each item. They individually reviewed the questionnaire to rate the relevance of each item to the respective domains using a 4-point Likert scale ranging from 1 (not relevant) to 4 (highly relevant) (Lau *et al.,* 2017; Ozair, Baharuddin & Yusoff, 2017) and provided feedback to enhance the items' relevance to the targeted domains. The analysis for content validation was based on the content validation index (CVI) values.

Conversion into online survey instrument

The paper-based SI-KAP questionnaire was transformed into an online survey using Google Forms prior to face validation with the intended participants. The first page of the online survey provided essential information about the study, including the purpose of the questionnaire, contact details of the researchers, a statement of confidentiality, and a declaration that participation was voluntary, with the right to withdraw at any time. At the end of this page, participants needed to confirm their eligibility for the study, acknowledge that they had read and understood the provided information, and give their informed consent by selecting the appropriate button, which then allowed access to the subsequent pages of the questionnaire.

The questionnaire was organised into three sections. Section A comprised seven items regarding socio-demographic characteristics. Section B included a single item about the participants' health history, allowing them to select multiple options if necessary. Finally, Section C presented the 18-item KAP domains. Participants needed to respond to all questions before proceeding to the conclusion of the questionnaire.

Face validation

For face validation, ten eligible Malaysian adults were involved. Using a non-face-to-face approach, they accessed the online version of the questionnaire to evaluate the clarity, ambiguity, and simplicity of the items, providing a score for each and were encouraged to submit written feedback. Following the methodology of content validation, each item was rated using a 4-point Likert scale. The analysis for face validation was based on the face validation index (FVI) values.

Analysis of content validation and face validation

Following a validation protocol for CVI guideline by The International Consultation on Incontinence Questionnaire (ICIQ, n.d.), scores rated from 1 to 4 during content and face validations were transformed into dichotomous values. Items rated 1 or 2 were coded as non-valid (represented as 0) and items rated 3 or 4 were coded as valid (represented as 1).

For content validity, the item-level-CVI (I-CVI) and scale-level-CVI (S-CVI) were calculated. The S-CVI was computed in two ways: S-CVI/UA (universal agreement method) and S-CVI/Ave (average calculation method). S-CVI/UA involved determining the number of items with 100% agreement by the experts and dividing this by the total number of items. S-CVI/Ave was calculated by summing the total I-CVI values and then dividing it by the number of items. For a panel of experts ranging from six to eight, a CVI value of 0.83 or

higher was considered acceptable for content validation (Lynn, 1986).

Similarly, for face validity, the item-level-FVI (I-FVI) and scale-level-FVI (S-FVI) were determined. S-FVI/UA and S-FVI/Ave were calculated using the same methods as I-CVI and S-CVI, respectively. For face validation with 10 raters, a FVI value of 0.83 or above was deemed acceptable (Marzuki, Yaacob & Yaacob, 2018).

All feedback were reviewed to refine the domains and items upon completion of the validation process. Decisions to edit, remove, or retain items were made after thorough discussion among the researchers, based on the CVI and FVI values, and comments received. The revised questionnaire was then moved to Phase II of the study.

Phase II

Pilot testing

The online SI-KAP questionnaire was pilot tested among 155 Malaysian adults who met the same eligibility criteria as those in Phase I. However, those who had participated in Phase I were excluded from participating in Phase II.

Reliability testing

To assess the internal consistency of the adapted questionnaire and its ability to produce consistent results across repeated measurements, the instrument was analysed for reliability using Cronbach's alpha (α). This coefficient α evaluates the degree to which different items measure the same attribute or domain. The reliability assessment was conducted following guidelines by Yusoff, Arifin & Hadie (2021). To calculate the α for each domain, responses for items based on multiple-choice options were converted dichotomously. For the knowledge, attitude, and practices domains, responses were coded as 0 (incorrect/disagree/never) or 1 (correct/agree/always).

Sample size and sampling method

Through established networks, convenience sampling was used to recruit seven experts, which is sufficient for conducting a content validity test (Lynn, 1986).

In contrast, face validation requires a minimum of ten raters who are typical users of the questionnaire rather than professionals or experts (Yusoff, 2019). To recruit potential subjects for this phase, convenience sampling was utilised by disseminating announcements via social networking sites (SNS) and through known networks. Interested respondents were screened against inclusion criteria: Malaysian nationals aged 18 years and above of any gender, and with the ability to read and understand English or Malay. Snowball sampling was subsequently employed to reach the target of ten eligible subjects.

The sample size for pilot testing was determined using a subject-to-item ratio of 5:1 (Tan, 2009). Therefore, a minimum of 90 participants was required (18 items x 5 = 90) in the testing. Anticipating a response rate of 72.7% (IPH, 2019a), the questionnaire was distributed to at least 155 participants. Following the completion of content and face validations, subject recruitment was conducted using the same method until at least 155 suitable participants matching the inclusion criteria were achieved.

Statistical analysis

Data analyses were conducted using the IBM SPSS Statistics for Windows version 25.0 (IBM Corp., Armonk, New York, USA). Socio-demographic characteristics of participants from the pilot test were analysed using descriptive statistics and data were reported as percentage values. For reliability testing, the α for each KAP domain was calculated. An α of at least 0.70 was deemed acceptable for this study (Taber, 2018).

Table 1. Summary adaptation of the SI-KAP questionnaire

Item no.	*Original 8-item MyCoSS questionnaire*	*Adapted 18-item SI-KAP questionnaire*	*Scoring responses in 18-item SI-KAP questionnaire*
			Response (score)
Knowledge domain			
1	-	Added: Recommended amount of salt intake in a day	• 5 g (about 1 teaspoon) (2) • 8 g (about 1 ½ teaspoons) (1) • 10 g (about 2 teaspoons) (1) • Don't know (1)
2	-	Added: Main sources of salt in the Malaysian diet	• Salt added during cooking (4) • Salt from processed foods such as soy sauce, fast food and snacks (3) • Salt from natural food sources such as shellfish and milk (2) • Don't know (1)
3	-	Added: Amount of salt allowed to be consumed	• Very little (4) • Right amount (3) • Too much (2) • Don't know (1)
4	-	Added: Relationship between salt and sodium	• Salt contains sodium (3) • Salt and sodium are the same (2) • Sodium contains salt (2) • Don't know (1)
5	Health problems related to high salt intake	No change except for answer rephrased	• Yes (3) • No (2) • Don't know (1)
6	Health problems related to high salt intake	No change except for answer rephrased	Can answer more than one: • High blood pressure (2) • Osteoporosis (2) • Stomach cancer (2) • Kidney stones (2) • None of the above (1) • Don't know (1)
Practice domain			
7	Practices of reducing salt intake at the table	• Modified to reducing soy and soy sauce intake at the table • Answer rephrased	• Never (4) • Sometimes (3) • Often (2) • Always (1)
8	Practices of reducing salt intake during cooking	• Modified to the amount of salt added during cooking • Answer rephrased	• None (4) • Very little (3) • Right amount (2) • Too much (1)
9	-	Added: Practices of reducing salt intake when eating out	• Never (1) • Sometimes (2) • Often (3) • Always (4)

Table 1. Summary adaptation of the SI-KAP questionnaire (*cont.)*

Item no.	*Original 8-item MyCoSS questionnaire*	*Adapted 18-item SI-KAP questionnaire*	*Scoring responses in 18-item SI-KAP questionnaire*
			Response (score)
10	-	• Moved from attitude domain: Amount of salt consumed • Question and answer rephrased	• Very little (4) • Right amount (3) • Too much (2) • Don't know (1)
11	Practices of reducing salt intake on a regular basis	No change except for answer rephrased	• Yes (3) • No (2) • Don't know (1)
12	Practices of reducing salt intake on a regular basis	No change except for answer rephrased	Can answer more than one: • Avoid eating foods prepared outside of home (1) • Avoid/minimise the consumption of processed foods (1) • Avoid adding salt shaker/soy sauce on the table as you eat it or right before you eat it (1) • Read the salt content on the food labels (1) • Buy alternative foods with low salt (1) • Limit the consumption of salty snacks (1) • Not adding of salt when cooking (1)
Attitude domain			
13	-	Added: Importance of identifying food that contains high amounts of salt	• Very important (4) • Important (3) • Less important (2) • Not important (1)
14	-	Added: They believe that they minimised their salt consumption	• Strongly agree (4) • Agree (3) • Slightly agree (2) • Disagree (1)
15	Importance of lowering of salt consumption	No change except for answer rephrased	• Very important (4) • Important (3) • Less important (2) • Not important (1)
16	-	Added: They believe that that lowering their salt intake will reduce their risk of getting hypertension	• Strongly agree (4) • Agree (3) • Slightly agree (2) • Disagree (1)

Table 1. Summary adaptation of the SI-KAP questionnaire (*cont.)*

Item no.	*Original 8-item MyCoSS questionnaire*	*Adapted 18-item SI-KAP questionnaire*	*Scoring responses in 18-item SI-KAP questionnaire* *Response (score)*
17	-	Added: They believe that adding salt to food will make it tastier	• Strongly agree (1) • Agree (2) • Slightly agree (3) • Disagree (4)
18	-	Added: Importance of checking the salt content on food labels	• Very important (4) • Important (3) • Less important (2) • Not important (1)
19	Amount of salt consumed	Moved to practice domain (item 10)	-

RESULTS

The adaptations and modifications to the MyCoSS questionnaire are summarised in Table 1, which also includes responses and scoring for the adapted version. The addition of new items was aimed to broaden the assessment of salt intake-related knowledge, attitudes, and practices (KAP), and to deepen the questionnaire's scope. The revised SI-KAP questionnaire comprised 18 items, with an equal number of six items in each of the three domains. It was administered in both English and the Malay languages, similar to the MyCoSS questionnaire.

Table 2. Content validity of SI-KAP Questionnaire evaluated by experts (*n*=7)

Item	*Domain*		
	Knowledge	*Attitude*	*Practice*
S-CVI/Ave	1.00	0.98	1.00
S-CVI/UA	1.00	1.00	1.00
Average proportion of items	1.00	0.98	1.00

For content validity, both the knowledge and practice domains achieved a S-CVI/UA and S-CVI/Ave value of 1.00 (Table 2). For the attitude domain, the S-CVI/UA was 1.00 and S-CVI/Ave was 0.98, deemed acceptable for the number of experts consulted (Lynn, 1986). No further modifications were made to the questionnaire as the experts provided no additional feedback.

Table 3. Face validity of SI-KAP Questionnaire evaluated by Malaysian adults (*n*=10)

Domain	*Component*	*S-FVI/ Ave*	*S-FVI/ UA*
Knowledge	Clarity	0.90	1.00
	Ambiguity	0.93	1.00
	Simplicity	0.93	1.00
Attitude	Clarity	0.90	0.83
	Ambiguity	0.90	0.83
	Simplicity	0.93	1.00
Practice	Clarity	0.90	0.67
	Ambiguity	0.88	0.67
	Simplicity	0.93	1.00

Face validity results (Table 3) indicated that the S-FVI/UA and S-FVI/Ave for clarity, ambiguity, and simplicity were above the acceptable threshold of 0.83 for all domains (Marzuki, Yaacob & Yaacob, 2018). This suggests that participants found the questionnaire's items, language, wording, and layout to be clear, simple, and straightforward. The S-FVI/UA for the practice domain

regarding clarity and ambiguity fell below the threshold, with a value of 0.67. Some participants found certain terms too complex; thus, minor corrections were made, including word substitutions with simpler synonyms.

The pilot test yielded 139 complete responses (89.7% response rate). Most participants (79.9%) were aged 18-29 years, followed by 30-39 years (10.8%), 50-59 years (5.8%), and 40-49 years (3.6%). Females represented 78.4% of the sample, while males accounted for 21.6%. Participants were predominantly of Chinese ethnicity (46.8%), with Malays (36.7%), Indians (11.5%), and others (5.0%) comprising the remainder. A significant majority (84.9%) were single, with 15.1% married. The participants were mostly educated to tertiary level (87.1%), with secondary education at 12.9%. Over half (61.2%) were students, 13.7% were private sector employees, 10.8% were unemployed, 7.9% were self-employed, and 6.5% worked in the government sector. The majority (69.8%) had a monthly household income of RM 4,849 or below, 24.5% between RM 4,850 and RM 10,969, and 5.8% at least RM 10,970.

Table 4. Reliability of SI-KAP Questionnaire assessed among Malaysian adults (*n*=139)

Domain	*Cronbach's alpha (α)*
Knowledge	0.72
Attitude	0.79
Practice	0.70

Cronbach's alpha values for internal consistency (Table 4) were 0.72 for the knowledge domain, 0.79 for attitude, and 0.70 for practice, suggesting that the adapted questionnaire reliably produces consistent outcomes across repeated measures.

DISCUSSION

To the best of our knowledge, this was the first study that has adapted the MyCoSS questionnaire and tested its validity and reliability. The questionnaire administered in past studies (IPH, 2019a; Haron *et al.,* 2021; Mansor *et al.,* 2021) showed that good knowledge and attitude towards dietary salt intake among Malaysians were not showcased through their practices. This discrepancy might arise from a lack of comprehensive knowledge and attitudes related to various aspects of dietary salt intake. Therefore, an adaptation through the SI-KAP questionnaire was necessary to capture the knowledge and attitude towards broader areas related to dietary salt intake. Furthermore, validation and reliability were tested to ensure that the adapted questionnaire accurately measures its intended constructs and produces consistent outcomes upon repetition.

Similar to local studies that adapted the MyCoSS questionnaire (Haron *et al.*, 2021; Ahmad *et al.*, 2020; Dahalim & Jusoh, 2020), we deemed it necessary to ask participants if they knew of the global recommended amount for daily salt intake (WHO, 2012). In the SI-KAP questionnaire, the item addressing this area was similar to previous studies (Ahmad *et al.*, 2020; Haron *et al.* 2021), since we assumed that participants who chose the correct answer knew of the national recommendation. Another new item that had not been addressed in any existing local studies was the focus on the main sources of salt in the Malaysian diet, where responses included salt added during cooking, salt from processed foods, fast foods, and snacks, as well as salt naturally present in raw food sources. This area is crucial as the common misconception is that salt primarily comes from only what is added during food preparation. Knowledge about the relationship between salt and sodium was also questioned since food products in the Malaysian markets are labelled with sodium content (Disease Control Division, 2021); thus, it is

necessary for Malaysians to distinguish between the two.

With regards to the attitude domain, the additional five items included opinions or beliefs about the importance of identifying foods containing a high amount of salt, beliefs about minimising salt consumption, whether lowering salt intake will reduce the risk of hypertension, whether adding salt to food enhances its taste, and the importance of checking salt content on food labels. The item assessing the participant's opinion regarding their salt consumption was moved to the practice domain, as it was perceived to fit better there. Similar to the study by Haron *et al.* (2021), this item was also moved to the practice domain.

With regards to practice, the two items that addressed the practices of reducing salt intake at the table and during cooking were modified in wording. For the first item, the MyCoSS questionnaire asked whether participants practised adding salt, sauce, soy sauce, or food enhancers to food at the table. This item was modified by excluding salt and food enhancers, as the practice of adding these substances to food upon eating is not common among the locals. Haron *et al.* (2021) included only soy sauce for this item in the practice domain, whereas Dahalim & Jusoh (2020) separated soy sauce and salt into two separate items. Similar to Haron *et al.* (2021), for the modification of the second item on practices of reducing salt during cooking, the question was changed from how often participants added salt during cooking to how much salt is usually added. Additionally, an item related to practices when eating out was added as eating out has become a common dining habit among Malaysians, with 70% of the population eating out regularly (IPH, 2014). The item from the attitude domain that addressed the amount of salt consumed was moved to this domain and modified to fit the context better.

In contrast to the MyCoSS questionnaire, the SI-KAP questionnaire enabled the findings to be presented not only in frequency and percentage, but also the classification levels of participants' knowledge, attitude, and practice. Compared to other local studies, only those by Mansor *et al.* (2021) and Haron *et al.* (2021) assigned scores to every item in order to classify the percentage score into different levels of each domain. Similar to Haron *et al.* (2021), the SI-KAP questionnaire used the classification by Bakarman *et al.* (1996) instead of the classification by Mansor *et al.* (2021) because the authors (Mansor *et al.*, 2021) did not justify the level of classification used.

Regarding content and face validity, the acceptable CVI values indicated that the items were relevant to their respective domains in the questionnaire. Also, the acceptable FVI values suggested that the items, language, wording, and layout of the questionnaire were clear, simple, and unambiguous. A direct comparison with other studies could not be made as no studies were found assessing the salt-related KAP questionnaire itself or addressing the validation process, even though adaptations of the MyCoSS questionnaire were made (Haron *et al.*, 2021; Ahmad *et al.*, 2020; Dahalim & Jusoh, 2020).

Regarding internal consistency, the α computed for each domain indicated that outcomes were consistent upon repeated measurements (Taber, 2018). In comparison to other studies, only Haron *et al.* (2021) reported the α of their questionnaire, which was at least 0.70, signifying that their adapted questionnaire was reliable.

This study was strengthened by the involvement of experts in salt reduction strategy to review the information gathered from the literature search. The SI-KAP questionnaire was ensured to be more comprehensive than the MyCoSS questionnaire as it covers a wider scope

related to dietary salt intake and is relevant to the local context. Similar to the MyCoSS questionnaire, the SI-KAP questionnaire was administered in the two languages commonly used in Malaysia, which may facilitate understanding among bilingual participants and those coming from various educational backgrounds. Nonetheless, limitations still exist. The present study only recruited Malaysian adults from Klang Valley, hence results cannot be generalised to the entire Malaysian adult population. Besides that, the use of an online questionnaire was vulnerable to response bias as participants could easily obtain information from the internet while answering the questionnaire.

This study has produced a valid and reliable questionnaire that can be used to evaluate dietary salt intake-related KAP in Malaysia. However, future researchers who adopt this questionnaire should at least perform an internal consistency analysis to ensure that the questionnaire is reliable for their targeted population. To ensure representative and unbiased sampling, future research should be conducted using a multi-stage random sampling method.

CONCLUSION

This study adapted the MyCoSS questionnaire that assessed the KAP of adults in Malaysia regarding salt intake. The SI-KAP questionnaire was proven to be valid and reliable for the intended purpose. With the inclusion of new salt-related topics, this questionnaire can provide a comprehensive evaluation of salt intake-KAP among Malaysian adults. Consequently, specific salt intake-related interventions could be developed and their impact evaluated to support the National Salt Reduction Programme in Malaysia.

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Authors' contributions

Zainorain Natasha ZA, Ngoh WH, Hng JW, Siti Aishah I and Maryam Hanis F, carried out the data collection and data analysis for content validity, face validity and reliability; Zainorain Natasha ZA, prepared the draft of the manuscript; Hasnah H, principal investigator, conceptualised and designed the study and reviewed the manuscript.

Conflict of interest

All authors declare no conflicts of interest.

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Associations between quantity and quality of dietary intake with haemoglobin concentration among female adolescents in Tasikmalaya, West Java, Indonesia

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ABSTRACT

Introduction: An imbalance in diet can lead to anaemia in young women, which can impact not only themselves, but also the next generation. This study aimed to determine associations between quantity and quality of dietary intake with haemoglobin (Hb) concentration among female adolescents in Tasikmalaya, West Java, Indonesia. **Methods:** A cross-sectional study was conducted on 347 young women aged 12-18 years from ten districts in Tasikmalaya City, selected by simple random sampling. Quantity and quality of dietary intake were measured by 2-repeated 24-hour dietary recalls, while portable haemoglobinometer (HemoCue® Hb 201+) was used to measure Hb concentration. Linear regression model predicted associations between quantity and quality of dietary intake with Hb concentration in female adolescents. **Results:** The proportion of subjects suffering from anaemia were 47.3%. Average intake of dietary iron was 6.7±3.0 mg and average dietary quality score was 32.6%. Dietary quality score and days of menstrual bleeding contributed as much as 12.7% to the variation in Hb concentration among female adolescents. **Conclusion:** Anaemia in female adolescents in Tasikmalaya, West Java, Indonesia is a serious public health problem. Diet quality score was associated with female adolescents' Hb concentration; therefore, improving the quality of diet is important to reduce anaemia.

Keywords: anaemia, dietary quality, dietary quantity, female adolescents, haemoglobin

INTRODUCTION

In the human life cycle, adolescents are those between the ages of 10-19 years old. There are around 1.2 billion adolescents worldwide and 90% live in low and middle-income countries (LMICs) (Shinde *et al.*, 2023). Anaemia is more common in female adolescents, especially those living in LMICs (Kundu *et al.,* 2023). Among female adolescents, their current nutritional status is not only important for their current health status, but also for their future. Female adolescents who are anaemic are at risk of suffering from anaemia during pregnancy and pregnant mothers who are anaemic are more likely to have babies who are also anaemic (UNICEF, 2021). If this condition is not resolved, it will cause an intergenerational cycle of malnutrition.

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An imbalance of dietary intake is one of the causes of anaemia in female adolescents (Li *et al.*, 2022). Micronutrient deficiencies in adolescents are often caused by insufficient food consumption to meet the needs of rapid growth during adolescence (Cusick & Kuch, 2012). Rapid growth in adolescents results in an increased need for iron to form haemoglobin in red blood cells (Shaka & Wondimagegne, 2018). In adolescents, increased iron needs require increased consumption of iron-rich foods. Iron adequacy among adolescents is determined by the quantity and quality of their dietary intake (Hunt, 2010). The quantity and quality of iron are determined by the main meals or snacks consumed by adolescents (Hidayanti *et al.*, 2023).

Iron with good bioavailability is found in animal-source foods (ASF) (Zhang, Goldsmith & Winter-Nelson, 2016). However, ASF consumption remains low in LMICs (Adesogan *et al.,* 2020). As a country in the LMICs group, consumption patterns of Indonesians are still dominated by plant-based foods (Suryana, Martianto & Baliwati, 2019). Vegetable foods, such as leafy green vegetables and nuts, are high in iron content, but they also contain phytic acid, which can inhibit iron absorption (Bhatnagar & Padilla-Zakour, 2021). However, consumption of ascorbic acid found in fruits can overcome iron absorption barriers caused by phytic acid (Piskin *et al.,* 2022). Therefore, a quality diet is needed to prevent deficiencies of macro- and micronutrients, one of which is anaemia in adolescents (Worku, Hailemicael & Wondmu, 2017).

Tasikmalaya is located in West Java, which is home to the indigenous Sundanese people. The Sundanese are a tribe known to like all kinds of plant foods such as vegetables and fruits (Darmayanti, 2016). In a study by Rahfiludin *et al.* (2021), the prevalence of anaemia among Sundanese is 32.4%, which is a moderate public health problem (Rahfiludin *et al.,* 2021). This study aimed to comprehensively explore the diet of female adolescents, including the quantity and quality of their dietary intake associated with haemoglobin concentration as an indicator of anaemia in this population.

MATERIALS AND METHODS

The research design used was an observational method with cross-sectional approach as the variables studied were measured simultaneously. The participants included were female adolescents aged 12-18 years who have menstruated. This research was conducted in 10 districts in Tasikmalaya City. The minimum sample size was 323 female adolescents. Calculation was based on the prevalence data for anaemia at 32.4% among female adolescents in Tasikmalaya, West Java, Indonesia (Rahfiludin *et al.*, 2021), with a 95% confidence level. The formula below was used to calculate the minimum sample size (Charan & Biswas, 2013):

$$n = \frac{Z_{\frac{\alpha}{2}}^{2} P(1-P)}{d^2}$$

Considering non-response bias, the sample was increased by 5% and it became 354. A total of 354 out of 5841 female adolescents who lived in Islamic Boarding Schools in Tasikmalaya were selected by simple random sampling. However, three students were unwilling to participate and thus excluded from this study. Four students did not complete the 2-repeated 24-hour dietary recall assessments and their data were excluded. In total, 347 female adolescent students were included in this study. Before the study, the research objectives were explained to subjects who met the inclusion criteria. Explanation was given to the subject, as well as their

legal guardian. If the subjects agreed to participate in this research, they would sign an informed assent and their legal guardian would sign an informed consent. The study was approved by the Research Ethics Commission of Mataram Health Polytecnic, Indonesia, with protocol number LB.01.03/6/8542/22.

The dependent variable was Hb concentration, measured using capillary blood with a portable haemoglobinometer (HemoCue® Hb 201+). Haemoglobin concentration was grouped according to the World Health Organization (WHO) cut-offs into anaemia (<12 g/dL) and normal (≥12 g/dL). Further, anaemia was grouped into mild anaemia (11-11.9 g/dL), moderate anaemia (8-10.9 g/dL), and severe anaemia (<8 g/dL) (WHO, 2011). Measurement of Hb concentration was carried out by three competent medical personnels from local universities.

The independent variables were quantity and quality of dietary intake. Quantity of dietary intake included the consumption of energy (kcal), protein (g), iron (including haem and non-haem) (mg), vitamin C (mg), calcium (mg), and phytic acid (mg), which were measured using the 2-repeated 24-hour dietary recall method. Haem iron is obtained from animal-source foods and non-haem iron is obtained from plant-source foods. Dietary intake was taken in household portions (spoon, plate, bowl, cup, etc.), then converted into grams. The open-source NutriSurvey (SEAMEO-TROPMED RCCN-University of Indonesia) was used to analyse all nutritional intake data (except phytic acid). Phytic acid was analysed using the Nutrisoft (Ministry of Health Republic of Indonesia). Quality of dietary intake was measured using the Dietary Quality Index for Adolescents (DQI-A) score instrument, which was the sum of the scores of dietary accessed (DA), dietary diversity (DD), and dietary equilibrium (DE). Data were measured using a 2x24-hour non-consecutive recall method. Furthermore, the data were grouped into nine groups, namely 1) water, 2) bread and cereal, 3) potato and grains, 4) vegetables, 5) fruits, 6) dairy products, 7) cheese, 8) protein-source foods, and 9) oil and fat (Cuenca-garcı *et al.,* 2013). Eight nutrition students from local universities conducted the diet recalls. They had previously received training before conducting the recalls.

Demographic variables measured in this study included age and education of the subjects. Age in years was measured based on the number of years since the subject was born until the time this research was conducted. Education was the level of education received by the subject. Education was grouped into junior high school and senior high school.

This study also measured other variables that are related to Hb concentration. These variables were menstrual history (menarche, days of bleeding per menses, and menstruation during Hb examination), illness, and habit of drinking tea and coffee. Menarche was measured based on the subject's age in years when she first got her period. Days of bleeding per menses was the average number of days the subject has menstruation each month. The data on menstruation during Hb examination was measured by asking subjects whether they were menstruating during the Hb examination. The answer was "yes" if the subject was menstruating during the Hb examination, and "no" if the subject was not menstruating during the Hb examination. Illness was measured by asking the subject whether they had any illnesses such as flu, diarrhoea, etc. in the past month. The answer was "yes" if the subject had been sick in the last month, and "no" if the subject had not been sick in the last month. Data on tea and coffee drinking

habits were obtained from the results of the 2-repeated 24-hour dietary recalls. Subjects were categorised as "yes" if they drank tea or coffee within 2 days of the recall, and "no" if they did not drink tea or coffee during the recall.

Data were analysed using the IBM SPSS Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA). Categorical data were presented in a frequency distribution table, while continuous data were presented in mean±standard deviation (*SD*). Spearman's rank was used to analyse the correlations between data on menstrual history (menarche and bleeding days per menstruation), quantity of dietary intake (consumption of energy, protein, iron, vitamin C, calcium, and phytic acid), and quality of dietary intake with Hb concentration. Independent *t*-test was used to analyse

Table 1. Characteristics of subjects

Variable	*n (%)*	*Mean±SD*	*p-value*
Demographic			
Age (years)		15.2±1.9	0.544[a]
Education level			
Junior high school	146 (42.1)		0.737[c]
Senior high school	201 (57.9)		
Menstrual history			
Menarche (years)		12.0±0.8	0.419[a]
Days of menstrual bleeding (days)		7.1±1.2	0.072[a*]
Menstruating during haemoglobin examination			0.016[b**]
Yes	57 (16.4)		
No	290 (83.6)		
If yes, how many days has it been (*n*=57)			
< 4th day	22 (38.6)		
≥ 4th day	35 (61.4)		
Illness			0.812[c]
Yes	116 (33.4)		
No	231 (66.6)		
A habit of drinking tea			0.236[b*]
Yes	175 (50.4)		
No	172 (49.6)		
A habit of drinking coffee			0.841[c]
Yes	81 (23.3)		
No	266 (76.7)		
Haemoglobin concentration (g/dL)		11.9±1.3	
Anaemia status (*n*=347)			
Normal	183 (52.7)		
Anaemia	164 (47.3)		
Anaemia grouping (*n*=165)			
Mild anaemia	90 (53.9)		
Moderate anaemia	77 (46.1)		

[a]derived from Spearman's rank, [b]derived from Mann-Whitney U test, [c]derived from independent *t*-test

[*]significant at $p<0.25$, [**]significant at $p<0.05$

Table 2. Quantity and quality of dietary intake among subjects

Variable	*Mean±SD*	*p-value*
Quantity of dietary intake		
Energy (kcal)	1431±613	0.134*
Protein (g)	31.5±13.1	0.030**
Iron (mg)	6.7±3.0	0.015**
Haem iron (mg)	1.1±1.1	0.091*
Non-haem iron (mg)	5.6±2.9	0.036**
Vitamin C (mg)	7.5±12.9	0.018**
Calcium (mg)	347.4±212.3	0.728
Phytic acid (mg)	593.3±257.2	0.702
Quality of dietary intake (DQI-A score)		
Dietary quality	27.4± 8.4	-
Dietary diversity	48.3±8.6	-
Dietary equilibrium	25.8±8.3	-
DQI-A score	33.8±5.6	<0.001**

*significant at $p<0.25$, **significant at $p<0.05$

differences in Hb concentration based on education level, illness, and habit of drinking coffee, because the data were normally distributed. Meanwhile, Mann-Whitney U test was used to analyse differences in Hb concentration based on menstruation during examination and habit of drinking tea because the data were not normally distributed. Data were considered statistically significant with a $p<0.05$. Furthermore, variables with a $p<0.25$ in the bivariate analysis were included in the linear regression analysis model.

RESULTS

Subjects who had complete data at the end of the study were 347 people (97.5%). The average age of the 347 subjects was 15 years and more than half had a senior high school education. The average age of the subject's first menstruation was 12 years old, with an average of seven bleeding days per menstruation. There were 16.4% of subjects who were menstruating when Hb concentration was checked and 33.4% of subjects who were sick in the last month. The percentage of subjects who had a habit of consuming tea (50.4%) was almost the same as those who did not. Meanwhile, the percentage of subjects who had the habit of consuming coffee was only 23.3% (Table 1).

The average Hb concentration was 11.9 g/dL with 164 subjects (47.3%) who suffered from anaemia (Hb <12 g/dL). Of the subjects with anaemia, 90 subjects (53.9%) had mild anaemia, 77 subjects (46.1%) had moderate anaemia, and none had severe anaemia (Table 1).

Age ($p=0.544$) and education ($p=0.737$) as demographic variables were not related to Hb concentration. As for menstrual history, age of menarche ($p=0.419$) and days of bleeding per menses ($p=0.072$) were not related to Hb concentration, while Hb concentration differed based on menstrual status during Hb examination ($p<0.05$). Haemoglobin concentration did not differ based on the incidence of illness in the last month ($p=0.812$) and the habit of drinking tea ($p=0.236$) and coffee ($p=0.841$) (Table 1).

The results showed that the average dietary intakes of energy, haem iron, and iron inhibitors (calcium and phytic acid)

Table 3. Final linear regression model to predict the independent variables associated with haemoglobin concentration

Variable	*β*	*Standardised coeff β*	*p-value*	*R*	R^2
Menstruating during haemoglobin examination	0.362	0.107	0.035	0.367	0.135
Quality of the dietary intake	0.062	0.290	<0.001		

were not related to Hb concentration. However, the dietary intakes of protein, total iron, non-haem iron, and iron enhancers (vitamin C) were related to Hb concentration. The results also showed that DQA-I score was related to Hb concentration (Table 2).

At the start of linear regression modelling to predict variables related to Hb concentration, ten variables with a $p<0.25$ were entered into the model. These variables were days of bleeding per menses, menstruation during Hb examination, habits of drinking tea, energy intake, protein intake, iron intake, haem iron intake, non-haem intake, dietary vitamin C intake, and dietary quality. At the end of the modelling, there were only two variables related to Hb concentration, namely menstruation during Hb examination ($p=0.035$) and quality of dietary intake ($p<0.001$) (Table 3).

DISCUSSION

This study showed that anaemia among adolescent girls in Tasikmalaya was 47.3%, which is considered a severe public health problem. This result was close to the screening results conducted by Roche *et al.* (2018), which showed that more than 50% of young women in West Java suffer from anaemia. Research by Agustina *et al.* (2020) stated that in West Java, 45% of young women experience anaemia. This result was also in line with researches in Bangladesh (Kundu *et al.*, 2023) and India (Scott *et al.*, 2022), which stated that the prevalence of anaemia in adolescents were 46.7% and 40%, respectively.

In this study, the consumption of energy, protein, iron, and vitamin C was still below the nutritional adequacy rate in Indonesia. Protein deficiency can cause several clinical syndromes, one of which is anaemia. Low protein consumption causes growth failure and worsens deficiencies of other nutrients, including iron. Protein functions as a carrier of iron to the bone marrow, which is the place for producing red blood cells (Wu, 2016). Small amounts of protein cause less iron to be carried to the bone marrow, causing a decrease in the size and colour of the red blood cells produced. This condition is characterised by low haemoglobin concentration and is known as anaemia (Ford, 2013). Low Hb concentration also occurs due to insufficient iron consumption and iron absorption (Silverberg, 2012).

Globally, most anaemia is caused by iron deficiency. Therefore, anaemia and iron deficiency anaemia are often considered synonyms. In general, an estimated 50% of the incidence of anaemia is iron deficiency anaemia (IDA). IDA occurs when the balance between iron consumption, the presence of iron stores in the body, and iron loss is insufficient for forming red blood cells or erythrocytes (Miller, 2013). A community-based survey conducted in several countries showed a specific contribution from iron deficiency in causing a high prevalence of anaemia (CDC & WHO, 2005).

In this study, dietary quality scores were correlated with Hb concentration. Research in Jambi Province, Indonesia also stated that there was a relationship

between dietary quality and Hb concentration in female adolescents (Merita *et al.*, 2019). Agustina *et al.* (2020) stated that an increase in DQI-A score was associated with a higher Hb concentration. Another factor related to anaemia in this study was menstruation during Hb examination. Menstrual bleeding is a major contributor to anaemia, therefore it should not be ignored in controlling anaemia (Nieblas-Bedolla, 2021).

This study had several limitations. Firstly, our study could not draw a causal relationship due to the cross-sectional nature of our data. Secondly, we used the recall method, which may lead to potential memory bias. The strength of this study was that we measured all components of the diet, including quantity and quality of dietary intake. In addition, we also measured other variables that might affect Hb concentration (menstrual history, illness, habit of drinking tea and coffee, calcium intake, and phytic acid intake).

CONCLUSION

Anaemia among female adolescents in Tasikmalaya, West Java, Indonesia, is a serious public health problem. Bleeding days per menstruation and dietary quality were observed to be related to Hb concentration (p<0.05). Quality of dietary intake needs to be improved to prevent anaemia.

Acknowledgement

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Authors contributions

Hidayanti L, head researcher, conceptualised and designed the study, led the data collection and data analysis, wrote the manuscript; Saraswati D, supervised data collection, assisted in data analysis and interpretation, reviewed the manuscript; Aisyah ES, supervised data collection and reviewed the manuscript.

Conflict of interest

We declare no conflict of interest in this study.

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Effects of nut and legume powder substitution in crackers prepared with wheat flour on postprandial plasma glucose response among healthy Thai adults

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ABSTRACT

Introduction: Crackers, one of the most consumed baked products, primarily contain refined wheat flour and have a moderate glycaemic index (GI). Nut and legume powders are used in baked goods to help regulate postprandial glycaemia; however, their glycaemic responses remain controversial. Our study aimed to compare the postprandial glycaemic responses between crackers with 30% wheat flour substitution by white kidney beans, cashew nuts, and almonds versus standard wheat crackers. **Methods:** Twelve adults were recruited for a five-session randomised controlled crossover study. In each session, they were randomly assigned to receive 50g carbohydrates from either a glucose solution or one of the four crackers. Plasma glucose levels were measured at baseline and 15, 30, 45, 60, 90, and 120 minutes after consumption. Satiety and hunger were evaluated using 100mm visual analogue scales at baseline and every 30 minutes until 120 minutes. **Results:** Mean incremental area under the curve (IAUC) for plasma glucose did not differ between the alternatives and wheat crackers, but was lowest for almond crackers. Compared with GI value of glucose solution, that of wheat, cashew nut, white kidney bean, and almond crackers were 39.97±23.13, 37.66±24.66, 35.85±10.86, and 28.09±17.92, respectively. Almond cracker consumption resulted in the highest mean IAUC for satiety and lowest for hunger, though non-significant. **Conclusion:** Crackers with 30% wheat flour substitution by nut and legume powders tended to improve postprandial glycaemia more than the standard crackers; however, acute responses on insulin and glucagon-like peptide-1 require further examination.

Keywords: cracker biscuit, flour substitutes, glycaemic response

INTRODUCTION

Postprandial hyperglycaemia is defined as a significant increase in plasma glucose levels after food consumption. It has a substantial effect on the development of type 2 diabetes, as well as microvascular and macrovascular complications linked to other illnesses (Ratner, 2001). Large quantities of starchy foods, especially refined grains, contribute to an elevation in blood glucose levels in addition to sugar. More consumption of refined grain has been reported to be strongly associated with higher fasting blood glucose levels (Radhika *et al.*, 2009). On the other hand, consuming intact whole grains results in a lower glycaemic response value than consuming refined

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grains (Musa-Veloso *et al.*, 2018). Similar to other epidemiological findings, increased consumption of nuts and legumes is associated with a reduced risk of diabetes and cardiovascular disease (Afshin *et al.*, 2014; Aune *et al.*, 2016). Hence, it is challenging and intriguing to develop functional foods containing whole grains, nuts or legumes to better control glycaemic responses and reduce the prevalence of diabetes.

Currently, the consumer demand for a variety of foods and/or baked products consisting of low glycaemic index (GI) flour, particularly alternative powders such as nut and legume powders is increasing. This expanding demand aims to regulate blood glucose levels and achieve more nutritional benefits (Hussain *et al.*, 2020; Lestari, Huriyati & Marsono, 2017). Cracker biscuits, typically known as crackers, are one of the most popular baked snack foods manufactured primarily from more than 80% refined wheat flour (WF) (Chavan *et al.*, 2016). According to Atkinson *et al.* (2021), plain crackers have a moderate GI. Despite this, excessive intake of crackers might be detrimental to health; therefore, the development of innovative low GI crackers is essential. Numerous studies have focused on formulating crackers by replacing WF with other ingredients, such as cashew nut flour, almond drink dregs-based flour, pigeon pea (PP) flour, soy flour, and rice bran (Gbenga-Fabusiwa *et al.*, 2019; Mishra & Chandra, 2012; Owiredu, Laryea & Barimah, 2014; Santoso & Pamungkaningtyas, 2022).

In the production of crackers, the highest overall acceptance score has been obtained when up to 30% of nut and legume powders are substituted for WF (Owiredu *et al.*, 2014; Wongdokmai & Prachansuwan, 2023). A limited number of studies have investigated the GI of newly developed crackers. In a recent study, the GI of biscuits produced with WF only was higher than that of biscuits made with PP flour and WF (Gbenga-Fabusiwa *et al.*, 2019). Similarly, water chestnut and barley flours were mixed together to produce a cracker with a low GI of 30.2 (Hussain *et al.*, 2020). The predicted GI of biscuits containing lentil or legume flour was reported to be slightly lower than those without lentil or legume flour (Di Cairano *et al.*, 2021). Hence, it has been proposed that crackers produced with WF partially substituted with alternative powders might be helpful for people with diabetes and/or those needing to control their blood glucose levels.

In the International Tables of Glycemic Index and Glycemic Load Values 2021 (Atkinson *et al.*, 2021), the glycaemic responses of a number of foods are provided; nevertheless, information on nuts, legumes, and their products remains scarce. Previously, we developed alternative crackers by replacing 30% of WF with three alternative powders: cashew nut, almond, and white kidney bean powders, which yielded the highest overall acceptance score (Wongdokmai & Prachansuwan, 2023). Nevertheless, it is necessary to comprehend the glycaemic response of our recently developed crackers to ensure that these crackers can help in postprandial plasma glucose management. Therefore, the present study aimed to compare the postprandial glycaemic response of crackers made with alternative powders (white kidney bean, cashew nut, and almond powders) with that of standard crackers among healthy Thai adults.

MATERIALS AND METHODS

Study design

This study was a single-blind, randomised controlled crossover trial. The participants attended one screening visit and five test visits involving the consumption of four different types of

Table 1. Formulation of wheat and alternative crackers

Component	*Content (g)*			
	Wheat	*Cashew nut*	*Almond*	*White kidney bean*
Wheat flour	100	70	70	70
Cashew nut powder	-	30	-	-
Almond powder	-	-	30	-
White kidney bean powder	-	-	-	30
Butter	30	30	30	30
Monk fruit sweetener	15	15	15	15
Plain milk (liquid)	15	15	15	15
Salt	1	1	1	1
Egg	13	13	13	13
Vanilla powder	1.7	1.7	1.7	1.7
Milk powder	5	5	5	5
Baking powder	0.3	0.3	0.3	0.3

crackers and a standard 50 g glucose solution as reference.

Sample size

According to a review by the Food and Agriculture Organization (1998)/ World Health Organization, analyses of glycaemic response and GI in humans have been mostly conducted among ten individuals. In the current investigation, a sample size of twelve participants was considered adequate to account for inter-individual variability.

Study participants

Twelve healthy adults (six men and six women) were recruited to participate in the study. The inclusion criteria were males and females (non-pregnant and non-lactating), aged between 20 and 60 years, with body mass index (BMI) between 18.5 and 22.9 kg/m^2, non-smoking and non-alcohol drinking, and no history of food allergies. The exclusion criteria were diabetes, liver disease, kidney disease, thyroid disease, heart disease, and other diseases that could affect glucose metabolism, as well as the use of oral hypoglycaemic agents, insulin therapy, nutritional supplements, herbal medicines, and other medications including antipsychotics, antihypertensives, oral contraceptives, and anti-osteoporotic drugs within the past month prior to the study. All participants signed an informed consent form before participating in the study. This study was conducted following the principles of the Declaration of Helsinki. The study protocol was approved by the Naresuan University-Network of Research Ethics Committee (COA No. 0020/2022), and was registered in the Thai Clinical Trials Registry (TCTR) (TCTR20221211001; (https://www.thaiclinicaltrials.org/show/TCTR20221211001, accessed on 10 December 2022).

Description of cracker products

Four types of crackers were produced using the same formulation, except for the types of flour used. Standard crackers were formulated with 100% WF and other ingredients (butter, egg, milk, erythritol, vanilla powder, salt, and baking soda). The other three types of crackers were made with alternative powders including cashew nut, almond, and white kidney bean powders, which replaced 30% of WF. The ingredient details of the crackers are illustrated in Table 1. All crackers were prepared according to the same process: briefly,

butter was beat with salt until it became creamy, then sugar, eggs, and milk were added. Thereafter, flour and other dry ingredients were sieved, mixed, and blended until they became well-homogenised. The dough was kneaded manually and pressed into a 2 mm thick sheet, cut into 3.5 × 4.5 cm pieces, and baked at 150°C for 15 minutes.

Study protocol

1. Screening visit

Eligible volunteers were requested to fast overnight before coming into the hospital in the morning for screening. Informed consent was obtained before any measurements or blood draws were done.

Anthropometric measurements

Height was measured using a stadiometer (Seca Limited, Birmingham, West Midlands, Middlesex, UK), while body weight and body composition were measured using a bioelectrical impedance analysis machine (Tanita BC-418, Tokyo, Japan). BMI was calculated using the standard formula: weight (in kilograms) divided by height (in meters) squared.

Biochemical measurements

A 5-mL sample of whole blood was collected from a forearm vein by a registered nurse. Blood glucose, insulin, and haemoglobin A1C were analysed using the enzymatic method (Cobas C501 analyser, Germany), electrochemiluminescence immunoassay method (Cobas E801 analyzer, Germany), and turbidimetric inhibition immunoassay method (Cobas C501 analyser), respectively. The intra-assay and inter-assay coefficients of variation were 1.90% and 1.97% for plasma glucose, 2.38% and 4.9% for serum insulin, and 1.99% and 2.64% for haemoglobin A1C (HbA1c), respectively. The Homeostasis Model Assessment–Insulin Resistance (HOMA-IR) index was calculated and presented for the general characteristics.

Clinical measurements

Systolic and diastolic blood pressures were measured using an automatic blood pressure monitor (Omron HEM-8712, Vietnam).

Dietary assessments

Participants were requested to record their food consumption for three days (two weekdays and one weekend day) before the screening visit. Energy, carbohydrate, protein, and fat intakes were calculated using the INMUCAL-Nutrients software version 4.0, Mahidol University. All dietary data were used for standardised dinner estimation and preparation.

2. Test visit

Participants were given a standardised dinner the night before every test visit (before 8 p.m.). The standardised meal consisted of rice and stir-fried chicken, based on their energy and nutrient requirements. The participants were asked to refrain from performing vigorous activities and consuming caffeine and alcohol on the day before the test visit. The participants were randomly assigned to the sequences of treatments using an online computer software (randomizer.org). All five test visits were separated by at least a 1-week washout period to minimise the carry-over effects.

For each test visit, the participants consumed 50 g of available carbohydrates from either the crackers or glucose solution along with 200 mL of plain water. The nutritional values of each cracker are listed in Table 2. The nutritional values of the crackers were analysed in duplicate according to standard methods. Protein, fat, moisture, ash, and dietary fibre contents were evaluated using the Kjeldahl's method (AOAC

Table 2. Proximate composition of wheat and alternative crackers

Component	*Content (g)*			
	Wheat	*Cashew nut*	*Almond*	*White kidney bean*
Energy (kcal)	458±0	469±1	482±0	446±0
Moisture (g/100 g)	0.23±0.00	0.30±0.09	0.16±0.01	0.64±0.03
Carbohydrate (g/100 g)	78.95±0.13	73.72±0.00	70.62±0.13	77.26±0.07
Fat (g/100 g)	12.59±0.02	15.44±1.00	17.65±0.01	11.28±0.02
Protein (g/100 g)	6.97±0.11	8.84±0.02	9.82±0.09	9.11±0.08
Dietary fibre (g/100 g)	2.37±0.06	3.13±0.01	3.24±0.11	9.58±0.53
Ash (g/100 g)	1.27±0.00	1.70±0.00	1.74±0.00	1.81±0.00

991.20), the direct extraction method (ISO 2450), the drying method (AOAC 990.19), the drying ash method (AOAC 920.10), and the enzymatic gravimetric method (AOAC 985.29), respectively. Carbohydrate contents were calculated as follows: 100 – moisture – protein – fat – ash, based on the Atwater factor (4 kcal for protein and carbohydrates, and 9 kcal for fat). The obtained values were calculated for 50 g of available carbohydrates as follows: available carbohydrate = 100 – (moisture+ protein + fat + dietary fibre + ash).

When the participants arrived at the appointed time, an indwelling intravenous cannula was inserted into a forearm vein by a registered nurse. A 3-mL baseline blood sample was taken after a 10- to 12-hour overnight fast. Subsequently, the participants were instructed to consume either the crackers or glucose solution within 10 minutes. Postprandial blood samples were collected at 15, 30, 45, 60, 90, and 120 minutes to analyse the plasma glucose levels. Throughout the test visit, the catheter line was kept covered with 3 mL of normal saline to prevent blood clotting. The participants were asked to sit and limit physical movements during the intervention. After 120 minutes, the catheter was removed, and the test visit was completed. The same protocol was repeated for all test visits. The plasma was centrifuged at 2,000 rpm for 10 minutes. Glucose levels from the plasma samples at each time point were determined using the enzymatic method (Cobas C501 analyzer, Germany).

One hundred-millimetre continuous-line visual analogue scales (VASs) were utilised to measure subjective feelings of satiety and hunger. The participants were asked to answer the VAS questionnaires at baseline and every 30 minutes until 120 minutes. Each feeling was rated by placing a mark across each line on the paper and the participants were not able to refer to their previous ratings when completing the questionnaires.

Incremental area under the curve (IAUC) calculation

The IAUC for plasma glucose, satiety, and hunger for reference food and test crackers were calculated geometrically using the trapezoidal rule via Prism version 5.01 (GraphPad, USA). All areas below the baseline were excluded from the calculations. Mean and standard deviation (*SD*) of IAUC for the reference food and test crackers were calculated.

Glycaemic index (GI) and glycaemic load (GL) calculations

The GI values were calculated by expressing the IAUC for glucose response of test crackers as a percentage of the IAUC for glucose response of the standard glucose solution for each participant. The GL of the crackers was

Table 3. General characteristics of the study participants (*N*=12)

Characteristic	*Value*†
Sex, *n* (%)	
Male	6 (50.0)
Female	6 (50.0)
Age, year	26.8±8.8
BMI, kg/m^2	21.3±1.5
Waist circumference, cm	73.9±5.4
Body composition	
Body fat, %	18.8±10.8
Lean body mass, kg	44.5±8.7
Systolic blood pressure, mmHg	116±10
Diastolic blood pressure, mmHg	74±12
Fasting plasma glucose level, mmol/L	4.9±0.4
Fasting serum insulin level, pmol/L	57.9±23.4
HbA1c level, %	5.1±0.3
HOMA-IR index	1.8±0.8

BMI: Body mass index; HOMA-IR: Homeostasis model assessment–insulin resistance
†The values are presented as *n* (%) or mean±*SD*

computed by multiplying the GI of each cracker by the proportion of available carbohydrates in a usual portion size (30 g of crackers) divided by 100.

Statistical analysis

Statistical analysis was performed using the PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago). Data were expressed as means±*SD*s. Two-tailed $p<0.05$ was considered significant. Distribution of data was analysed using the Shapiro–Wilk test. Repeated measures analysis of variance (ANOVA) was used to evaluate postprandial plasma glucose level, satiety score, and hunger score, testing for time × treatment interactions and the effect of time and test crackers separately. One-way ANOVA with Bonferroni's test was used to determine the significance of mean differences between the groups.

RESULTS

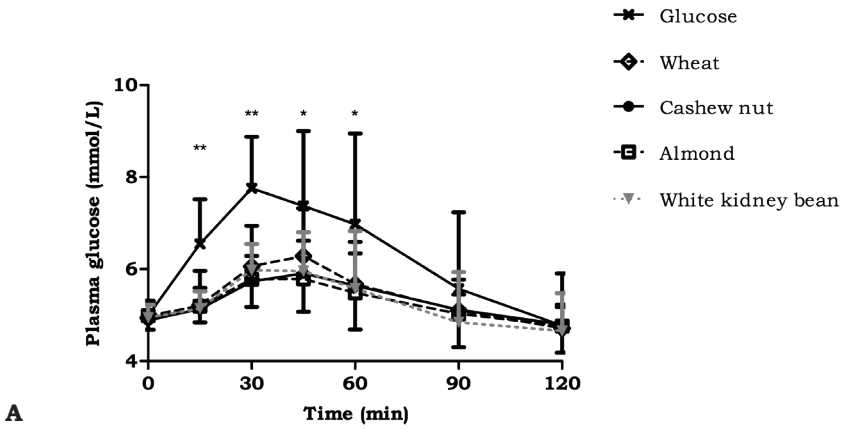
Characteristics of the study sample

Twelve healthy Thai adults completed the study, and their general characteristics are shown in Table 3. Equal numbers of men and women were recruited. Mean BMI was 21.3±1.5 kg/m^2. The participants were apparently healthy and had normal BMI, plasma glucose level, HbA1c level, and HOMA-IR index.

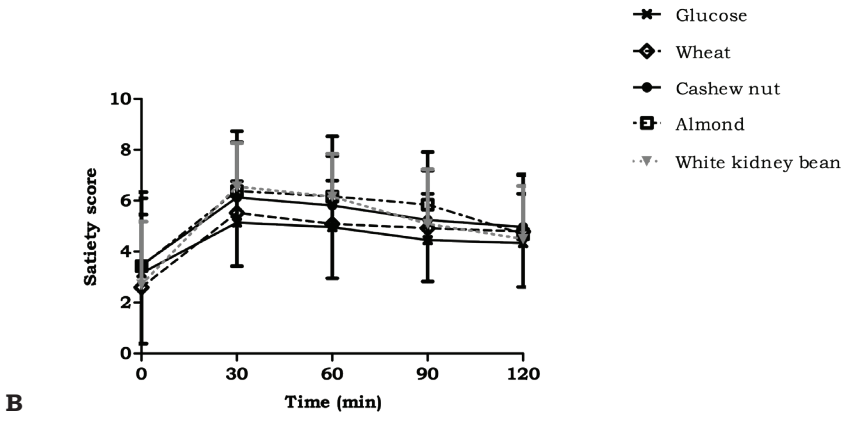
Comparison of plasma glucose responses

Figure 1A displays the plasma glucose responses following consumption of the glucose solution and four test crackers. Plasma glucose concentration peaked at 30 minutes after consuming either the glucose solution or the test crackers and then returned to baseline levels within 2 hours, as shown in Supplementary Table 1. Mean IAUC for plasma glucose was substantially higher after glucose solution consumption than after test cracker consumption (Table 4). Although the mean IAUC for plasma glucose after test cracker consumption was not significantly different from that after wheat cracker consumption, it appeared to be lower, especially for almond crackers (Table 4).

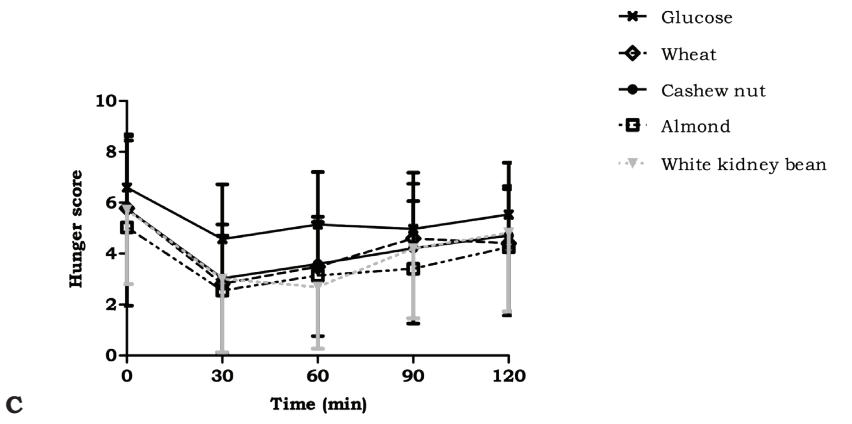
The GI values of wheat, cashew nut, white kidney bean, and almond crackers



A



B



C

Figure 1. Acute response effects on plasma glucose level (A), satiety score (B), and hunger score (C) after consumption of glucose solution and four test crackers. The values are presented as mean±*SD*. The mean values are significantly different from each other: $^{*}p<0.05$, $^{**}p<0.01$, which were determined using repeated measures ANOVA with Bonferroni's correction for *post-hoc* comparisons between treatments.

Table 4. IAUC for plasma glucose, hunger, and satiety in response to consumption of glucose solution and four test crackers in healthy Thai adults

Parameter	*Glucose solution*	*Cracker*			
		Wheat	*Cashew nut*	*Almond*	*White kidney bean*
Glucose IAUC (mmol min/L)	179±107[a]	71±46[b]	63±36[b]	50±32[b]	64±44[b]
Satiety IAUC (score min)	549±180[a]	577±219[a]	643±208[a]	674±236[a]	641±177[a]
Hunger IAUC (score min)	623±156[a]	480±152[a]	482±182[a]	412±212[a]	455±222[a]

IAUC: Incremental area under the curve
The values are presented as mean±*SD*. The IAUC was calculated using Prism version 5.01. The mean values at each treatment (same row) with different superscript letters are significantly different ($p<0.05$), which were determined using one-way ANOVA with Bonferroni's correction for *post-hoc* comparisons.

were 39.97±23.13, 37.66±24.66, 35.85±10.86, and 28.09±17.92, respectively, in comparison with glucose solution. When considering a standard portion of crackers, the GL values for the wheat, cashew nut, white kidney beans, and almond crackers were observed to be low (≤10), with values of 9.18, 7.97, 7.28, and 5.68, respectively.

Comparison of satiety and hunger scores

Satiety scores reached their peak at 30 minutes after consuming either the glucose solution or test crackers and then returned close to baseline levels within 2 hours (see Supplementary Tables 2 and 3). As illustrated in Figures 1B and 1C and Table 4, ingestion of almond crackers was likely to result in the mean IAUC for satiety being the highest and for hunger being the lowest. Mean IAUC for satiety for wheat crackers and glucose solution tended to be lower than that for the three test crackers, although the differences were not significant. Moreover, there was no difference in the mean IAUC for hunger between the four test crackers and glucose solution.

DISCUSSION

The present study demonstrated that even though there was no significant difference between alternative crackers and wheat crackers, the crackers partially made with nut and legume powders tended to yield greater benefits on postprandial glycaemic responses among healthy Thai participants than the standard crackers. This finding could be attributed to the sugar-free cracker recipe we created. In the study, newly developed crackers were prepared using a non-nutritive sweetener in place of sugar; therefore, no significant difference was observed between the crackers. Consistently, our wheat crackers appeared to have a lower GI than those in a previous report (Atkinson *et al.*, 2021).

Herein, it was observed that the postprandial glycaemic response of alternative crackers had a slightly beneficial impact on regulating plasma glucose levels compared to wheat crackers, potentially attributable to the substitution of nut and legume powders. Generally, nuts have a relatively low GI of 22±1, whereas legumes have a slightly higher GI of 34±14 (Atkinson *et al.*, 2021). The glycaemic response values of alternative crackers made with almonds, cashew nuts, and white kidney beans as a substitute for 30% of WF were therefore slightly higher than the previously reported values of nuts and legumes (Atkinson *et al.*, 2021). In

Supplementary Table 1. Baseline and postprandial plasma glucose concentrations after consumption of test diets at the different time points

Time (*min*)	*Plasma glucose concentration (mmol/L)*				
	Glucose solution	*Wheat cracker*	*Cashew nut cracker*	*Almond cracker*	*White kidney bean cracker*
0	4.99±0.28[a]	4.94±0.37[a]	4.89±0.42[a]	4.99±0.30[a]	4.94±0.28[a]
15	6.55±0.97[b]	5.21±0.75[a]	5.13±0.46[a,b]	5.19±0.35[a,b]	5.14±0.37[a,b]
30	7.76±1.12[c]	6.06±0.88[b,c]	5.73±0.55[b]	5.78±0.60[b]	5.98±0.57[b,c]
45	7.37±1.63[b,c]	6.28±1.04[b,c]	5.91±0.71[b]	5.79±0.72[b]	5.95±0.85[b,c]
60	6.98±1.97[b,c]	5.67±0.92[a,b]	5.64±0.70[a,b]	5.48±0.79[a,b]	5.58±1.25[b,c]
90	5.57±1.66[a]	5.10±0.67[a,b]	5.12±0.33[a,b]	5.03±0.73[a,b]	4.84±1.09[a,b]
120	4.77±1.13[a]	4.71±0.52[a,b]	4.80±0.38[a]	4.76±0.58[a]	4.65±0.83[a,b]

The values are presented as mean±*SD*. The means values at each time of measurements (same column) with different superscript letters are significantly different ($p<0.05$), which were determined using repeated measures ANOVA and Bonferroni's correction for *post-hoc* comparisons.

Supplementary Table 2. Satiety scores at baseline and after consumption of test diets at the different time points

Time (*min*)	*Satiety score*				
	Glucose solution	*Wheat cracker*	*Cashew nut cracker*	*Almond cracker*	*White kidney bean cracker*
0	3.2±2.3[a]	2.6±2.2[a]	3.5±2.6[a]	3.4±2.9[a]	2.7±2.5[a]
30	5.1±1.6[a]	5.5±2.1[b]	6.1±2.2[b]	6.4±2.3[b]	6.6±1.7[b]
60	5.0±1.8[a]	5.1±2.1[b]	5.8±1.9[b]	6.2±2.4[b]	6.2±1.7[b,c]
90	4.5±1.8[a]	4.9±2.1[b]	5.2±1.9[a,b]	5.8±2.1[b]	5.1±2.2[c]
120	4.3±1.9[a]	4.8±2.2[a,b]	5.0±2.0[a,b]	4.7±2.3[a]	4.5±2.1[a,c]

The values are presented as mean±*SD*. The means values at each time of measurements (same column) with different superscript letters are significantly different ($p<0.05$), which were determined using repeated measures ANOVA and Bonferroni's correction for *post-hoc* comparisons.

Supplementary Table 3. Hunger scores at baseline and after consumption of test diets at the different time points

Time (*min*)	*Hunger score*				
	Glucose solution	*Wheat cracker*	*Cashew nut cracker*	*Almond cracker*	*White kidney bean cracker*
0	6.6±2.0[a]	5.8±2.9[a]	5.8±2.7[a]	5.0±3.1[a]	5.7±2.9[a]
30	4.6±2.1[a]	2.8±1.9[a]	3.0±2.1[a]	2.5±2.5[a]	3.0±2.9[a,b]
60	5.1±2.1[a]	3.5±1.7[a]	3.6±1.9[a]	3.1±2.4[a]	2.7±2.4[b]
90	5.0±2.2[a]	4.6±2.2[a]	4.2±1.9[a]	3.4±2.1[a]	4.2±2.7[a,b]
120	5.5±2.0[a]	4.4±2.2[a]	4.7±1.8[a]	4.3±2.7[a]	4.8±3.1[a]

The values are presented as mean±*SD*. The means values at each time of measurements (same column) with different superscript letters are significantly different ($p<0.05$), which were determined using repeated measures ANOVA and Bonferroni's correction for *post-hoc* comparisons.

a review, the postprandial glycaemic response value of food products enriched with legumes appeared to be lower than that of original food products, depending on the level of substitution (Binou, Yanni & Karathanos, 2022).

In a previous study, biscuits made with PP flour mixed with WF at a ratio of 25% to 75% displayed a lower GI than biscuits made with WF by at least 5% (25% PP, 55.60±0.53; 50% PP, 51.16±1.12; 75% PP, 44.70±0.52; WF, 60.59±0.37) (Gbenga-Fabusiwa *et al.*, 2019). Another prior study revealed that mixed nuts significantly reduced the 2-hour postprandial glycaemic response when combined with 50 g of available carbohydrates from white bread in a dose-response manner (Kendall *et al.*, 2011). Similarly, consuming 30, 60, or 90 g of almonds along with white bread can blunt the postprandial glycaemic response of white bread in a dose-dependent manner, as shown by a GI of 106, 63, and 45, respectively (Josse *et al.*, 2007). These results confirmed the findings of the current investigation that substituting 30% of WF with nut or legume powders could achieve a postprandial glycaemic response reduction of 4% or higher. Hence, the level of substitution or quantity of legume or nut powders is one of the crucial factors influencing postprandial glycaemic response of food products.

Although there were no significant differences in the glycaemic responses of the four test crackers, the crackers produced with almond powder had the lowest glycaemic response value. This finding could be explained by the fact that almond crackers have a higher energy density than cashew nut, white kidney bean, and wheat crackers. In a prior study, there was a positive correlation between increased energy and gastric-emptying time after consumption of a meal containing different energy and macronutrients (Westphal *et al.*, 2004). Food products with a higher energy density and fat content would slow down the rate of gastric emptying, consequently reducing postprandial glycaemic response and increasing satiety (Tan, Dhillon & Mattes, 2014). Our almond crackers consistently contained the highest number of calories and fat among the crackers; this might be the reason why a better glucose response and increased satiety were achieved from almond crackers.

In the present study, the responses in terms of blood glucose levels and satiety scores after consumption of the white kidney bean and cashew nut crackers were similar. These results may be explained by the fact that white kidney bean crackers have greater dietary fibre content than cashew nut crackers, which have higher fat content. The comprehensive review by Russell *et al.* (2016) revealed that the type and amount of fibre play a key role in slowing the rate of carbohydrate digestion and absorption, as well as gastric emptying, resulting in beneficial effects on postprandial glycaemic control and insulinemic response. Likewise, as aforementioned, consuming oil/fat could slow the gastric-emptying rate and delay a rise in blood glucose, insulin, and glucose-dependent insulinotropic polypeptide levels in people with type 2 diabetes (Gentilcore *et al.*, 2006). It would be plausible to state that dietary fibre or fat content affects satiety level and glycaemic response.

This study had some strengths. Firstly, the crossover study was conducted among the same individuals and the participants were given a standardised dinner meal to control inter-day alterations. Secondly, the crackers were prepared with the same ingredients, except for the ratio of alternative powders to WF, so the effects

on plasma glucose would arise from the nut and legume powders. However, iso-calories and iso-macronutrients, as well as a similar serving size could not be provided to the participants, which might have influenced gastric emptying and gut hormone secretion, consequently leading to different glycaemic responses. Additionally, the study protocol did not strictly adhere to ISO26642:2010 guidelines, especially concerning the lack of repeated tests for the reference food or glucose solution. Ideally, this response should have been assessed repeatedly, with each participant undergoing the test at least three times. This non-adherence could potentially contribute to an increase in the effect of day-to-day variations in glucose tolerance.

CONCLUSION

Based on the present findings, crackers produced with 30% WF substitution by nut and legume powders tended to have more benefits on postprandial glycaemia than standard crackers prepared with 100% WF. However, the acute responses on insulin and glucagon-like peptide-1 should be further examined.

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Authors' contributions

Wongdokmai R, performed the study, collected the data, and reviewed the manuscript; Sridonpai P, analysed the data and reviewed the manuscript; Prachansuwan A, conceptualised and designed the study, prepared the draft of the manuscript, and finalised the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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Correlation between body mass index and haemoglobin level of adolescent girls in a stunting locus area at Tangerang, Indonesia

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ABSTRACT

Introduction: In Indonesia, anaemia is known to be extremely common in female adolescents. In addition, the problem of overweight/obesity in teenagers is becoming more prevalent, even in stunting locus areas. This study aimed to examine the correlation between body mass index (BMI) and haemoglobin levels among adolescent girls in Tangerang's stunting locus area. **Methods:** This cross-sectional study included 171 adolescent girls attending four junior and senior high schools in Tangerang's stunting locus area. Adolescents who matched the inclusion criteria— healthy, having lived in Sukamantri for more than six months, and willing to participate were chosen by a multistage cluster sampling procedure. Body weight and fat were measured, and Z-score for BMI-for-age was determined. Haemoglobin levels were measured by the Mission Hb Testing System. Multiple linear regression test was applied for the analysis. **Results:** The prevalences of thinness/severe thinness, normal, and overweight/obesity were 5.3%, 70.8%, and 23.9%, respectively. There were 20% of anaemic girls. Among anaemic girls, there were 26% overweight/obese and no thin/very thin girls. A weak, negative correlation between BMI with haemoglobin levels was observed (R^2=0.054, p<0.001). **Conclusion:** The correlation between BMI and haemoglobin level was weak in our sample of adolescent girls in the stunting locus area. The current study emphasised the importance of additional research that includes several haematological and inflammatory biomarkers to better understand the complex relationship between nutritional status and haemoglobin level.

Keywords: adolescent girls, anaemia, body fat, body mass index

INTRODUCTION

Anaemia is a serious global public health issue that particularly affects female adolescents. It is known to be extremely common in low-income countries and more common in the female population. Anaemia is defined as haemoglobin (Hb) levels <12.0 g/dL in women (Varghese *et al*, 2019). Untreated anaemia in adolescence increases anaemia risk in pregnancy. The latest national data showed that there is a dramatic increase in anaemia prevalence among pregnant women reaching 48.9%. The prevalence of anaemia in female adolescents is also increasing at an alarming rate (Ministry of Health Republic of Indonesia, 2019). Anaemia in adolescence results

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in decreased mental and physical capacities, as well as educational performance (Sari *et al.,* 2022). It also causes a serious threat to future safe pregnancy in adolescent girls (Handari, Anies & Nugraheni, 2022).

Anaemia is caused by a poor intake of nutrients, particularly iron. Although it is known that a deficiency in iron causes 50.0% of all anaemia cases, it is still important to assess the cause of anaemia based on specific and local factors. Deficiencies in protein, vitamins A and B12, copper, and folate can also cause anaemia, as well as malaria, human immunodeficiency viruses (HIV), tuberculosis, and parasitic infections (Mrimi *et al,* 2022). Anaemia results in a variety of symptoms, including fatigue, weakness, sleepiness, shortness of breath, and dizziness. In addition, anaemia has been linked to lower levels of academic achievement and productivity.

On the other hand, overweight/obesity is one of the most frequently stated problems in adolescents and a growing public health concern. After Singapore, Indonesia has the second highest percentage of obese teenagers (12.2%), followed by Thailand (8%), Malaysia (6%), and Vietnam (4.6%) (Liberali, Kupek & Assis, 2020). Based on a national survey, the prevalence of obesity among teenagers has increased two to three times from 1993 to 2014 (Oddo, Maehara & Rah, 2019).

Indonesia has a 20% prevalence of overweight and obese teenagers between the ages of 13 and 15 years and a 13.6% prevalence of obese adolescents between the ages of 16 and 18 years. Compared to 2013, there has been a rise in the prevalence of obese teenagers in Indonesia. The prevalence of obesity among adolescents aged 13 to 15 years has climbed by 0.4%, while the prevalence of obesity among adolescents aged 16 to 18 years has increased by 2.2% (Ministry of Health Republic of Indonesia, 2019). The prevalence of overweight/obesity is increasing more in adolescent girls than in boys (Rachmi, Li & Alison Baur, 2017).

Anaemia is often multifactorial and not an independent phenomenon. Recently, considerable literature has grown around the theme of the co-occurrence of overweight/obesity and anaemia. A cross-sectional study using the most recent Health Surveys of 52 countries showed an increased tendency of anaemia and obesity concomitantly in adolescent girls (Irache, Gil & Caleyachetty, 2022). Studies undertaken in Indonesia provided conflicting evidence concerning the relationship between body mass index (BMI) and anaemia or Hb level. Some cross-sectional studies observed that adolescent girls with overweight were more at risk for anaemia (Sandy et al., 2021; Syah, 2022). However, other cross-sectional studies showed that there were no relationships between overweight/obesity with anaemia (Adiyani *et al.,* 2020; Mulyani, Lupiana & Yunianto, 2021). On the other hand, some observed that underweight female adolescents had a higher risk of anaemia (Risna'im *et al.,* 2022; Enggardany et al., 2021).

In Indonesia, the problem of overweight/obesity in teenagers is becoming more prevalent, as is the problem of anaemia, even in stunting locus areas. Numerous initiatives have been put in place by the Indonesian government with the goal of eliminating stunting and reaching the target of 14% by 2024. Combating anaemia in teenage females was where the programme strategy started, particularly in some of Indonesia's stunting locus areas. Nevertheless, overweight and obesity, which have recently increased significantly among girls, even in stunting locus areas, have not been taken into consideration by these programmes

aimed at eliminating anaemia. The programme's efficacy may be hampered if the growing issue of obesity among teenagers in stunting locus areas, who are also susceptible to anaemia, is not taken into account.

There are limited studies on the relationship between BMI and Hb levels in stunting locus areas in Indonesia. This study, therefore, set out to examine the correlation between BMI and Hb levels among adolescent girls in Tangerang's stunting locus area, Indonesia.

MATERIALS AND METHODS

Study design and sampling

This cross-sectional study was conducted in Sukamantri village, a village with significant stunting issues in the Tangerang Regency. Sukamantri has a large population. The high population density was triggered by the establishment of many manufacturing industries. This research was carried out from May to December 2022. This research received ethical approval from the Esa Unggul University Code of Ethics Enforcement Council, Research Ethics Committee, with an ethical review number 0922-10.027 /DPKE-KEP/ FINAL-EA/UEU/X/2022.

In this stunting locus, there were eight junior and high schools, with 756 teenage girls enrolled in total. The study involved adolescent girls attending four schools in Sukamantri village, which included two junior high schools (*SMPN 2 Pasarkemis* and *SMP Tunas Harapan*) and two senior high schools (*SMK Persada* and *SMK Tunas Harapan*). These four schools were chosen over the other four in this stunting locus area due to their higher proportion of female students.

Sample size was counted using the Lemeshow formula (Lwanga *et al*, 1991). This study was a subset of a parent research, which had used the sample size formula to assess the output of an anaemia reduction programme (percentage of anaemia in adolescent girls) in this stunting locus. According to a 23.9% prevalence of anaemia among adolescent girls, a total of 171 samples were taken at a 95% confidence interval and 6.0% absolute deviation of the sample from the population rate. The samples were selected using a multistage cluster sampling method. Firstly, cluster sampling was carried out proportionally to the number of female students in each school. Secondly, a systematic random sampling technique was applied to select samples from each class. The interval in systematic random sampling was determined by dividing the total number of teenage girls enrolled in the school by the required sample size. Based on the sequence of female students' names in the attendance book from classes 1 through 3, the resulting interval number was utilised to choose the subjects.

Criteria for selecting the subjects were as follows: 1) Has lived in Sukamantri for more than six months; 2) Healthy; 3) Not having period at the time of blood collection; and 4) Willing to be a respondent. Exclusion criteria were: 1) Sick; and 2) Absent during the data collection process. Prior to data collection, the respondents received an explanation of the purpose and benefits of the study. Respondents who were willing and agreed to be respondents signed an informed consent sheet.

Data collection

Sociodemographic characteristics of female adolescents, including age, parent's education, family size, experience of receiving counselling on anaemia, menstrual status, and menarche age, were collected using a structured interviewing questionnaire. Body weight and fat were measured by the Bioelectrical Impedance Analyser

(BIA) Tanita BC-541 (Tanita Corp., Tokyo, Japan). Weight measurement was conducted at least two hours after eating or exercise. After tuning on the unit, the setting of respondent's age, gender, and height proceeded. Before stepping on the measuring platform, respondents removed their socks, shoes, and heavy clothing, and were requested to ensure that their feet were clean. Then, respondents were asked to step onto the scale once "0.0" appeared on the display. Weight was displayed first and as respondents continued standing on the scale, body fat percentage reading then appeared on the display.

Height measurement was obtained using a microtoise mounted to a wall. Before taking the measurement, respondents were requested to remove their shoes and stood with their backs to the wall, facing ahead. The backs of their feet, calves, bottom, upper back, and head should be in touching the wall. They should be directly beneath the drop-down of the measurement instrument. Measurements were carried out by trained enumerators.

Hb level was identified by taking capillary blood at the fingertip using the Mission Hb Testing System (Hb within run precision ≤3%; Hb total precision CV ≤3%; accuracy: venous blood R^2:0.992, capillary blood R^2:0.993) (ACON Laboratories Inc, 2023). Some studies observed that Hb concentration determined by the Mission Hb Testing System has comparable and acceptable agreement with that determined by a haematology analyser (Dua, Aggarwal & Sharma, 2021). It works using the reflectance photometry method. The blood sampling techniques were: 1) Remove the first drop of blood; 2) Apply light pressure to get a second drop of blood; 3) Collect 10 µL of capillary blood using a capillary transfer tube or pipette; 4) Hold the tube slightly down and touch the tip of the tube to the drop of blood. Automatically, the blood sample will be drawn up to the filling line; and 5) Align the tip of the tube with the strip area so that a drop of blood (about 10 µL) can be applied to the strip area. Hb measurement was performed by a laboratory analyst.

Data analyses

In descriptive analysis, continuous data were shown as mean and standard deviation (*SD*). Frequency distribution was described based on age, menstruation, nutrition status, percent body fat, family size, parents' education, and experience of getting counselling on anaemia. Based on Nelson Textbook (Kliegman *et al*, 2020), adolescence is a period from 10 to 21 years of age. It is divided into three stages, namely early (10-13 years), middle (14-17 years), and late (18-21 years) adolescence. Age was constructed based on these three age stages for descriptive analysis.

BMI data was determined by BMI-for-age. Z-score for BMI-for-age was determined and classified using the World Health Organization AnthroPlus software (WHO, 2009). BMI was classified into thinness/severe thinness (<-2.01*SD*), normal body weight (-2.00*SD* to +1.00*SD*), and overweight/obesity (>+1.01*SD*) (WHO, 2007). Classification of percent body fat was based on age-specific cut-offs from the body fat reference curves (McCarthy *et al.,* 2006) and divided into two groups (normal and overfat). Hb level was classified as normal if it was 12.0 g/dL or more and anaemic if less than 12.0 g/dL (Varghese *et al*, 2019).

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, N.Y., USA). The normality test used was Kolmogorov–Smirnov. Independent *t*-test and one-way analysis of variance

(ANOVA) were used to compare mean Hb levels by each group. The correlation between BMI and Hb level was analysed using multiple linear regression. The level of statistical significance was set at 5.0%.

RESULTS

The mid-adolescence age range (14–17 years) accounted for the majority (50.9%) of adolescent girls. Typically, the parents have graduated from senior high school. The majority of teenage girls (60.2%) were from small households (≤4 people). Most of the adolescent girls (72.5%) admitted they had never received counselling on anaemia.

A small proportion of adolescent girls were thin or very thin (5.3%). The majority (70.8%) had normal BMI. Prevalence of overweight/obese was 23.9% (14.4% overweight; 9.5% obese). This was a high level (>10.0%) of overweight problem, based on the cut-off for nutrition problems of public health significance (WHO, 2018). The proportion of overweight/obese adolescent girls was nearly five times that of thin/very thin, and higher than the national average (23.9% vs. 13.0%).

Almost one-third (23.4%) of respondents were overfat, whereas 76.6% had normal body fat. The average age of menarche was 11.6+0.9 years. Almost all (97.1%) of them had menstruated. The average Hb concentration was 13.1±1.5 g/dL. Anaemia affected about one in five adolescent girls, which indicates a nutrition problem of moderate public health significance (20.0-39.0%) based on WHO (2015).

There was no anaemia found in thin or very thin female adolescents. Anaemia was more prevalent in overweight/obese and normal-weight girls compared to thin/very thin girls (Table 1). There were no differences in mean haemoglobin levels based on menstrual status, nutrition status (BMI-for-age), level of percent body fat, parents' education, household size, and having received anaemia counselling.

There was no significant correlation between BMI (p>0.05) and Hb levels (Figure 1). A significant correlation between BMI and Hb level was observed (β=-0.550, R^2=0.054, p<0.001) after adjusting for body fat in the multiple linear regression (Figure 2). BMI demonstrated a weak, negative correlation with Hb levels in adolescent girls. Although R^2 was only 5.4%, this does not imply that it is meaningless as it is dependent on the field of study. Studying Hb levels in adolescent girls, which have a wide range of influencing factors, will make it very difficult to obtain much higher r-squared values.

DISCUSSION

This study demonstrated that BMI had a weak, negative correlation with Hb levels in adolescent girls. This finding confirmed a study in India that discovered a negative correlation between BMI and Hb levels (Acharya *et al.*, 2018), as well as another study showing that overweight adolescent girls were more at risk of anaemia (Eftekhari, Mozaffari-Khosravi & Shidfar, 2009).

The present result differs from that of a research on Korean adolescents, which observed that BMI was positively correlated with Hb level (Jeong *et al.*, 2022). The Korean study included boys and girls aged 10-18 years old. The current study was also different from a research on women aged 15-49 years old in Bangladesh, which found that the risk of anaemia was higher in underweight women and decreased in obese/ overweight women when compared to normal women (Kamruzzaman, 2021). The difference in results could be due to the fact that the Korea and Bangladesh studies had, respectively, both genders

Table 1. Distribution of adolescent girls according to sociodemographic characteristics and nutrition status (*n*=171)

Characteristics	*n (%)*	*Haemoglobin (g/dL)*	
		Mean±SD	*p*††
Haemoglobin level	171 (100.0)	13.1±1.5	-
Anaemia status			
Normal	137 (80.1)	13.1±1.5	-
Anaemia	34 (19.9)	10.9±0.9	
Age (years), mean±*SD*	13.7±1.5		-
Age range†			0.331
Early adolescence	77 (45.0)	13.0±1.4	
Middle adolescence	87 (50.9)	13.1±1.5	
Late adolescence	7 (4.1)	13.1±1.6	
BMI-for-age *z-score*, mean±*SD*	0.1±1.4		-
Nutrition status‡			0.683
Thinness/severe thinness	9 (5.3)	13.0±1.5	
Normal	121 (70.8)	13.4±0.9	
Overweight/obesity	41 (23.9)	13.1±1.3	
Body fat %, mean±*SD*	27.5±8.6		-
Percent body fat level			0.509
Normal	131 (76.6)	13.0±1.5	
Overfat	40 (23.4)	13.2±1.2	
Menarche age (year), mean±*SD*	11.6±0.9		
Menstrual status			0.417
No	5 (2.9)	13.6±0.9	
Yes	166 (97.1)	13.0±1.5	
Mother's education§			0.651
Low	67 (39.2)	13.0±1.4	
High	104 (60.8)	13.1±1.5	
Father's education§			0.979
Low	52 (30.4)	13.1±1.4	
High	119 (69.6)	13.1±1.5	
Number of household members (person), mean±*SD*	4.3±1.2		
Household size¶			0.360
Small	103 (60.2)	12.9±1.5	
Moderate	59 (34.5)	13.2±1.4	
Big	9 (5.3)	13.3±1.7	
Having received counselling on anaemia			0.313
Never	124 (72.5)	13.0±1.5	
Ever	47 (27.5)	13.2±1.4	

†Age range: early (10-13 years), middle (14-17 years), and late (18-21 years)
‡Nutrition status: thinness/severe thinness (<-2.01*SD*), normal body weight (-2.00*SD* to +1.00*SD*), and overweight/obesity (>+1.01*SD*)
§Education: low (< senior high school) and high (≥ senior high school)
¶Household size: small (≤4 people), moderate (5-6 people), big (≥7 people)
Classification of percent body fat was based on age-specific cut-offs from the body fat reference curves (McCarthy *et al.,* 2006)
††Independent *t*-test and one-way ANOVA

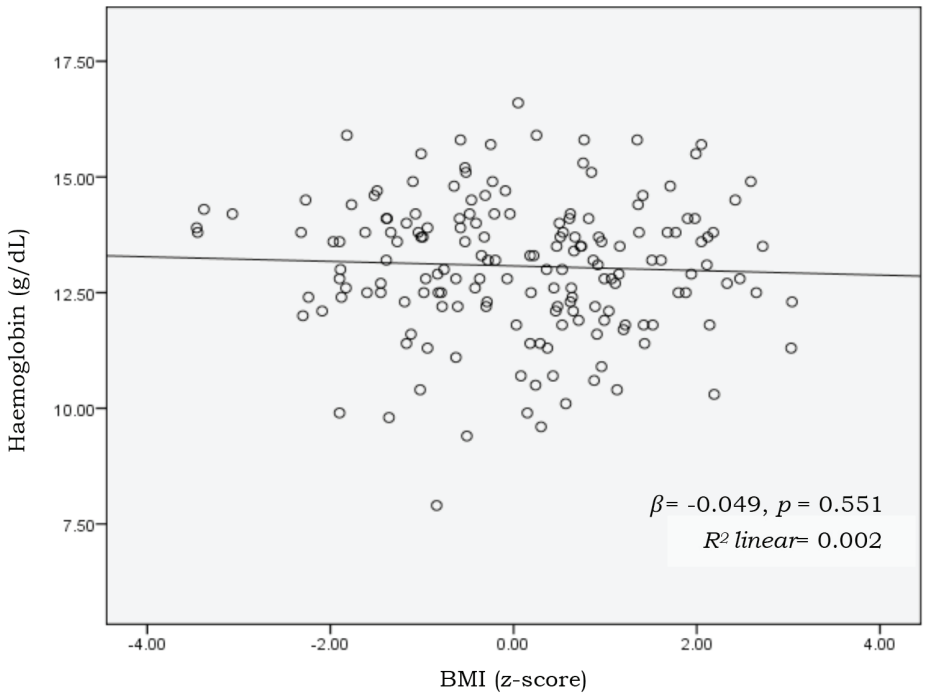

Figure 1. The correlation between BMI and Hb levels among adolescent girls

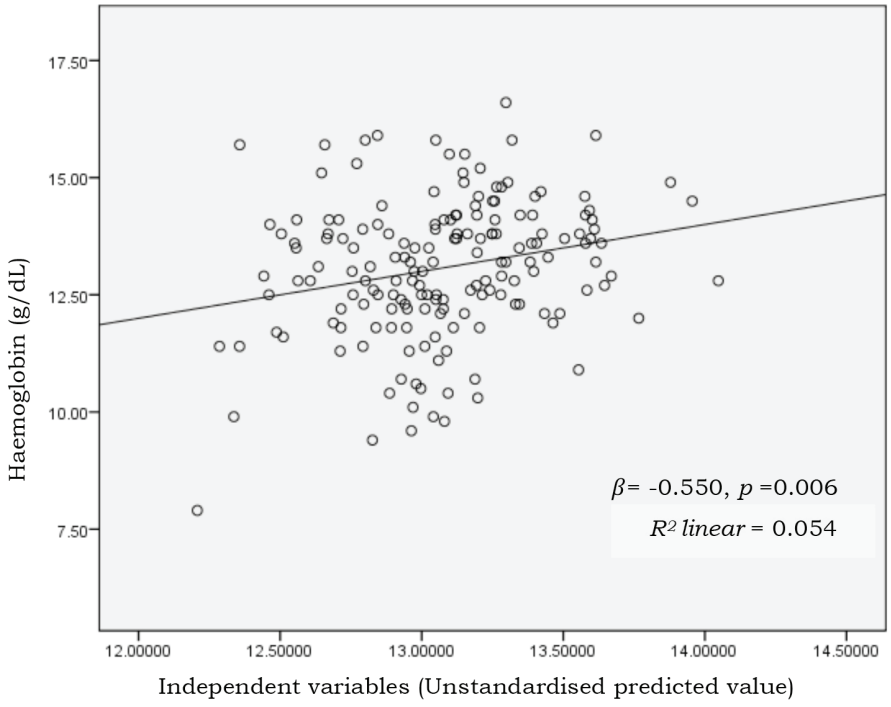

Figure 2. Multiple linear regression on BMI and Hb levels in adolescent girls, after adjusting for body fat.

and a broader age range of respondents than this study, which only included adolescent girls aged 10 to 18 years.

The contradictory results of several studies studying the relationship between BMI and Hb levels could be influenced by variances in the growing phase among study participants. Late adolescence differs from early and middle adolescence in the puberty process, including the patterns of growth spurt and body fat growth. Furthermore, male and female body fat growth rates differ. There is a different pattern in the development of percent body fat between girls and boys. The addition of body fat for female adolescents increases significantly, in contrast to male adolescents who tend to experience a decrease in body fat (Rodríguez *et al.,* 2005). The process of puberty, including growth spurt, moving from childhood to adolescence, affects body fat. These are due to the presence of puberty development factors, such as breast growth, in teenage girls. Increases in skinfold thickness and lean body mass (LBM) are all physiologically related to increases in Hb, haematocrit, and total iron binding capacity (Micozzi, Albanes & Stevens, 1989).

Some overweight/obese adolescents (22.0%) had anaemia in this study and this might be due to the presence of fat accumulation in body fat. Fat accumulation can interfere with iron absorption (Hilton *et al.,* 2023). Iron deficiency anaemia (IDA) is common in adolescents with overweight/obesity. A study found that anaemia in overweight/obesity was not caused by a lack of iron intake or lower food security in the households of adolescent girls (Jones *et al.,* 2017). Another study found that there were no differences between normal weight and overweight/obese adolescent girls in intakes of heme and non-heme iron or other nutrients that influenced iron absorption, even though iron intake was higher in obese adolescent girls than in normal adolescent girls (Hendarto, Febriyanto & Kaban, 2018).

A study involving 62 healthy and non-anaemic women found that iron absorption in overweight/obese women was only two-thirds that of normal-weight women (Cepeda-Lopez *et al.,* 2015). The mechanism underlying the increased risk of anaemia in overweight/obesity remains unknown. Possible causes include dilutional hypoferremia, inadequate iron intake, increased iron requirements, and impaired iron absorption in overweight/obese adolescents because of inflammation (Yanoff *et al.,* 2007).

The strength of the current study was that the study data was primary, meaning there was complete control over the study design and measurement techniques. Aside from that, the use of BIA to estimate percent body fat (PBF) measurement may not have introduced a significant bias, as evidenced by studies showing that the bias in BIA measurement versus dual-energy X-ray absorptiometry (DXA) is minor, whether in European or Asian populations (Carpenter *et al.,* 2013).

Due to practical constraints, this study could not provide a comprehensive measure of the effect of BMI to Hb levels. Our work had some limitations that should be considered in future research. Firstly, Hb was the only haematological biomarker used without taking into account other biomarkers such as serum ferritin, iron, and inflammatory biomarkers such as hepcidin, CRP, and others. As a result, it is difficult to explain differences with other study findings regarding anaemia prevalence, Hb level, or iron level across obese and underweight individuals. Secondly, the number of underweight and overweight/obese adolescent girls was lower, which may have been an issue in determining

the correlation between BMI and Hb levels among adolescent girls. As a result, the current study emphasises the importance of including numerous anaemia indicators in future studies in order to solve these constraints and properly explain the relationship between BMI and Hb level. In addition, with a small sample size, these results need to be interpreted with caution.

CONCLUSION

In conclusion, our study on adolescent girls found that there was a weak, negative correlation between BMI and Hb level after adjusting for body fat. The current study emphasised the importance of additional research that includes several haematological and inflammatory biomarkers to better understand the complex relationship between BMI and Hb level.

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Authors' contributions

Nadiyah, principal investigator, conceptualised and designed the study, led the data collection, prepared the draft of the manuscript, and reviewed the manuscript; Jus'at I, advised on data analysis and interpretation, and reviewed the manuscript.

Conflict of interest

Authors have no conflict of interest to disclose.

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Online training needs assessment (TNA) among Municipal Nutrition Action Officers (MNAOs) in the Philippines

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ABSTRACT

Introduction: A training needs assessment (TNA) was conducted by the Department of Science and Technology, Food and Nutrition Research Institute (DOST-FNRI) to design appropriate and relevant trainings for Municipal Nutrition Action Officers (MNAOs). In the Philippines, MNAO is a nutrition officer who serves at the municipal level and is tasked to ensure the localisation of the Philippine Plan of Action for Nutrition (PPAN) in Local Government Units (LGU) to ensure proper implementation of activities on Public Health Nutrition (PHN). **Methods:** A total of 162 MNAOs in the country answered the online TNA survey conducted from April to May 2023. **Results:** Based on the results of the TNA survey, there was a need for DOST-FNRI to design and conduct trainings related to the top three core competencies identified by MNAOs: Creating policies and standards related to food and nutrition; advocating legislation, regulation, and nutrition policies; and designing appropriate nutrition information education and communication (IEC) materials. **Conclusion:** Based on the study results, it is recommended that LGUs allocate funds for capacity building of the public health workforce to create a skilled workforce in the community that will coordinate the formulation, implementation, monitoring, and evaluation of nutrition plans at the municipal level. For future consideration, curriculum design for professional development in public health nutrition should include core competencies on food and nutrition policy programme, nutrition programme management, and IEC development.

Keywords: capacity-building, competency, training needs assessment

INTRODUCTION

The need for nutrition educators who are competent, motivated with sufficient resources and access to the most recent ideas and best practices in the world is increasing (Hughes, 2003a). Competency is more than the knowledge and skills of individuals, but also about the motivation and leadership skills in line with the organisation (Mueller *et al.,* 2015). In the Philippines, Local Nutrition Focal Points (LNFP), or more commonly known as Nutrition Action Officers (NAO), serve as nutrition educators. The said function is subsumed in their administrative responsibilities to manage and ensure the delivery of quality nutrition service among its constituents in the local

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government units (LGU). Depending on which level of local government unit, the title changes with the addition of the local level before the words "nutrition action officer". An MNAO is the head of the nutrition office who handles nutrition programmes at the municipal level. To ensure that various nutrition-specific and nutrition-related/sensitive programmes are implemented efficiently, the National Nutrition Council (NNC), the country's highest policy making and coordinating body on nutrition, released its latest version of a proposal in 2021 for the creation of nutrition offices and its first ever NAO Handbook published in 2022 to guide both existing and new nutrition action officers. Moreover, in Ignacio & Bullecer's study, they described MNAOs as important for achieving successful implementation of the Philippine Plan of Action for Nutrition or PPAN, a directional framework for the improvement of the country's nutrition status (Ignacio & Bullecer, 2015).

The main responsibility of a NAO is to coordinate the formulation, implementation, monitoring, and evaluation of the LGU's nutrition action plan (NNC, 2022) and to manage the nutrition programmes of his/her locality; orient and update the Local Nutrition Council members on the PPAN and nutrition-related laws, policies and programmes; and conduct nutrition promotion or advocacy activities, among other responsibilities (NNC, 2021). While there is a preference for a registered nutritionist-dietitian or a graduate of similar degree relevant to the position of a nutrition action officer, Ignacio & Bullecer (2015) reported otherwise, stating that in the case of most municipalities, the position of MNAO is not a permanent post and is occasionally dependent on the current Local Chief Executive (LCE), making the MNAO a "MNAO designate". MNAO designate or designated MNAO is the term used to refer to an individual who is assigned to perform the duties of an MNAO. Sometimes, the MNAO designate is also performing other duties from another line agency where he/she is originally assigned to; this puts the nutrition office under the line agency where the MNAO designate is primarily connected (Ignacio & Bullecer, 2015). One of the common issues identified and problem stated in the NAO Handbook is the "difficulty in coping with the demands of the position", especially for MNAO designates who perform dual roles (NNC, 2022). This supports the study conducted by Ignacio & Bullecer in 2015 where the findings revealed that MNAO designates felt inadequate in performing their functions as MNAO, further suggesting that there is a need for capacity development.

Taking all these into consideration, this present study sought to identify the training needs of MNAOs in the field of public health and community nutrition in their respective municipalities. Specifically, it determined: (1) the willingness of LGUs and MNAOs to pay for training and how much training fee they were willing to pay; (2) the preferred mode and number of days allotted for attendance in training; (3) the degree of proficiency on public health and community nutrition; and (4) the perceived need for training on public health and community nutrition. The results of this study will be used to design appropriate and relevant trainings that will be included in the current course offerings of the Department of Science and Technology, Food and Nutrition Research Institute (DOST-FNRI).

MATERIALS AND METHODS

The study employed quantitative method and developed an online survey questionnaire that was administered

among study participants to identify the training needs of MNAOs in the Philippines.

Study participants

The participants of the study were registered nutritionist-dietitians performing as MNAOs or MNAO designates in the local government units in the Philippines.

Research instrument

There were two stages in developing the research instrument. The first stage was the development of the questionnaire, followed by the pre-testing of the questionnaire.

Stage 1: Development of questionnaire

The training needs assessment (TNA) online questionnaire developed by DOST-FNRI for determining the training needs of the members of the Nutritionist Dietitians Association of the Philippines (NDAP) was used in this study particularly questions on public health. This online questionnaire was based on the International Competency Standards for Dietitian-Nutritionists developed by the International Confederation of Dietetic Associations in 2016 and the Essential Practice Competencies for the Commission on Dietetic Registration's Credentialed Nutrition and Dietetics Practitioners written by Worsfold, Grant & Barnhill (2015) for the Academy of Nutrition and Dietetics (2015). The online survey questionnaire was pre-tested before its administration and it included seven nutrition field competencies as follows: public health, food service, business and industry, clinical, academe, research, and ethics and professionalism.

Specifically, questions on core competencies in the field of public health from the DOST-FNRI-TNA online questionnaire were used in this study. For each public health and community nutrition competency, participants were asked to answer the degree of proficiency and perceived need for training.

The degree of proficiency was answered by the respondents based on the following:

- Competent – None to less than three years community and public health work-related experience; knowledge of the subjects/topics in the area/skills are gained from undergraduate course;
- Advance – More than three years community and public health work-related experience, but without graduate degree related to food and nutrition; OR none to less than three years community and public health work-related experience, but with graduate degree or graduate units related to food and nutrition; knowledge of the subjects/topics in the area/skills are gained from work experience or graduate school;
- Proficient – Three years or more community and public health work-related experience, with a Master's Degree related to food and nutrition or with a doctoral degree unit; possess knowledge/ skill, but less than the level of an expert; able to discuss and consistently implement majority of the subjects/topics in this area;
- Expert – Five years community and public health work-related experience or more with a Doctoral Degree related to food and nutrition; possess knowledge/ skill as a result of training and experience/able to speak and act in authority in this area.

Meanwhile, the perceived need for training was answered based on the following:

a. No training needed
b. Low need for training
c. Moderate need for training
d. High need for training

Stage 2: Pre-testing of the questionnaire

Pre-testing is an assessment of the entire questionnaire, its administration, and the encoding of its data for analysis. It is recommended to conduct pre-testing on a sample of around 35 participants (Farnik & Pierzchala, 2012).

For this study, pre-testing was conducted among 30 MNAOs recruited through the assistance of NNC. Google Forms was used as the platform for the creation of online survey questionnaire and collection of responses. Once the participants agreed to join the study, invitation letters and informed consent forms were sent to them. After obtaining the accomplished informed consent forms, the link to the online questionnaire was sent to them.

Cronbach's alpha of the questionnaire was computed to determine if the scale of 0.70 was reliable. The results of pre-testing using the Cronbach's alpha for core competency questions and perceived training ranged from 0.8 to 0.95. There were no revisions done to the questionnaire.

Data collection

To ensure full participation of MNAOs in the study, the DOST-FNRI sent an official letter to NNC to enjoin MNAOs of different municipalities all over the country to accomplish the TNA questionnaire. Link to the TNA online survey questionnaire was sent to NNC for dissemination to MNAOs. The DOST-FNRI research team also followed-up on the participants through their official registered email addresses contained in the NNC directory.

Respondents accomplished the online TNA questionnaire via Google Forms. There were two major parts to the online TNA questionnaire, namely the profile of the respondents and the field of competencies.

Statistical analysis

Data collected from study participants were processed and analysed. For data analysis, frequencies and proportions or percentages were generated for each of the competencies using IBM SPSS Statistics for Windows version 21.0 (IBM Corporation, Armonk, New York).

Ethical consideration

Prior to the conduct of the online TNA survey, the questionnaire and informed consent form used for the study were approved by the FNRI Institutional Ethics Review Committee, with Protocol Code FIERC-2021-013. Information regarding the TNA's objectives, type of research intervention, participant selection, voluntary participation, procedure, duration, risks and benefits, reimbursements, confidentiality, sharing of results, right to refuse or withdraw, and contact details were included in the informed consent form. Participants agreed to participate in the study by clicking the consent button in the Google Forms. Participants were assured of the confidentiality of information collected in the study.

RESULTS

Results from the online TNA survey among MNAOs are shown in the tables. A total of 162 MNAOs in the country answered the online TNA survey from April to May 2023. Majority of the respondents were females (78.4%) and one-third (34.0%) of the respondents were 31-40 years old.

Table 1 shows that majority (66.7%) of the MNAOs who answered the TNA survey were those working in the public health nutrition service from one to ten years. Face-to-face training was the preferred mode of training (79.6%) as indicated in Table 2. Most of the participants (82.0%) mentioned that their respective LGUs were willing to pay for their training in the amount of PHP 1,000 to PHP 5,000 for three days as shown in Table 3. In addition, a total of 46 participants (28.4%) were willing to pay for their own training in the amount of PHP 1,000 to PHP 5,000 as shown in Table 3. Table 4 shows the degree of proficiency of training for the fields of public health nutrition and community nutrition. In general, across all competencies, 50% of the TNA survey participants rated their degree of proficiency as competent.

For perceived need of training, seven core competencies were perceived as high need for training. These included: (1) advocating legislation, regulation, and nutrition policies that may impact nutrition in the community; (2) creating policies and standards related to food and nutrition; (3) designing nutrition information, education and communication (IEC) materials; (4) designing nutrition programmes within the municipality using appropriate indicators; (5) implementing public health activities; (6) evaluating nutrition programmes within the municipality using appropriate indicators; and (7) implementing nutrition programmes within the municipality with appropriate timetable and budget allocation. The two core competencies which the study participants perceived with moderate need were monitoring nutrition programmes within the municipality using appropriate indicators and presenting and discussing the nutrition programmes to barangay, municipal, and provincial nutrition committee as shown in Table 5.

Table 1. General characteristics and number of years in service of TNA survey participants

Characteristics and number of years in service	*n (%)*
Sex	
Male	32 (19.8)
Female	127 (78.4)
Prefer not to say	3 (1.8)
Age	
19-20 years old	1 (0.7)
21-30 years old	25 (15.4)
31-40 years old	55 (34.0)
41-50 years old	49 (30.2)
51-59 years old	25(15.4)
60 years old and above	7(4.3)
Number of years in public health nutrition service	
0 years	7 (4.3)
<1 year	16 (9.9)
1-10 years	108 (66.7)
11-20 years	17 (10.5)
21-30 years	7 (4.3)
31-40 years	5 (3.1)
41-50 years	1 (0.6)
No answer	1 (0.6)
Number of years in community nutrition service	
0 years	4 (2.4)
<1 year	19 (11.7)
1-10 years	109 (67.3)
11-20 years	20 (12.3)
21-30 years	8(5.0)
31-40 years	1(0.6)
41-50 years	1 (0.6)

DISCUSSION

This study identified the training needs of MNAOs in the field of public health and community nutrition in their respective municipalities. Results of this study can be used in designing appropriate and relevant trainings for MNAOs.

The Philippines has three levels of local governments, as follows: (1) provincial and independent cities, (2)

Table 2. Preferred mode of training and number of days allotted for attendance in training

Preferred mode of training and number of days allotted for attendance in training	*n (%)*
Preferred mode of training	
Face-to-face	129 (79.6)
Online synchronous training	18 (11.1)
Online asynchronous training	5(3.1)
Combination of online synchronous and asynchronous training	10 (6.2)
Number of days	
1 day	8 (5.0)
2 days	35 (21.6)
3 days	100 (61.7)
>3 days	17 (10.5)
Other answers[†]	2 (1.2)

[†]Other answers included: Any day, it depends on the day needed for the seminar

municipality/city, and (3) barangay. According to NNC in their 2022 NAO Handbook, each sub-national level (regional, provincial, municipal, and barangay) has a dedicated Local Nutrition Committee (LNC) comprising of the LCE, NAOs and representatives from the same agencies that are part of the NNC at the national level. The title of the nutrition action officer will depend on which level of local government unit they are under. For example, a PNAO or Provincial Nutrition Action Officer is the NAO of a province, a CNAO for the city, and MNAO for the municipal level. There is no NAO for the barangay level, instead the MNAO coordinates with the head of the LNC, in this case, the Barangay Captain and the Barangay Nutrition Scholars (BNS). In the Philippines, majority of MNAOs were females, who were tasked to ensure the localisation of the PPAN in LGUs to ensure proper implementation of activities on public health nutrition.

Face-to face training is commonly used as the traditional learning method and conducted in large or small groups (Gonzalez & Vodicka, 2008). In this study, the preferred mode of delivery for training is through face-to-face training. Studies showed that face-to-face training is the most powerful way of providing training because it allows opportunities for participants to dialogue, interact, discuss, and have immediate feedback from the facilitator (Fetsco & McClure, 2005; Benson *et. al.*, 2005).

In the study done by Ignacio & Bullecer (2015), one of the identified factors for smooth implementation of nutrition programmes is the strong political support that is also evident in the results of this present study, where most of the participants (82.0%) mentioned that their respective LGUs were willing to pay for their training in the amount of PHP 1,000 to PHP 5,000 (2 to 100 US dollars).

In this study, almost 50.0% of the TNA survey participants rated their degree of proficiency as competent across all competencies such as designing, presenting, discussing, implementing, and monitoring nutrition programmes within the municipality with appropriate timetable and budget allocation. This may be attributed to the four main roles of a NAO as indicated in the Handbook for Nutrition Action Officers (2022) that comprised the following: (1) advocates for the adaptation of policies that were

Table 3. LGU's willingness to pay MNAOs training and willingness to pay for own training

LGU to pay for training MNAOs training and to pay for own training	*n (%)*
LGU to pay for training	
Yes	133 (82.0)
No	29 (18.0)
Training fee† (If yes, how much)	
<1000 PHP	4 (2.5)
1000-5000 PHP	38 (23.5)
5001-10,000 PHP	15 (9.2)
>10,000 PHP	14 (8.6)
No answer	51 (31.5)
Other answers‡	40 (24.7)
To pay for own training	
Yes	46 (28.4)
No	116 (71.6)
Training fee†	
0 PHP	1 (0.6)
<1000 PHP	3 (1.9)
1000-5000 PHP	25 (15.4)
5001-10,000 PHP	2 (1.2)
>10,000 PHP	2 (1.2)
No answer	120 (74.1)
Others answers‡	9 (5.6)

LGU: Local Government Unit; MNAOs: Municipal Nutrition Action Officers
†1 US dollar = 56.18 PHP (as of March 1, 2023)
‡Other answers included: Only travelling expenses can be shouldered by LGU; all expenses, any reasonable amount; chargeable against training and seminar allocation; depending on the place of training and how much to be spent; depends on Commission on Audit (COA) guideline, depends on LGU budget; for meals and snacks of the participants; if on official business, no specific amount, per diem - depends on the distance; usual transportation expenses and allowances, actual expense, depends on the cost, minimal amount, transportation and meals

formulated at the national and sub-national levels; (2) organises and facilitates the planning of workshop with the nutrition planning team serving as the resource person during the workshop; (3) coordinates and facilitates programmes and initiatives to relevant stakeholders; and (4) ensures the success of the activities of the nutrition council and reports the status of different priority groups to the LCE. LCE refers to the governor at the provincial level, mayor at the city or municipal level (NNC, 2022). Monitoring the status of nutrition projects and activities, conducting interviews of mothers, caregivers and barangay leaders during regular visits are also one of the NAO's duties and responsibilities. This includes monitoring the results and evaluation of nutrition programmes, which is conducted once or twice a year. Lastly, a NAO ensures the successful implementation of the Operation Timbang (OPT) Plus every first quarter of the year, making sure that the results of the OPT are recorded, consolidated, and analysed for presentation to the LNC and LCE (NNC, 2022).

Competency is defined by Hughes (2003a) as the standard for workforce development, while the Dietitians Board

Table 4. Frequencies on the degree of proficiency on public health and community nutrition core competencies among survey participants

Core competencies	*Degree of proficiency (n=162)*				
	Competent	*Advance*	*Proficient*	*Expert*	*No answer*
Public Health/Community Nutrition					
Design nutrition programmes within the municipality using appropriate indicators	81 (50.0)	51 (31.5)	14 (8.6)	1 (0.6)	15 (9.3)
Present and discuss the nutrition programmes to barangay, municipal and provincial nutrition committee	78 (48.1)	57 (35.2)	14 (8.6)	2 (1.2)	11 (6.8)
Implement nutrition programmes within the municipality with appropriate timetable and budget allocation	82 (50.6)	52 (32.1)	14 (8.6)	3 (1.9)	11 (6.8)
Monitor nutrition programmes implemented within the municipality using appropriate indicators	74 (45.7)	55 (34.0)	12 (7.4)	5 (3.1)	16 (9.9)
Evaluate nutrition programmes within the municipality using appropriate indicators	71 (43.8)	53 (32.7)	15 (9.3)	4 (2.5)	19 (11.7)
Design appropriate nutrition information education and communication (IEC) materials	75 (46.3)	49 (30.2)	17 (10.5)	4 (2.5)	17 (10.5)
Advocate legislation, regulation, and nutrition policies that may impact nutrition in the community	76 (46.9)	48 (26.6)	14 (8.6)	4 (2.5)	20 (12.3)
Implement public health	75 (46.3)	54 (33.3)	16 (9.9)	5 (3.1)	12 (7.4)
Create policies and standards related to food and nutrition	73 (45.1)	49 (30.2)	17 (10.5)	3 (1.9)	20 (12.3)

(2017) defined competency as overarching practices needed to work safely and effectively across the dietetic practice. However, Hughes (2003a) argued that competency standards are a variation of a worldwide movement within the sectors of education, training, and profession, further elaborating that the foundation of this movement is the idea that in order for individuals to perform well in a job, they must be taught and evaluated on their knowledge, skills, and attitudes necessary for an effective performance. Competency standards serve as a guide to a variety of workforce development tasks namely: providing a framework for the design and assessment of curricula that support the minimum standards, evaluating individuals' suitability for practice, guiding continuing professional development, and assisting in the evaluation and design of jobs (Jonsdottir *et al.,* 2011).

While competency standards vary from region to region and country to country, these are set as a common

Table 5. Frequencies on the perceived need for training on public health and community nutrition core competencies among survey participants

Core competencies	*Perceived need for training (n=162)*				
	Not needed	*Low*	*Moderate*	*High*	*No answer*
Public Health/Community Nutrition					
Design nutrition programmes within the municipality using appropriate indicators	3 (1.9)	17 (10.5)	67 (41.4)	73 (45.1)	2 (1.2)
Present and discuss the nutrition programmes to barangay, municipal and provincial nutrition committee	5 (3.1)	25 (15.4)	70 (43.2)	60 (37.0)	2 (1.2)
Implement nutrition programmes within the municipality with appropriate timetable, and budget allocation	3 (1.9)	24 (14.8)	65 (40.1)	69 (42.6)	1 (0.6)
Monitor nutrition programmes implemented within the municipality using appropriate indicators	4 (2.5)	24 (14.8)	66 (40.7)	65 (40.1)	3 (1.9)
Evaluate nutrition programmes within the municipality using appropriate indicators	3 (1.9)	23 (14.2)	64 (39.5)	70 (43.2)	2 (1.2)
Design appropriate nutrition information education and communication (IEC) materials	5 (3.1)	21 (13.0)	57 (35.2)	77 (47.5)	2 (1.2)
Advocate legislation, regulation, and nutrition policies that may impact nutrition in the community.	2 (1.2)	16 (9.9)	61 (37.7)	80 (49.4)	3 (1.9)
Implement public health	6 (3.7)	22 (13.6)	60 (37.0)	71 (43.8)	3 (1.9)
Create policies and standards related to food and nutrition	3 (1.9)	16 (9.9)	59 (36.4)	80 (49.4)	4 (2.5)

ground (Dietitians Board, 2017). With International Confederation of Dietetics Associations (ICDA, 2016) cautioning that the international standards are not intended to replace any national standards, rather, these are meant to serve as a uniform foundation for national standards development or as the only standards where no other standards exist. While critics claim that an overemphasis on skills could result in people only being proficient in a certain occupation, supporters of the competency-based training method view it as a counterbalance against education resulting in people who know but cannot perform (Rivers, Aggleton & Whitty, 1998; Hughes, 2003a). Even with such varying outlooks, competencies are a widely accepted workforce development tool in public health. The key idea is that, while there are differences in the

mix of competencies needed to effectively address local issues in socio-cultural and other contexts, the competencies necessary for effective public health nutrition practice are generally consistent across countries and settings (Hughs, 2003a).

Competencies are the standards, and core competencies, on the other hand, are the necessary and quantifiable components of each competency. These are the knowledge, attitudes, skills, and behaviours that apply to all registered nutritionist-dietitians (RNDs) (Dietitians Board, 2017). A competent NAO is able to coordinate the formulation, implementation, monitoring, and evaluation of the nutrition plan at their respective local government level. It can be surmised that the core competencies of a NAO are based on these functions. This is confirmed by the Dietitians Board (2017), which has enumerated the following core competencies pertaining to public health nutrition. First, a dietitian should be able to apply public health nutrition knowledge to monitor and survey the population to create interventions, and implement and evaluate such interventions. Second, a dietitian can assist in the capacity building of vulnerable groups, while meeting clients' and stakeholders' needs to reduce health inequalities. Third, the dietitian must be able to contribute in the strategic planning of developing and improving services (Dietitians Board, 2017).

These are further supported by the ICDA with its International Competency Standards for Dietitian-Nutritionist, enumerating similar competencies such as: develops and implements intervention plans, monitors and evaluates outcomes, and reports on it; establishes collaborative (shared) partnerships, consults with and advises clients, caregivers, team members and other stakeholders to improve care; uses client intervention and community development approaches, and collects and analyses relevant information related to an identified issue and proposes a solution (ICDA, 2016).

For perceived need of training, seven core competencies were identified by the MNAOs as high need for training. These included creating policies and standards related to food and nutrition, and advocating legislation, regulation, and nutrition policies that may impact nutrition in the community. These needs were followed by implementing nutrition programmes within the municipality with appropriate timetable and budget allocation.

Study results suggested that there was a need to enhance the knowledge and skills of MNAOs through capacity building. Capacity building is known in different terms such as continuing education and competency development for education (CapEd), to name a few. These are terms that mean provision for individuals to learn and improve their knowledge and skills by targeting specific competencies of the subject area or the profession.

Studies have acknowledged the importance of continuing professional development for effective delivery of service, especially for those professionals in the field of health whose competencies should be up to date (Martin *et al.*, 2008). As cited by Martin *et al.* (2008), the importance of continuing professional development as a means of access to current scientific information on nutrition is important to improve the profession's competence in a dynamic healthcare environment. This emphasises the significance of strengthening societal capacity to safeguard and promote public health by first creating a skilled public health workforce (Hughes, 2003a). The ability of communities to handle public health nutrition concerns is significantly

influenced by the public health workforce's capabilities (Jonsdottir *et al.*, 2011; Baillie *et al.*, 2009).

The studies of Palermo, Hughes & McCall (2010) and Hughes (2003b) believe that the important stage in the development of public health nutritionists' competencies should be done in the first few years following the qualification as a dietitian. Additionally, there is evidence suggesting that the existing NAOs lack the expertise necessary to carry out their job in an efficient manner. Ignacio & Bullecer (2015) recommended capacity building among MNAOs after their study revealed that MNAOs learned by performing duties and from assistance from the PNAOs.

CONCLUSION

Empowering the MNAOs in the field of public health and community nutrition is vital as they play a crucial role in the implementation of nutrition programmes. Equally important, the training needs of MNAOs identified in this study should be considered as vital inputs in designing appropriate and relevant trainings.

Based on the results of the TNA survey, DOST-FNRI will design and conduct trainings addressing the top three identified core competencies: (1) creating policies and standards related to food and nutrition; (2) advocating legislation, regulation, and nutrition policies; and (3) designing appropriate nutrition IEC materials.

It is recommended to LCEs that the following trainings be included in training programmes for MNAOs:

1. Food and Nutrition Policy Programmes,
2. IEC and Training Materials Development (Print and Non-Print),
3. Nutrition Leadership,
4. Nutrition Programmes Management,
5. Nutritional Assessment, and
6. Programme's Effectiveness and Cost Effectiveness.

The study findings support the need to allocate funds for capacity building of the public health workforce to create a skilled workforce in the community that will coordinate the formulation, implementation, monitoring, and evaluation of nutrition plans at the municipal level. For future consideration, curriculum design for professional development in public health nutrition should include core competencies on food and nutrition policy programmes, nutrition programmes management, and IEC development.

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Authors' contributions

Glorioso IG, principal investigator, conceptualised and designed the study, prepared the online TNA questionnaire, conducted pre-testing of online TNA questionnaire before its use, prepared the draft of the manuscript; revised the manuscript based on comments and suggestions of editor; and finalise the manuscript; and submitted the final manuscript to the Malaysian Journal of Nutrition; Gonzales MS, co-investigator, gave comments on the design of the study, edited the developed online TNA questionnaire, reviewed the draft manuscript; edited the draft and final manuscript before submission to the Malaysian Journal of Nutrition; Santos TM, co-investigator, conducted

review of related literature on TNA, assisted in the preparation of draft manuscript; and proofread the final manuscript.

Conflict of interest

The authors declare no conflict of interest.

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