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Contents

Nutritional Status, Dietary Intake and Body Composition

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Association of socio-demographic characteristics, nutritional status, risk of malnutrition and depression with quality of life among elderly haemodialysis patients

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ABSTRACT

Introduction: A compromised quality of life (QOL) as a result of haemodialysis (HD) is a rising global issue. Elderly HD patients face more challenges than younger counterparts. This study determined the association of socio-demographic characteristics, nutritional status, risk of malnutrition and depression with QOL, among elderly HD patients. **Methods:** A cross-sectional study was conducted among 112 HD elderly patients in selected dialysis centres in Selangor, Malaysia. The patients completed interview-based questionnaires on socio-demographic characteristics, risk of malnutrition (Dialysis Malnutrition Score, DMS), depression (Patient Health Questionaire-9, PHQ-9) and QOL (KDQOL-36). Anthropometric measurements, 24-hour dietary recall and food intake information were obtained from them and biochemical data from their medical records. **Results:** Just over half (50.9%) of the patients had a normal body mass index while 85.7% had optimal albumin levels. The proportion of patients who met the recommended energy and protein intakes were 19.0% and 3.4%, respectively. Patients were at moderate risk of malnutrition, had minimal depression level and perceived better QOL in terms of effects and symptoms of kidney disease. There was a significant positive correlation between protein intake and the physical domain of QOL (p=0.02) and negative correlation between risk of malnutrition with physical and mental composites of QOL (p<0.001). There was significant negative correlation between depression and physical composite, mental composite, burden, effects and the symptoms of kidney disease (p<0.001). **Conclusion:** The present findings provide better insight on QOL for future screening, preventive measures and intervention. Further investigation regarding factors associated with QOL among elderly patients is recommended.

Keywords: Quality of life, nutritional status, depression, haemodialysis, elderly

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INTRODUCTION

Chronic kidney disease (CKD) is a serious health problem that affects 10% of the world's population (El-Sayead, Mohamed Ahmed & Ali Mahmoud, 2015). Haemodialysis (HD) is one of renal replacement therapy (RRT) modalities that is used to prevent progression to complications such as anemia, cardiovascular disease, metabolic bone disease and dyslipidemia among end-stage renal disease (ESRD) patients (Iyasere *et al.*, 2016). In fact, the prevalence rate of HD in Malaysia had increased rapidly from 2006 to 2015. In 2015, 33,456 HD patients representing prevalence rate of 1097 per million populations were reported by the 23rd Report of the Malaysian Dialysis and Transplant Registry 2015 (Wong & Goh, 2015). According to the Malaysia Country Report, elderly is defined as people who aged 60 and above, a definition that is in consonance with those of the Ministry of Health and United Nations. The elderly patients face more challenges than their younger counterparts as the presence of geriatric syndromes, such as functional impairment, fall and frailty compromise their QOL and survival (Beberashvili *et al.*, 2016).

Quality of Life (QOL) can be defined as an individual's perception and satisfaction in life with regard to goals, social relationships, expectations, standards and independency. QOL can be used as prognosis and prediction for outcomes including survival rate. Poor QOL is high among HD patients and it is associated with increased hospitalisation and mortality rates (Morsch, Goncalves & Barros, 2006). HD results in a reduced QOL as it is time-consuming and as expensive for patients in the low to middle income groups. In addition, patients on HD are required to restrict themselves in order to have better control of their serum potassium and phosphorus level (Mujais *et al.*, 2009; Choi & Ha, 2013). In the long term, HD patients will develop a caregiver dependency and be deprived of freedom, employment opportunities, social interaction and family life.

The socio-demographic characteristics of HD patients have a great influence on their QOL. Advanced age contributes to poorer QOL because physical and cognitive functions deteriorate as age increases. Women were found to have a lower QOL and this may be the result of psychological effects that are secondary to hormonal changes (Guerra-Guerrero *et al.*, 2012). HD patients with a higher education level are able to perceive a better QOL. Kimmel & Patel (2006) stated that highly educated patients could access better economic opportunities and more information. Better education improved the compliance to therapeutic regimes and provided better adaption to changes in life (Ebrahimi *et al.*, 2016; Anees *et al.*, 2018). Social and family supports are crucial to QOL. HD patients who lived with other family members were found to have higher expectations for their future (Kim & Park, 2015).

Malnutrition is common in dialysis patients and worsens with age. Over one-third of dialysis patients have mild to severe malnutrition. Nutritional status is chief determinants in QOL in dialysis patients (Lacquaniti *et al.*, 2009). Uraemia reduces appetite and muscle mass, and induces negative nitrogen balance in HD patients. Accumulation of urea together with metabolic acidosis speeds up muscle protein catabolism (Kadiri, Nechba & Oulim, 2011). Dialysis-related factors induce higher demand for energy and protein requirements because some nutrients are lost into the dialysate during HD (Agboton *et al.*, 2017).

ESRD patients who receive maintenance dialysis exhibit a high prevalence of depression. Early diagnosis of depression is often missed,

most probably due to the similarities between depressive symptoms and uremic symptoms (Palmer *et al.,* 2015). The prevalence among elderly patients in hospital setting and nursing home is 40% and is 15% in the community setting (Ibrahim & El Salamony, 2008). Severity of depression has been found to be associated with serum phosphorus levels and the intensity of uraemia pruritus, which, in turn, have a negative effect on vitality, emotional functioning and social functioning (Zyoud *et al.*, 2016). Body pain has been found to be associated with more severely depressed patients.

The findings of the associations of socio-demographic characteristics, nutritional status, risk of malnutrition and depression with QOL are inconsistent. In addition, limited research related to the associations has been done on elderly HD patients in Malaysia. The aim of this cross-sectional study was to assess these associations among HD elderly patients in selected two dialysis centres in Selangor.

MATERIALS AND METHODS

Participants

Two private dialysis centres in each subdivision of the districts of Hulu Langat and Petaling in the state of Selangor in Malaysia were randomly selected for this study. A total of 112 HD elderly patients consisting of 62 males (55.4%) and 50 females (44.6%), were recruited. Their mean age was 67.4±7.0 years (range 60-95 years). The inclusion criteria were patients who had been on HD for at least three months, were aged 60 years and above and who were clinically stable. The study excluded patients with major sensory, motor or cognitive impairment, those who were hospitalised for more than 7 days during the previous month and those with a history of renal transplantation.

Materials

Socio-demographic data were obtained by way of an interview-based questionnaire. Anthropometric measurements were conducted to obtain height and pre- and post- dialysis weights to assess nutritional status. Data of serum albumin, creatinine and haemoglobin were obtained from patients' latest blood test result available in medical record upon visit to the respective HD centres. Medical Nutrition Therapy Guideline for CKD (MOH, 2005) was used as reference for the biochemical parameters with cut-off point of >35 g/L and >11 g/L for albumin and haemoglobin, respectively. There was no definite cut-off point for serum creatinine as patients with renal failure always demonstrate abnormal high creatinine level which could biased the result given that the normal range of creatinine fro healthy population is 53-97 mcg/l according to 5th Edition of Mobsby's Manual of Diagnostic and Laboratory Tests (Pagana & Pagana, 2014). Energy and protein intake of patients were assessed by way of 24-hour dietary recall for non-HD days and a food record for HD days. Food intake was recorded using household measurements that were converted into weight (g). Energy and protein intake were then analysed by using the Nutritionist Pro (Axxya Systems, USA) software.

The risk of malnutrition was assessed using the Dialysis Malnutrition Score (DMS) (Kalantar-Zadeh *et al.*, 1999). DMS consists of two parts with seven components each of which is graded on a scale of 5-points. The two main parts are: (1) Patient's related medical history (weight change, dietary intake, gastrointestinal symptoms, functional capacity, co-morbidity) and (2) Physical examination (subcutaneous fat and signs of muscle wasting) (Kalantar-Zadeh *et al.*, 1999). The malnutrition score is the sum of all seven components and the

DMS score can range from 7 (normal) to 35 (severely malnourished).

The Patient Health Questionaire-9 (PHQ-9) was used to measure the depression among the respondents (Kroenke, Spitzer & Williams, 2001). Nine items of PHQ-9 symptoms that were assessed were of the previous two weeks and were scored from 0 (absence of symptoms) to 3 (presence of symptoms nearly every day). The total score was the sum of each item thus, the score ranged from 0-27, with higher scores indicating more severe depressive symptoms.

QOL was measured using KDQOL-36 (Hays *et al.*, 1994). This instrument comprises 36 items with two main elements: (1) 12 items of Medical Outcomes Survey (MOS) SF-12 survey to assess the perceptions of subjects of their own mental and physical functioning and (2) 24 kidney-disease targeted items. The five subscales of KDQOL-36 had average scores from 0-100 with higher scores indicating better perceived health-related quality of life.

Procedure

The data collection was conducted over six months. Ethical approval was obtained from the Ethics Committee for Research involving Human Subjects (JKEUPM) of Universiti Putra Malaysia (Project reference number: FPSK [EXP17] P003). An approval letter was obtained from the two haemodialysis centres involved before study was conducted. The content of the interview was explained to patients and their informed consent was obtained on a signed form before the start. The HD patients completed the interview-based questionnaire on socio-demographic characteristics, risk of malnutrition, depression and QOL. Anthropometric measurements were done before HD session, the interview was conducted during HD session and biochemical data was obtained after dialysis session. All data collected were analysed using the IBM SPSS Statistics 23 software package. The Nutritionist Pro software was used to analyse the dietary intake of the subjects. The correlation between continuous variables was determined by using the Pearson's Product Moment Correlation Test.

RESULTS

Mean age of the subjects was 67±7 years old. Majority of the patients was from the Malay (62.5%) and Muslim (64.3%) communities. Approximately 77.6% of the patients were married and most had of them received a secondary education (47.3%). Almost all of the patients (96.4%) were either unemployed or retired while the employed patients (3.6%) worked in private sector. A large proportion (82.1%) of the patients did not have any income and were financially supported either by their children or grandchildren's (Table 1).

The anthropometric, biochemical and nutritional data of patients are shown in Table 2. Half of the patients (50.9%) were in the normal weight category while 27.7% and 9.8% of patients fell into overweight and obese categories, respectively. Most of the patients (85.7%) recorded albumin levels within the reference intervals. The mean haemoglobin level was 10.2±2.2 g/L and 58.9% of the patients had low haemoglobin level. The mean serum creatinine level of the patients was 678±183 μmol/L with 100% of the patients had serum creatinine level above the normal value of 53-97 mcg/L. The mean energy and protein intakes of patients were 20±8 kcal/kg and 0.8±0.4 g/kg, respectively. Both intakes were low with 91.0% of patients did not have adequate energy intake whereas 86.6% of them did not have adequate protein intake.

The mean DMS score was 12.9±3.3 (range 7-24) and 45.5% of the patients

Table 1. Socio-demographic characteristics of subjects (n=112)

Characteristics	*n (%)*
Sex	
Male	62 (55.4)
Female	50 (44.6)
Ethnicity	
Malay	70 (62.5)
Chinese	26 (23.2)
Indian	16 (14.3)
Others	0 (0.0)
Religion	
Islam	72 (64.3)
Buddhism	25 (22.3)
Christianity	2 (1.8)
Hinduism	13 (11.6)
Others	0 (0.0)
Marital Status	
Single	5 (4.5)
Married	87 (77.6)
Divorce/Widowed	20 (17.9)
Education Level	
No formal education	14 (12.5)
Primary education	29 (25.9)
Secondary education	53 (47.3)
Diploma/Bachelor/Master/PhD	16 (14.3)
Current Employment Status	
Unemployed/Retired	108 (96.4)
Private	4 (3.6)
Monthly Household Income	
No income	92 (82.1)
<RM1000	6 (5.4)
RM1000-RM2000	5 (4.5)
RM2001-RM3000	6 (5.4)
≥RM3001	3 (2.7)

Table 2. Anthropometric, biochemical and dietary intake data of patients (*n*=112)

Characteristics	*Mean±SD*	*Range*
Anthropometric		
Height (cm)	160.7±8.8	138.0-188.2
Dry Weight (kg)	62.2±13.4	35.5-111.8
BMI (kg/m^2)	24.1±4.8	14.8-42.3
Biochemical		
Albumin (g/L)	38.0±4.3	21.0-50.0
Haemoglobin (g/L)	10.2±2.2	2.5-16.2
Creatinine (umol/L)	678±183	354-1220
Dietary Intake		
Energy (kcal/kg)	20±8	7-48
Protein (g/kg)	0.8±0.4	0.2-2.2

Table 3. Quality of Life (QOL) subscales of patients

Items	*Mean±SD*
SF-12 components	
SF-12 Physical Composite	54.8±27.7
SF-12 Mental Composite	69.7±19.6
Kidney-disease specific	
Burden of kidney disease	51.1±27.7
Effects of kidney disease	80.3±14.4
Symptom/ Problem list	81.2±16.9

had a moderate risk of malnutrition. In the assessment for depression, the mean score of PHQ-9 was 5.0±3.9 with half of the patients (50.0%) having mild depression. Patients scored better in the two elements of QOL assessment, namely, in term of effects and symptoms of kidney disease, with mean scores 80.3±14.4 and 81.2±16.9, respectively (Table 3). On the contrary, patients scored lower in physical composite and burden of kidney disease subscales compared to other subscales.

The present study demonstrated that age was not associated with QOL of patients. There was no significant correlation between nutritional status and QOL except that between protein intake and the physical composite subscale of QOL. This study revealed that protein intake was poor but showed significant positive correlation with the physical composite of QOL (r=0.193, p=0.042) (Table 4). There was significant negative correlation between the risk of malnutrition and physical and mental composites of QOL (r=-0.417; r=-0.343, p<0.001). Depression correlated with all subscales of KDQOL-36. Significant negative correlations were found between PHQ-9 mean score and physical composite, mental composite, burden, symptoms and effects of kidney disease, respectively (r=-0.458; r=-0.501; r=-0.321; r=0.443; r=-0.299, p<0.001) (Table 4).

DISCUSSION

Almost all the patients in this study were either unemployed or retired. This might be due to the long duration of HD treatment and complications of kidney disease which lead to the early retirement of HD patients (Guerra-Guerrero *et al.,* 2012). Although majority of the HD patients were of normal weight, over a third (37.5%) was found to be overweight or obese. Most of the patients had normal albumin levels but showed reduced haemoglobin. Inflammation and metabolic acidosis were assumed to be well-controlled among patients due to normal albumin levels. Low haemoglobin levels are common among HD patients as their kidneys lose function to produce erythropoietin. Even if erythropoietin-stimulating agent is given, it might be ineffective since elderly patients might have reduced response to this therapy (Jung *et al.,* 2015). Most of the patients did not have adequate intake of energy and protein intake. This may have been due to altered taste, lethargy, disrupted mealtime and dietary restriction after dialysis initiation (Lynch *et al.,* 2013).

Patients in this study had a moderate risk of malnutrition. Some experienced a small weight loss, decreased functional capacity to carry out routine activities such as walking a great distance, climbing stairs and carrying a heavy load besides they complained of their ability to tolerate with suboptimal diet.

Table 4. Pearson's product moment correlation between age, nutritional status, risk of malnutrition, depression and quality of life (QOL) among subjects (n=112)

	Total Score		*SF-12 Physical Composite*		*SF-12 Mental Composite*		*Burden of Kidney Disease*		*Symptom/ Problem List*		*Effects of Kidney Disease*	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Socio-demographic												
Age	-0.039	0.680	-0.098	0.304	-0.400	0.672	-0.098	0.305	0.022	0.819	0.065	0.499
Nutrition Status												
BMI	-0.068	0.479	-0.049	0.608	-0.088	0.357	0.400	0.677	-0.074	0.440	-0.048	0.616
Serum albumin	0.062	0.518	0.700	0.462	0.035	0.713	0.121	0.203	0.069	0.472	-0.077	0.420
Haemoglobin	0.044	0.642	-0.092	0.333	-0.030	0.751	0.035	0.717	0.107	0.262	0.139	-0.063
Serum creatinine	0.136	0.152	0.020	0.833	0.089	0.353	0.051	0.594	0.036	0.703	-0.063	0.512
Energy intake	0.119	0.210	0.050	0.602	0.118	0.215	0.031	0.747	-0.010	0.915	0.086	0.365
Protein intake	0.219*	0.020	0.193*	0.042	0.162	0.089	0.048	0.612	0.108	0.255	0.121	0.204
Risk of Malnutrition												
DMS Score	-0.368**	<0.001	-0.417**	<0.001	-0.343**	<0.001	-0.176	0.064	-0.183	0.054	-0.162	0.089
Depression												
PHQ-9	-0.579**	<0.001	-0.458**	<0.001	-0.501**	<0.001	-0.321**	0.001	-0.443**	<0.001	-0.299**	<0.001

* Correlation is significant at p<0.05
** Correlation is significant at p<0.01

The presence of hypoguesia and metallic taste may have affected the appetite of HD patients, resulting in diminished dietary intake and weight loss (Lynch *et al.,* 2013). Nausea and vomiting are known side effects of dialysis whereas diarrhoea may occur from intestinal infection or electrolyte imbalance during dialysis process. Aging, increase in duration of the dialysis treatment, co-morbidity, physical inactive as well as a prolonged inadequate dietary intake may impair the physical ability of HD patients (Harvinder *et al.,* 2016).

Most of the patients had mild depression. Patients also suffered from post-dialysis lethargy and fatigue all the day and insomnia during bedtime. This contributed to sleepiness and drowsiness during daytime. These conditions could be explained by elevated levels of plasma orexin which, disturbs the metabolism of melatonin thereby interfering with sleep and contributing to wakefulness (Jhamb *et al.,* 2008; Li *et al.,* 2016). QOL of patients that was evaluated by five subscales of KDQOL-36 and patients scored better QOL in terms of the mental composite, effects and symptoms of kidney disease. The desirable mental outcome can be explained by adaptation of expectation towards chronic disease and dialysis-induced complications that the patients had developed after certain period of time. The results indicated that there was no significant correlation between age and all subscales of QOL. This may be because previous studies included patients aged 18 and above, as against the present study which only had patients aged 60 and above (Calvancante *et al.,* 2013).

Protein intake was low but showed significant positive correlation with the physical composite of QOL. The reason may be due to protein from dietary intake helps to replenish the protein loss from catabolic process of dialysis to re-synthesise muscle protein. Inadequate protein intake could result in fatigue, susceptibility to infection and weight loss or muscle wasting. Consequently, the effects of inadequate protein accelerate the depletion in physical performance of patients (Johansen *et al.,* 2003; Raimundo *et al.,* 2006). The findings of the present study supported the previous findings which stated that energy, protein and some key micronutrient deficiencies could exert a negative effect on QOL of HD patients Ohri-Vachaspati & Sehgal, 1999; Raimundo *et al.,* 2006).

There was significant negative correlation between risk of malnutrition and the physical and mental composites of QOL. Similar results were obtained in previous studies although those studies used different measures to determine the malnutrition of HD patients. Ibrahim & El Salamony (2008) and Sohrabi *et al.,* (2015) showed a negative correlation between risk of malnutrition and QOL, in which Malnutrition Inflammation Score was used as measure of malnutrition. Lower physical and mental functions were found in more severe malnourished patients. Depression was correlated with all subscales of KDQOL-36 in this study. Significant negative correlations were found between the PHQ-9 mean score and with the physical composite, mental composite, burden, effects and symptoms of kidney disease. Similar findings were found in the studies of Oliveira *et al.* (2012), Li *et al.* (2016) and Ganu *et al.* (2018) which demonstrated moderate to strong negative correlation between depression and quality of life with $p<0.001$ for the former and $p<0.01$ for the later. Itching and pain in joint or bone could be found in more severe depressed patients together with low self- image and low expectation for future.

CONCLUSION

Age, body mass index, serum albumin, creatinine, haemoglobin and energy intake were not found to be associated with QOL. An increase in protein intake may improve QOL, especially physical function. Severe malnutrition is associated with poorer physical and mental health. Depressed HD patients suffered from impaired physical, mental function, burden, effects and symptoms of kidney disease. QOL decreases as severity of depression increases. The present findings provide better insight on mechanism of nutritional status and depression and their associations with QOL for future screening, preventive measures and intervention. Further investigation regarding factors associated with QOL in elderly patients in the Malaysia setting is recommended.

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Authors' contributions

FIMS, led the data collection in Hulu Langat district; LZY, conceptualized the study, responsible for data analysis and interpretation and prepared the draft of the manuscript; NO, principal investigator, advised on the data analysis and interpretation and reviewed the manuscript; NFZ & ZAMD, research committee member, reviewed the manuscript.

Conflict of interest

The authors declared of no conflict of interest.

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Prevalence and determinants of Instrumental Activities of Daily Living (IADL) disability among community-dwelling elderly in a semi-urban setting in Peninsular Malaysia

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ABSTRACT

Introduction: The ability to perform daily living activities among the elderly is important, as physical disability may lead to dependency and various public health implications. This study aimed to determine the prevalence of instrumental activities of daily living (IADL) disability and its association with socio-demographic characteristics, dietary intake, social participation, perceived-health-status and risk of falls. **Methods:** This cross-sectional study was conducted among community-based elderly in the Gombak District of Selangor. 258 respondents aged 60-88 years old (mean age 66±6.5 years) were recruited through multi-stage proportional sampling. Most of the respondents (88.4%) aged 60-74 years and 11.6% were ≥75 years. IADL disability was determined using an eight-item IADL scale. The presence of IADL disability was defined as needing help in at least one or more of eight-IADL activities. Dietary intake and fall risk were assessed using diet history questionnaire (DHQ) and 21-item fall risk index (FRI-21), respectively. **Results:** The prevalence of IADL disability among the respondents was 58.1%. A binary logistic regression analyses showed that the following factors predicted IADL disability: advanced age (≥75 years, OR=6.4; 95% CI: 1.3, 30.8), being unmarried (OR=2.5; 95% CI: 1.1, 5.9), unemployed/retired (OR=2.3; 95% CI: 1.2, 4.3), and at risk of falls (OR=2.5; 95% CI: 1.3, 6.1). **Conclusion:** Predictors such as marriage and employment highlight the importance of social support among elderly. In practical terms, this means that it is incumbent upon caregivers, family members, and the community to provide both physical and emotional support if the functional status of the elderly is to be improved.

Keywords: IADL disability, elderly, functional status, Malaysia

INTRODUCTION

An increase in life expectancy, coupled with a widespread decline in fertility and mortality, has led to a recent rise in the population of the elderly on a global scale. For many developing countries, including Malaysia, this demographic transition is becoming more apparent, although its pattern varies considerably between countries (Bloom, Canning & Finlay, 2010).

Physical disability is common among the elderly. Developed countries have reported its prevalence ranging 12.0-

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15.0% (Ramsay *et al.*, 2008; den Ouden *et al.*, 2013). In contrast, the prevalence rate in developing countries appears to be slightly higher, at 29.0-48.0% (Chalise, Saito & Kai, 2008; Malhotra, Chan & Ostbye, 2010). Malaysia appears to have much higher prevalence of physical disability compared with more developed countries but is still within the range of that of developing countries (Hairi *et al.*, 2010). The elderly are at the greatest risk of becoming dependent, as they suffer difficulties and need assistance to carry out both basic activities of daily living (BADL) and instrumental activities of daily living (IADL). The IADL are key life tasks that seniors must manage to be safe & independent. They include cleaning and maintaining the house, managing money, moving within the community and preparing meals. IADL disability is defined as experiencing difficulty in carrying out activities that are essential to independent living**.**

Dependence is the main factor impacting the health and quality of life for the elderly, caregivers, and relatives (Millán-Calenti *et al.*, 2010). The implications of dependency may also lead to an increase in the use of health care services, admission to nursing homes, and hospitalisation (Zisberg *et al.*, 2015). As the number of dependent elderly is predicted to increase, this will impose an enormous and growing economic cost on society.

Much research has been conducted around the world on physical disability among the elderly, but the data from the developed countries may not be applicable to the Malaysian context. Recent studies on the specific IADL disabilities of the Malaysian elderly are limited, with the exception of the work of Momtaz, Hamid & Ibrahim (2012) and Suzana *et al.* (2013). The primary objective of this study was, therefore, to determine the prevalence of disability in IADLs among the elderly in a semi-urban setting, in Peninsular Malaysia. This study also aimed to determine the specific factors associated with IADL disability within the study population.

MATERIALS AND METHODS

Study design and sampling method

This cross-sectional study was conducted in Mukim Batu, which is one of the sub-districts of Gombak District, in the state of Selangor, in Peninsular Malaysia. Mukim Batu is a semi-urban area situated approximately in the middle of Gombak. A multi-stage proportional sampling method was used for the selection of the study location. The Gombak district was selected as the proportion of the elderly was one of the highest among the other eight districts of Selangor. The Gombak District consists of four sub-districts. The sub-district of Mukim Batu was selected as it had the highest proportion of elderly compared to the others. All 16 villages in Mukim Batu were selected. The number of respondents recruited from each village was based on the proportion of elderly from each village. Prospective respondents then were identified in each village, from a comprehensive community list of names, of both genders, that was provided by Head of Mukim Batu. They were randomly selected using a 'Research Randomiser' web-based application, sorted according to each village. The community in Mukim Batu was informed about the data collection process through their respective heads of villages. House-to-house visits were made and only the elderly, who had been identified in specific household, were invited to participate in this study.

Participants

A total of 258 elderly individuals were recruited from June to December 2013 based on the inclusion and exclusion criteria of this study: a person was

included if they had resided in the study location for >12 months, were Malaysian, aged ≥60 years, and able to communicate effectively. Subjects were excluded if they were reported by their family members that they had mental illnesses such as dementia/Alzheimer, terminally ill (end stage cancer/ rehabilitation), bedridden, or suffered hearing difficulties or deafness. In the cases where the subject was unable to respond to the interviewer due to language barrier, the primary caregiver was asked to be a proxy respondent.

Data collection

Measurement of IADL disability

The IADL questionnaire was used to assess the ability of the respondents to perform eight daily activities, as defined by Lawton & Brody (1969). These were: ability to use telephone; shopping; prepare meals; perform housekeeping chores; do the laundry; use of public transport; taking medication; and handling finances. Respondents were interviewed to obtain information about their ability to perform these eight daily activities. On the basis of their responses, the respondents were then classified into IADL disability Present or IADL disability Absent. For this study, the presence of IADL disability was defined as the need for help with at least one or more of the eight-item IADL activities (Millán-Calenti *et al.*, 2012). The reliability of IADL used in this study revealed a Cronbach's alpha value of 0.58.

Socio-demographic characteristics

A set of questionnaires was used to obtain general socio-demographic information about the respondents, which included gender, age, ethnicity, educational level, marital status, living arrangements, working status, and main economic resource. This information was obtained via face-to-face interviews.

Dietary intake

The amount of food items consumed by the respondents in the past week was recorded by a validated diet history questionnaire (DHQ), via interview, to establish their 'usual' weekly food consumption patterns. The DHQ has the advantage of requiring limited effort by the respondents and should provide detailed information about the food consumed and meal patterns over a longer period, provided that the data are collected by a trained interviewer (Shahar, Earland & Abdulrahman, 2000). The intake of nutrients (energy and protein) was compared with the Recommended Nutrient Intake (RNI) (NCCFN, 2017).

Social participation

Two self-reported items on social relation and participation were used to assess the social participation of the respondents:

- Social relations: visited their friends and/or relatives at least once a week with the possible responses of yes or no (Noguiera *et al.*, 2010).
- Social participation: taking part in and/or attending social functions at least once a week with the possible responses of yes or no (Noguiera *et al.*, 2010).

Perceived health status

Two self-rated items were used to assess the perceived health status of the respondents, including:

- Self-rated health: with the possible responses being: poor, neutral, good, and excellent (Nascimento *et al.*, 2012).
- Self-rated health relative to peers: perceived health relative to peers, with the possible responses being poor, neutral, good, and excellent (Nascimento *et al.*, 2012).

Table 1. Socio-demographic characteristics, dietary intake, social participation, perceived health status and fall risk of respondents (*n*=258) by gender. Figures in parentheses represent the percentages

Characteristics	*Male* (*n*=123)	*Female* (*n*=135)	*Total (n=258)*
Age			
60-74 years	104 (84.6)	124 (91.9)	228 (88.4)
≥75 years	19 (15.4)	11 (8.1)	30 (11.6)
(M±SD)	66±6.8	65±6.1	66±6.5
Ethnicity			
Malay	82 (66.7)	88 (65.2)	170 (65.9)
Chinese	22 (17.9)	29 (21.5)	51 (19.8)
Indian	19 (15.4)	18 (13.3)	37 (14.3)
Educational Level			
No formal education	2 (1.6)	13 (9.6)*	15 (5.8)
Primary education	57 (46.3)	71 (52.6)	128 (49.6)
Secondary education	51 (41.5)	45 (33.3)	96 (37.2)
Tertiary education	13 (10.6)	6 (4.4)	19 (7.4)
Marital status			
Single	6 (4.9)	1 (0.7)*	7 (2.7)
Married	108 (87.8)	93 (68.9)	201 (77.9)
Widowed/Divorced	9 (7.3)	41 (30.4)	50 (19.4)
Living arrangements			
Living alone	4 (3.3)	5 (3.7)	9 (3.5)
Living with others	119 (96.7)	130 (96.3)	249 (96.5)
Employment			
Unemployed	3 (2.4)	63 (46.6)*	66 (25.6)
Retired	68 (55.3)	43 (31.9)	111 (43.0)
Employed	52 (42.3)	29 (21.5)	81 (31.4)
Income resources			
Pension	48 (39.0)	15 (11.1)*	63 (24.4)
Salary	30 (24.4)	17 (12.6)	47 (18.2)
Children	23 (18.7)	61 (45.2)	84 (32.6)
Other (savings, social welfare)	22 (17.9)	42 (31.1)	64 (24.8)
Dietary intake			
<RNI energy †	72 (58.5)	91 (67.4)	163 (63.2)
Energy intake, kcal (*M±SD*)	1966±543	1642±505**	1796±547
<RNI protein ‡	67 (54.5)	70 (51.9)	137 (53.1)
Protein intake, g (*M±SD*)	57.99±16.73	50.00±16.41**	53.81±17.01
Visiting friends and/or relatives			
Yes	117 (95.1)	115 (85.2)*	232 (89.9)
No	6 (4.9)	20 (14.8)	26 (10.1)
Participation in activity/social programs			
Yes	85 (69.1)	62 (45.9)*	147 (57.0)
No	38 (30.9)	73 (54.1)	111 (43.0)
Perceived of own health status			
Excellent/Good	111 (90.2)	115 (85.2)	226 (87.6)
Neutral/Poor	12 (9.8)	20 (14.8)	32 (12.4)
Perceived health in relation to peers			
Excellent/Good	116 (94.3)	126 (93.3)	242 (93.8)
Neutral/Poor	7 (5.7)	9 (6.7)	16 (6.2)

Characteristics	*Male* (*n*=123)	*Female* (*n*=135)	*Total (n=258)*
Fall risk			
Low (0-8)	105 (85.4)	93 (68.9)*	198 (76.7)
Medium (9-10)	7 (5.7)	17 (12.6)	24 (9.3)
High (11-21)	11 (8.9)	25 (18.5)	36 (14.0)
FRI-21 score (*M*±*SD*)	5.98±2.98	7.47±3.10**	6.76±3.12

**p<0.05,* significant difference between gender (chi-squared test); ***p<0.05,* significant difference between gender (independent *t*-test);
†<RNI energy (Male <2010 kcal/day; Female <1780 kcal/day)
‡<RNI protein (Male <59 g/day; Female <51 g/day)

Risk of falls

This study used the validated 21-item Fall Risk Index (FRI-21) questionnaire to assess the risk of falls. This index encompassed physical, cognitive, emotional and social aspects of functioning, as well as environmental factors (Toba *et al.*, 2005). Each item was scored 1, when risk was present and 0 when risk was absent. The sum of all items ranged from 0-21, with higher scores indicating higher risk of falls. A cut-off of 9-10 points is useful for early detection of fall risk (Ishimoto *et al.*, 2012). The reliability of FRI-21 in this study indicated Cronbach's alpha value of 0.67.

Data analysis

The Nutritionist Pro™ Diet Analysis (Axxya Systems, Woodinville, WA, USA) software with the Nutrient Composition of Malaysian Food Database (Tee *et al.,* 1997) was used to analyse the dietary intake of the respondents obtained from the DHQ. In addition to DHQ, data from the questionnaire were analysed using IBM's Statistical Package for the Social Sciences (SPSS) version 25.0. The independent *t*-test was used to test the differences of the mean of variables between gender and age group. The chi-square test was used to determine the significance of association ($p<0.05$) between IADL disability with demographic data, dietary intake, perceived health status and risk of falls. However, if ≥1 cells had expected frequency of ≤5, then the Fisher's exact test was used instead. Factors which were statistically associated ($p<0.05$) were analysed using a multivariate binary logistic regression using an enter method to identify the best correlates of IADL disability.

Ethical approval

This study was approved by the University Research Ethics Committee of the Universiti Putra Malaysia (JKEUPM). Written informed consent was obtained from all participants or their family members prior to data collection.

RESULTS

Out of the 277 eligible participants, 258 agreed to participate in this study, giving a response rate of 93.1%. The socio-demographic characteristics of the study population are shown in Table 1. The sample had a similar distribution of males (48.0%) and females (52.0%). The mean age of the respondents was 66±6.5 years, ranging from 60-88 years. Most of the respondents (88.4%) were from the 'younger elderly' group between 60-74 years old and only 11.6% were from the 'older elderly' group (≥ 75 years old). The respondents comprised representatives of three main ethnic groups in Malaysia: Malays (65.9%), Chinese (19.8%) and

Table 2. Prevalence of IADL disability of the respondents, *n* (%) and *M*±*SD*

8-item IADL disability	*Male*			*Female*			*Total (n=258)*
	60-74 years old (n=104)	*≥75 years old (n=19)*	*Subtotal (n=123)*	*60-74 Years old (n=124)*	*≥75 Years old (n=11)*	*Subtotal (n=135)*	
Present disability	49 (47.1)	17 (89.5)*	66 (53.7)	73 (58.9)	11 (100.0)*	84 (62.2)	150 (58.1)
Absent disability	55 (52.9)	2 (10.5)	57 (46.3)	51 (41.1)	–	51 (37.8)	108 (41.9)
IADL score (*M*±*SD*)	7.14±1.15	5.47±1.50**	6.88±1.35	6.81±1.25	4.64±1.29**	6.64±1.39	6.76±1.37

**p<0.05,* significant difference between age group (chi-squared test)
***p<0.05,* significant difference between age group (independent *t*-test)

Indians (14.3%). Most of the respondents lived with others (96.5%) and only a few 3.5% lived alone. The majority of the females (62.2%) had received only a primary level education or none as against 47.9% of the men. Fewer women were in employment compared to men (21.0% versus 43.2%) and more were dependent on their children and others for financial resources compared to men (76.3% versus 36.6%). Women were also less likely than men to be married (68.9% versus 87.8%).

The mean energy intake of the respondents which were 1966±543 kcal/day and 1642±505 kcal/day for males and females, respectively did not achieve the Malaysian RNI. The mean intake for protein, being 57.99±16.73 g/day and 50.00±16.41 g/day for males and females, respectively was also lower than Malaysian RNI. Overall, more than half of the respondents consumed energy (63.2%) and protein (53.1%) below the RNI level. In regard to social participation, it was found that males were more likely to pay visits and participate in any activities compared to th female participants. Overall, most of the respondents perceived their own health status (87.6%) and their health in relation to their peers (93.8%) as being "excellent/good". The respondents reported a mean FRI-21 score of 6.76±3.12, with females having a significantly higher risk of falls (7.47±3.10) compared with males (5.98±2.98). Overall, 23.3% were identified having at risk of falls, with 31.1% of them being females, compared with 14.6% males.

The mean±SD for the IADL ability of the respondents was 6.76±1.37 (Table 2). It appears, from their lower IADL scores, that females had poorer functional status compared to males although there was no significant difference between the genders. In contrast, the results showed that there was a significant difference in the mean of IADL score between age groups in both genders (p <0.001); respondents from the younger elderly group had higher IADL scores compared to those from the older group. More than half (58.1%) of the respondents were unable to execute at least one IADL and this was almost doubled for the older elderly (male=89.5%; female=100.0%) compared to the younger elderly (male=47.1%; female=58.9%).

Bivariate analysis showed a significant association between several factors and IADL disability. These factors were: age group, ethnicity, educational level, marital status, employment

Table 3. Distribution of socio-demographic characteristics, dietary intake, social participation, perceived health status and fall risk by IADL disability, *n* (%)

Independent Variables	*Present IADL Disability (n=150)*	*Absent IADL Disability (n=108)*	χ^2 *value*	*p-value*
Age group				
60-74 years old	122 (53.5)	106 (46.5)	17.28*	0.000
≥75 years old	28 (93.3)	2 (6.7)		
Gender				
Male	66 (53.7)	57 (46.3)	1.94	0.164
Female	84 (62.2)	51 (37.8)		
Ethnicity				
Chinese	22 (43.1)	29 (56.9)	6.05**	0.049
Malay	104 (61.2)	66 (38.8)		
Indian	24 (64.9)	13 (35.1)		
Educational Level				
Formal education	137 (56.4)	106 (43.6)	5.35*	0.028
No formal education	13 (86.7)	2 (13.3)		
Marital status				
Married	103 (51.2)	98 (48.8)	17.78**	0.000
Single/Widowed/Divorced	47 (82.5)	10 (17.5)		
Living Arrangements				
Living with others	144 (57.8)	105 (42.2)	0.28	0.738
Living alone	6 (66.7)	3 (33.3)		
Employment				
Employed	30 (37.0)	51 (63.0)	21.60**	0.000
Unemployed/Retired	120 (67.8)	57 (32.2)		
Dietary Intake				
≥RNI energy (kcal)	42 (44.2)	53 (55.8)	11.99**	0.000
<RNI Energy (kcal)	108 (66.3)	55 (33.7)		
≥RNI protein (g)	61 (50.4)	60 (49.6)	5.59**	0.018
<RNI protein (g)	89 (65.0)	48 (35.0)		
Visiting friends and/or relatives				
Yes	125 (53.9)	107 (46.1)	17.17*	0.000
No	25 (96.2)	1 (3.8)		
Taking part in activity/social programs				
Yes	66 (44.9)	81 (55.1)	24.62**	0.000
No	84 (75.7)	27 (24.3)		
Perception of own health status				
Excellent/Good	123 (54.4)	103 (45.6)	10.33**	0.000
Neutral/Poor	27 (84.4)	5 (15.6)		
Perceived health in relation to peers				
Excellent/Good	136 (56.2)	106 (43.8)	6.04*	0.017
Neutral/Poor	14 (87.5)	2 (12.5)		
Fall risk				
No risk	99 (50.0)	99 (50.0)	23.74**	0.000
At risk	51 (85.0)	9 (15.0)		

**p<0.05,* significant difference between age group (Fisher's exact test)
***p<0.05,* significant difference between age group (chi-squared test)

Table 4. Binary logistic regression analysis for factors predicting IADL disability (*n*=150)

Variables	*Frequency (n=150)*	*Adjusted OR (95% CI)*	*p-value*
Age group			
60-74 years old	122	1.000	0.020*
≥75 years old	28	6.4 (1.3, 30.8)	
Ethnicity			
Chinese	22	1.000	0.363
Malay	104	1.4 (0.7, 3.0)	0.315
Indian	24	2.1 (0.7, 5.8)	0.171
Educational Level			
Formal Education	137	1.000	0.546
No formal education	13	1.8 (0.3, 10.9)	
Marital status			
Married	103	1.000	0.038*
Single/Widowed/Divorced	47	2.5 (1.1, 5.9)	
Employment			
Employed	30	1.000	0.011*
Unemployed/Retired	120	2.3 (1.2, 4.3)	
Dietary Intake			
≥RNI Energy (kcal)	42	1.000	0.185
<RNI Energy (kcal)	108	1.5 (0.8, 2.7)	
≥RNI Protein (g)	61	1.00	
<RNI Protein (g)	89	1.1 (0.5, 2.3)	0.902
Visiting friends and/or relatives			
Yes	125	1.000	0.109
No	25	5.7 (0.7, 48.0)	
Taking part in activity/social programs			
Yes	66	1.000	0.062
No	84	1.8 (0.3, 5.8)	
Perceived of own health status			
Excellent/Good	123	1.000	0.678
Neutral/Poor	27	1.4 (0.3, 6.0)	
Perceived health in relation to peers			
Excellent/Good	136	1.000	0.988
Neutral/Poor	14	1.0 (0.1, 7.5)	
Fall risk			
No risk	99	1.000	0.049*
At risk	51	2.5 (1.3, 6.1)	

**p<0.05,* represents statistical significance

status, energy and protein intake, social relations, social participation, self-rated health, and fall risk. Detailed findings are shown in Table 3. The respondents of advanced age group (≥75 years), who were unmarried, and unemployed, had energy and protein intakes of less than RNI values were associated with IADL disability. From a multivariate binary logistic regression analysis (Table 4), the significant determinants of IADL disability for this study were found to be advanced age (≥75 years old, OR=6.4; 95% CI: 1.3, 30.8), being unmarried (OR=2.5; 95% CI: 1.1, 5.9), unemployed/retired (OR=2.3; 95% CI: 1.2, 4.3), and at risk of falls (OR=2.5; 95% CI: 1.3, 6.1).

DISCUSSION

This study contributes to the literature on the prevalence of self-reported physical disability using IADL, which is one of important predictors for a good quality of life (Onunkwor *et al.*, 2016). Malaysia is experiencing a dramatic increase in elderly population (Bloom *et al.*, 2010) and studies have highlighted that social support (Feng *et al.*, 2013), sufficient dietary intake, absence of depression and cognitive impairment (Vanoh *et al.*, 2017) are among the contributory factors for a healthy physical functioning of elderly (Sathasivam *et al.*, 2015). Although numerous studies on physical disability have been undertaken worldwide, variations in physical disability assessment (e.g. different instrument and scoring methods) across these studies make any direct comparisons difficult. With this limitation, it is reasonable that this study should only be matched with local studies such as those of Nur' Asyura *et al.* (2010), Momtaz *et al.* (2012), and Suzana *et al.* (2013). This is in addition to only a few foreign studies such as Chalise *et al.* (2008), Coustasse *et al.* (2008), Ramsay *et al.* (2008), and Millán-Calenti *et al.* (2010) all of which also defined disability as the inability to perform at least one of the IADL items.

In this study, the prevalence of IADL disability among the respondents was 58.1%. This finding is comparable with the previous local study of Nur'Asyura *et al.* (2010) among community-dwelling elderly in the rural areas of Selangor and the state of Negeri Sembilan (located south of Selangor), where the prevalence of IADL disability among the respondents was about fifty percent (49.8%). More recently, Suzana and colleagues (2012) reported that almost half of their free-living respondents (43.0%) from a Federal Land Development Authority (FELDA) agricultural settlement were found to be physically dependent. In stark contrast to these figures, an earlier local study reported that the prevalence of IADL disability among the free-living elderly was only 13.0% (Shahar *et al.*, 2007). It was noted, then, that there are different ranges of prevalence for IADL disability among the Malaysian elderly. These findings should be interpreted cautiously since there is the possibility of a different number of IADL items used, sample sizes, and settings of the sample studied.

The prevalence of IADL disability in the results of the present study appears to be higher than that in most other countries. Using the same IADL instrument and scoring method, Coustasse *et al.* (2008) reported that 12.8% of the elderly in the United States were disabled in terms of IADL, while a study in Britain reported a 15.0% rate of IADLs (Ramsay *et al.*, 2008). Interestingly, some Asian countries also reported a similar lower prevalence of IADL disability, in contrast to this study, including Nepal (29.2%) and Sri Lanka (32.3%) (Chalise *et al.*, 2008; Malhotra *et al.*, 2010). However, there are several studies which also offer quite similar findings to our study. For instance, studies in Spain and Taiwan reported 53.5% and 48.1% respectively (Hsu & Jhan, 2008; Millán-Calenti *et al.*, 2010). The wide disparity between the ranges of prevalence between the countries might be explained by the fact that IADL is influenced by societal, environmental, and cultural factors, such as readiness to adapt and accepting the "sick role" or learned dependency. The high prevalence of IADL disability in this study could be attributed to two IADL items: the ability to use public transport and shopping for groceries, both of which require the elderly to leave their housing areas. This could be due to other external factors such as the accessibility to own transportation, safety issues and the

lack of provision of support from their close family members or neighbours. In Malaysia, the prevalence of a deeply rooted traditional family culture makes it incumbent on younger family members to take care of the elderly. Unsurprisingly then, most of the respondents (96.5%) in this study do not live alone but with others (Hairi *et al.*, 2010). It may be concluded that Malaysian elderly tend, as a rule, to be dependent on others or at least are ready to seek assistance. It is also possible that though they claimed to be unable to perform such daily tasks, they were, in fact, not usually allowed to do so by those around them.

The different prevalence rates of IADL disability in these studies is most likely due to the different physical disability scales, items, and scoring methods, that were used. However, the general findings regarding predictors of disability were quite similar. Many studies have shown the significant predictors of IADL disability are old age, being unmarried, unemployment, and at risk of falls (Coustasse *et al.*, 2008; Hsu & Jhan, 2008; Hairi *et al.*, 2010; Lund, Nilsson & Avlund, 2010; d'Orsi, Xavier & Ramos, 2011; Ishimoto *et al.*, 2012; Nascimento *et al.*, 2012). The present study confirms the majority of the predictors that were reported and extends their findings.

In this study, age was found to be a significant risk factor for IADL disability; with increasing age, the odds of reporting disability also increased. Typically, older people are more fragile, are highly susceptible to chronic diseases, and usually after their 70's show a greater loss of muscle mass which would result in difficulties in performing routine activities (Danielewicz, Barbosa & Del Duca, 2014). The importance of marriage as a factor influencing daily activities was also observed among respondents in this study. It is reasonable to assume that marriage might influence one's overall health status through the social support provided by the spouse, and thereby have a preventative effect on functional disability among elderly people (Pandey, 2011; Chao *et al.*, 2013). Marriage is one of the central sources of social support, and greater social interaction may encourage the elderly to remain physically active, and thus decrease their risk of developing disabilities (Hays *et al.*, 2001).

In this study, being unemployed when elderly was a significant predictor of disability in terms of IADLs. Being unemployed is often associated with low income and poverty, which might lead to a lower standard of living, an unhealthy lifestyle and diet, less frequent use of healthcare services, which may therefore promote a higher risk of diseases (Hairi *et al.*, 2010). The working environment provides a form of social support and interaction with colleagues, which in turn keep the working elderly active and help maintain their functional status (d'Orsi *et al.*, 2011). Thus, it was unsurprising that a study among the Indian elderly found that the likelihood of disability among economically disadvantaged elderly people was higher than those having average to above average incomes (Pandey, 2011). In this study, being at risk of falls was shown to strongly increase the risk of IADL disability among the respondents. As would be expected, post-fall injury or fracture might result in a loss of confidence and reduce activity levels, leading to functional decline. At present, there is still a lack of knowledge about the possible association between fall risk and IADL disability and this is an area for further research.

This study had some limitations. Firstly, the study design was cross-sectional, consequently only showing descriptive relationships, and no conclusions on causality could be drawn. Then, the methodology that used was limited to self-reported questionnaires,

which might lead to under- or over-reporting. Misclassification bias can be expected making it more difficult to detect if real associations are present. A performance-based physical disability assessment is recommended for future studies to determine the magnitude of the physical disability. Therefore, cause and effect relationships as well as the magnitude of the contributions of some associations that have been reported need to be further investigated with larger sample sizes using longitudinal, randomised, controlled study design, in various populations across the region.

CONCLUSION

This study reported a substantial prevalence of IADL disability among the elderly respondents, consistent with the predictors of IADL disability found in some previous studies. It can be strongly concluded, that predictors such as marriage and employment highlight the importance of social support for the elderly, in the Malaysian context. From a wider perspective, the importance of caregivers, family members, and community for providing their support physically and emotionally is necessary if the functional status of the elderly is to be improved.

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Authors' contributions

MFM, conceptualised and designed the study, led the data collection and prepared the draft of the manuscript; ZI, conceptualised and designed the study, provided advice on the data analysis and its interpretation, and reviewed the manuscript; SNAA, provided advice on the data analysis and interpretation, and reviewed the manuscript; CYM provided advice on the data analysis, interpretation of the findings and reviewed the manuscript.

Conflict of interest

None of the authors declared a conflict of interest.

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Health-related quality of life of elderly with chronic obstructive pulmonary disease from selected government institutions

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ABSTRACT

Introduction: It is widely recognised that health-related quality of life (HRQOL) is impaired in chronic obstructive pulmonary disease (COPD) patients. Most previous studies were conducted among the younger adult population and there is limited information on the elderly population. This study aimed to determine the COPD assessment test (CAT) score in the elderly with COPD. **Methods:** This was a cross-sectional study involving 140 elderly patients who had been diagnosed with COPD at two selected government institutions. Data on socio-demographic and health status were collected by interviewing patients and reviewing their medical records. The HRQOL was measured using CAT. The independence sample t-test and one-way ANOVA were conducted to compare the CAT scores with socio-demographic and health status. **Results:** The socio-demographic and health characteristics of the patients were as follows: majority (54%) were aged 60-70 years, male (97%), Malay (59%), married (75%), ex-smokers (72%), had attained primary education (48%), had co-morbidities (54%), no history of hospitalisation or visits to the emergency department due to COPD (57%), and were in moderate stage of airflow obstruction (53%). The mean of CAT score was 21.87±6.85 and the majority of the patients were classified as having worst symptoms of COPD (93%) as they had high CAT score which was ≥ 10. **Conclusion:** Majority of the patients in this study had high scores of CAT, which indicated poor HRQOL. Ex-smokers had higher scores compared to non-smokers. More attention need to be given to these subgroups in order to increase their quality of life.

Keywords: HRQOL, elderly, COPD, CAT score

INTRODUCTION

Aging is the process related to a variety of molecular and cellular damage that has accumulated as age increases (Steves, Spector & Jackson, 2012). This damage will lead to an increased risk of diseases as a result of the decline of physiological reserves (WHO, 2015). Chronic Obstructive Pulmonary

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Disease (COPD) is a common disease among elderly, characterised by a slow progressive obstruction of the airway leading to the interference of normal breathing (WHO, 2018).

According to Global Burden of Disease Study, about 174 million cases of COPD were reported in 2015, which increased to 251 million in 2016 (WHO, 2018). The increasing number of COPD cases makes it a leading cause of mortality and morbidity in the world (Rabe & Watz, 2017). Apart from that, COPD is classified as one of the top ten diseases causing a high burden to patient's life (Institute for Health Metrics and Evaluation, 2010). Cough, sputum production and shortness of breath are the main causes of the high burden, resulting in a decline of the health-related quality of life (HRQOL) (Martín *et al.*, 2008). HRQOL is a subjective evaluation of an individual's or a group's perceived physical and mental health over time. It goes beyond direct measures of population health, life expectancy, and causes of death, and focuses on the impact health status has on quality of life (CDC, 2016).

HRQOL can be measured using generic and disease-specific instruments. The generic instrument covers a broader view of health while the disease-specific instrument concentrates on symptoms and function impairments related to COPD (Jones, 2013). The disease-specific instrument was commonly used to measure HRQOL in COPD patients as it is more sensitive toward changes in the impact of the disease (Glaab, Vogelmeier & Buhl, 2010).

Impact of COPD on HRQOL has been well established in many countries (Agrawal, Joshi & Jain, 2015; Kim *et al.,* 2013; Sundh *et al.,* 2015). In Malaysia, a study that investigated HRQOL in COPD patients showed that lung function was related to HRQOL (Draman *et al.,* 2013). An earlier local study also found that ethnicity, marital status, educational level, economic status, smoking and severity of the disease was related to HRQOL (Maria *et al.,* 2010). However, most of the studies were conducted among the adult population and used the generic questionnaire to assess HRQOL.

HRQOL is important in managing COPD whether in primary or secondary health care (Arne *et al.*, 2009). The Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommended an assessment on the impact of the disease toward patients as part of COPD assessment (GOLD, 2018). Studies to determine HRQOL among the elderly with COPD are therefore indicated. The main objective of the present study was to determine the COPD assessment test (CAT) score in elderly patients with COPD while the specific objective was to compare CAT score with the socio-demographic and health status of the patients.

MATERIALS AND METHODS

Study design

In this cross-sectional study, 140 elderly patients with COPD were recruited from the Respiratory Clinic of Institute of Respiratory Medicine and the Serdang Hospital. The data collection was undertaken from August 2017 to January 2018. Those included were aged ≥ 60 years, diagnosed with COPD, Malaysian citizens and able to stand properly without aid.

The number of patients who were involved in this study was estimated using the two proportion formula as below:

$$n = \frac{Z21\text{-}\alpha/2\ [P1\ (1\text{-}P1) + P2\ (1\text{-}P2)]}{d2}$$

$$n = \frac{1.962\ [0.96\ (1\text{-}0.96) + 0.051\ (1\text{-}0.051)]}{0.052}$$

n =133 patients

n = sample size

Z1-α/2 = z score at 1-α/2 confidence level (Z1-α/2 = 1.96)

P1 = prevalence for non-COPD group (P1 = 0.96) (Loh *et al.*, 2016)
P2 = prevalence for COPD group (P2 = 0.051) (Lim *et al.*, 2015)
d2 = desire precision (d = 0.05)

Based on the calculation, at least 133 patients were required for this study. Using convenience sampling, all elderly patients with COPD who were available during data collection period were screened based on the inclusion criteria. About 197 patients met the criteria but only 140 of them agreed to participate in the study.

Permission to conduct data collection at the Institute of Respiratory Medicine and the Serdang Hospital was obtained from both institutions. Ethical approval was granted by the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM) and the Medical Research & Ethics Committee (MREC) with registration no. NNMR-17-589-34392. A written informed consent was obtained from the patients. If patients were unable to respond due to language barrier, the primary care-giver was appointed as the proxy respondent for the questionnaire and the interview.

Measurements

This study consisted of three parts, namely socio-demographic, health status and HRQOL. An interviewer-administered structured questionnaire was used for the socio-demographic and HRQOL parts, while the health status was determined using both interview and a review patient's medical record.

Socio-demographic

The socio-demographic data that was collected included the age, sex, race, educational level and marital status of the patient. In addition, their smoking habits were recorded based on their admission.

Health status

Data on co-morbidities, history of hospitalisation or emergency department due to the COPD and severity of airflow obstruction were obtained from the medical records of the patients. For co-morbidities, this study focused on the diseases that are commonly observed in COPD patients such as cardiovascular disease, type 2 diabetes mellitus, chronic kidney disease and hypertension. The history of hospitalisation or visits to the visits to the emergency department due to COPD in previous one year was recorded. The severity of airflow obstruction was assessed using the spirometry test and was classified according to forced expiratory volume in one second (FEV_1) value: GOLD 1 (Mild), $FEV_1 \geq 80\%$ predicted; GOLD 2 (Moderate), $50\% \leq FEV_1 < 80\%$ predicted; GOLD 3 (Severe), $30\% \leq FEV_1 < 50\%$ predicted; GOLD 4 (Very severe), $FEV_1 < 30\%$ predicted (GOLD, 2018).

Health-related quality of life

CAT is a disease-specific instrument that was used in this study to measure HRQOL. This instrument was selected as it has fewer items and is therefore less time consuming and more convenient for clinical application (GOLD, 2018). Besides that, it is a validated questionnaire for use with COPD patients (Jones *et al.,* 2009). There are eight questions in CAT covering cough, phlegm, chest tightness, breathlessness when going up an elevation (e.g. hills/ stairs), activity limitation at home, self-confidence about leaving home, sleep and energy. The patients needed to answer based on a 6 Likert scale, 0 describing the best state or condition and 5 the worst. The patients were required to choose one answer for each question. The scores of the individual questions were added to obtain the total score. The total score ranged from 0-40 indicating the best to the worst condition (Jones *et*

Table 1. Demographic and health characteristics of the patients with COPD (*n*=140)

Characteristics	*n (%)*	*Mean±SD*
Socio-demographic		
Age (years)		70±7
60-70 years	76 (54)	
>70 years	64 (46)	
Gender		
Male	136 (97)	
Female	4 (3)	
Race		
Malay	82 (59)	
Chinese	37 (26)	
Indian	21 (15)	
Educational level		
None	16 (11)	
Primary schooling	67 (48)	
Secondary schooling	42 (30)	
Tertiary schooling	15 (11)	
Marital status		
Single	8 (6)	
Married	105 (75)	
Divorced/Widowed	27 (19)	
Smoking habits		
Smoker	30 (22)	
Ex-smoker	101 (72)	
Non-smoker	9 (6)	
Amount of cigarettes/ day†		
Less than 1 pack (20 cigarettes/pack)	27 (90)	
1 pack (20 cigarettes/pack)	3 (10)	
More than 1 pack (20 cigarettes/pack)	0 (0)	
Health status		
Co-morbidities		
Not present with co-morbidities	64 (46)	
Present with co-morbidities	76 (54)	
Hypertension	56 (74)	
Diabetes Mellitus	29 (38)	
Heart disease	18 (24)	
Dyslipidaemia	14 (18)	
Chronic Kidney Disease	6 (8)	
History of hospitalization or visits to emergency department due to COPD		
None	79 (57)	
At least one episode	38 (27)	
More than one episode	23 (16)	
Severity of COPD‡		
Mild ($FEV_1 \geq 80\%$ predicted)	14 (13)	
Moderate ($50\% \leq FEV_1 < 80\%$ predicted)	58 (53)	
Severe ($30\% \leq FEV_1 < 50\%$ predicted)	34 (31)	
Very severe ($FEV_1 < 30\%$ predicted)	3 (3)	
Health-related quality of life		
Total score of CAT		21.87±6.85
Less symptoms (< 10)	10 (7)	
More symptoms (≥ 10)	130 (93)	

† *N*=30, based on number of smokers

‡ *N*=109, missing data due to no latest spirometry test for the past one year

Table 2. Mean of CAT score by socio-demographic and health status among elderly with COPD (*N*=140)

Variables	*n*	*CAT score*		
		Mean±SD	*t/F*	*p*
Socio-demographic				
Age (years)				
60-70	76	21.45±6.78	0.062	0.427
>70	64	22.38±6.95		
Sex				
Male	136	21.79±6.92	-0.852	0.396
Female	4	24.75±3.30		
Race				
Malay	82	21.96±7.13	0.351	0.705
Chinese	37	22.30±6.60		
Indian	21	20.76±6.36		
Educational level				
None	16	22.19±7.28	0.815	0.488
Primary schooling	67	22.57±6.94		
Secondary schooling	42	21.43±6.71		
Tertiary schooling	15	19.67±6.47		
Marital status				
Single/Divorced/Widowed	35	22.37±5.69	0.497	0.620
Married	105	21.70±7.21		
Smoking habits				
Smoker	30	21.90±5.72	3.300	0.040*
Ex-smoker	101	22.36±7.17[a]		
Non-smoker	9	16.33±4.06[a]		
Health status				
Co-morbidities				
Not present	64	22.03±6.48	0.252	0.801
Present	76	21.71±7.19		
History of hospitalization or visit emergency department due to COPD				
None	79	20.77±6.80	2.883	0.059
At least one episode	38	22.63±7.21		
More than one episode	23	24.39±5.76		
Severity of airflow obstruction[†]				
Mild ($FEV_1 \geq 80\%$ predicted)	14	20.50±7.89	0.289	0.833
Moderate ($50\% \leq FEV_1 < 80\%$ predicted)	58	22.38±7.46		
Severe ($30\% \leq FEV_1 < 50\%$ predicted	34	22.47±5.75		
Very severe ($FEV_1 < 30\%$ predicted)	3	22.67±14.64		

Identical superscript letters indicate significant difference
*p<0.050
[†]n=109, missing data due to no latest spirometry test for the past one year

al., 2009). Based on GOLD (2018), the total scores of CAT are classified based on the presence of symptoms, namely, few symptoms (<10) or more symptoms (≥10).

Statistical Analysis

The data collected were analysed using the Statistical Package for Social Sciences (SPSS) version 22 software. Descriptive analysis was used to report the frequency, percentage, mean and standard deviation. The independent-samples t-test and one-way analysis of variance (ANOVA) with the post hoc Turkey test were performed to compare the CAT score with socio-demographic and health status. The level of significance of the *p*-value was set at 0.05 for all the statistical tests.

RESULTS

The socio-demographic and health characteristics of the patients are shown in Table 1. The mean score for CAT was 21.87±6.85 with a range of 4-36. The majority of the patients (93%) had more symptoms of COPD as they had the total score of CAT ≥ 10.

Table 2 shows the mean of CAT score by socio-demographic and health status. The patients who were older (age >70 years), female, Chinese, single and with primary schooling had a higher CAT scores compared to others for these characteristics, but no significant difference was found. In terms of the smoking habit, ex-smokers had a significantly higher CAT score than to non-smokers ($p<0.05$). However, there were no differences between non-smokers and smokers, as well as between smokers and ex-smokers.

Patients without co-morbidities surprisingly had a worse CAT score than patients presented with co-morbidities, but with no significant difference. The patients who had a history of hospitalisation or visits emergency department due to the COPD had a higher CAT score than those who did not. The patients who had very severe stage of airflow obstruction also showed similar results. But differences were not significant for both.

DISCUSSION

The mean CAT score for this study was 21.87±6.85, which is almost similar to the findings of previous studies in a developed country, the United Kingdom (Dodd *et al.*, 2012; Kelly *et al.*, 2012). The studies by Dodd *et al.* (2012) and Kelly *et al.* (2012) reported that the mean of CAT score for their studies were 22.1±7.5 and 23.1±8.2, respectively. By contrast, a study in Japan found that the mean CAT for their elderly patients (65-74 years, 5±8; 75-84 years, 8±8; > 85 years, 9±8.5) was better compared to that of the present study and the studies done in the United Kingdom (Kobayashi *et al.*, 2014). The difference might be because the patients from the Japan study had COPD explained to them at the hospital (Kobayashi *et al.*, 2014). Thus, their better knowledge of the disease might have helped them achieve a higher quality of life.

This study found that 93% of the patients had high CAT scores (≥10) that indicated worse symptoms of COPD. This proportion was higher than the 80% found in a local study in Kelantan (Draman *et al.,* 2013). A study conducted in South Korea indicated similar results, which 69% of their patients had high CAT scores (Kim *et al.,* 2013).

The finding of no significant differences for CAT score for age is consistent with that obtained by Sundh *et al.* (2011). This could be because the age of the elderly patients in this study did not vary greatly and hence the CAT score may not vary much as well. No significant differences were found in our study in CAT score for gender, race, educational level and marital status which is inconsistent with the findings of Maria *et al.* (2010). This might be

explained by the small number of female patients in this study. Apart from that, HRQOL may be influenced by other factors which were not being examined in this study such as the body mass index, patient's occupation and income.

Our finding that ex-smokers had poor HRQOL compared to non-smokers is in agreement with that of another study by Sundh *et al.* (2011). As smoking is a risk factor for COPD, it may explain why their lung function was worse compared to the others, leading to their poor quality of life (GOLD, 2018). Thomsen *et al.* (2013) found that non-smokers with COPD had less symptoms and less airflow obstruction compared to COPD patients with smoking history.

The poor quality of life is more common in COPD patients who had co-morbidities (Sundh *et al.,* 2011). HRQOL became worse as the number of co-morbidities increased (Wacker *et al.,* 2016). This could be the result of them seeking for health care more frequently compared to patients with COPD only. However, the present study found no significant difference of HRQOL between patients with and without co-morbidities. This could be due to under reporting of co-morbidities, since our study selected only five common diseases for this purpose. The patients were considered as not having co-morbidities, when they did not suffer from any of these.

The patients who were frequently admitted to hospital due to COPD had worse HRQOL is consonant with the findings of Jones *et al.* (2011). A higher number of hospital admissions was closely related with poor HRQOL (Hong *et al.,* 2015). They were admitted to hospital more frequently as their quality of life decreased. Our finding that quality of life worsened as the severity of the airflow obstruction increased in patients is consistent with that of other studies (Jones *et al.,* 2011; Agrawal *et al.,* 2015; Hong *et al.,* 2015; Wacker *et al.,* 2016).

Other than factors discussed above, poor nutritional status might be another contributor of poor HRQOL. COPD and elderly patients are usually presented with poor nutritional status (King, Cordova & Scharf, 2008; Saka *et al.*, 2010). As a result of this, COPD patients experienced a decline in exercise ability, which then in turn contributed to poor HRQOL (Mostert *et al.*, 2000).

Use of a validated HRQOL questionnaire is the strength of the study. The CAT questionnaire has been used in many studies and validated in several countries. It is the latest disease-specific questionnaire that is used to determine HRQOL in COPD patients. A limitation of this study is that it was dominated by male patients. Apart from that, this study used secondary data from medical records for health status information like co-morbidities, history of hospitalisation or visits to the emergency department due to acute exacerbation and results of the spirometry tests. Thus, data may have been incomplete and insufficient. This could have interfered with the results of study. Besides that, multiple logistic regression could not be performed to predict factors that contributed to the HRQOL, as data for HRQOL was not equally distributed. Future studies should be larger to explore the socio-demographic and health status contributions towards HRQOL.

CONCLUSION

COPD does indeed have a negative impact on elderly patients especially among former smokers as they presented with higher CAT score compared to others. Healthcare professionals should pay closer attention to this group and implement suitable interventions such as providing pulmonary rehabilitation and advice on smoking cessation. Interventions should be carried out early to increase their quality of life and delay the disease progress.

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Author's contribution

N-FY, researcher, devised and conducted the study, data analysis and interpretation, prepared the draft of the manuscript; NO, principal investigator, assisted in study and result's interpretation, reviewed the manuscript; SNAA, assisted in the study, the interpretation of the results, and reviewed the manuscript; UND, assisted in study and result's interpretation, reviewed the manuscript; BNMY, assisted in the study, the interpretation of results and reviewed the manuscript.

Conflict of interest

The authors have no conflicts of interest to declare.

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Simple method for assessing standing height using recumbent length in bedridden patients using soft and firm mattresses

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ABSTRACT

Introduction: The accurate measurement of the height of bedridden patients is difficult. Height assessment is required for the calculation of body mass index, which is crucial for determining the nutrition status of a patient. This study aimed to validate recumbent length measurement against the standing height measurement using soft and firm mattresses and to derive predictive equations to calculate the actual height of bedridden patients on mattresses with different firmness. **Methods**: Ninety-nine hospitalised participants (mean age 48.9±13.9 years; range 21–80 years) (49 men, 50 women) and 100 healthy participants (mean age 36.8±13.6 years; range 21–77 years) (50 men, 50 women) were recruited. Standing height was measured using a stadiometer. Recumbent length was measured using a 2 metre long measuring tape. Hospitalised participants lay on soft mattress and healthy participants on firm mattress. **Results**: Using Bland–Altman plot, 96% of hospitalised participants using soft mattress were within 2.5±2.7 cm (mean±2SD) whereas 97% of healthy participants using firm mattress were within 2.1±2.1 cm. The regression equation developed using firm mattress was Standing height (cm) = 0.993 x Recumbent length – 0.943; (r^2=0.982). The regression equation developed using soft mattress was Standing height (cm) = 1.012 x Recumbent length – 4.477; (r^2=0.981). **Conclusion**: We concluded that recumbent length is a valid clinical tool to estimate standing height. Standing height can be estimated from the predictive equations developed for patients lying on soft or firm mattresses.

Keywords: Recumbent length, height, measuring tape, Asian, bedridden

INTRODUCTION

Patients may be immobilised and bedridden because of stroke, head trauma, severe acute brain injury (Creutzfeldt & Hough, 2015) or hip or leg fracture (Selikson, Damus & Hamerman, 1988). The accurate assessment of height in this group is necessary to evaluate body mass index (BMI), which is crucial for determining the nutritional status of these patients. In addition, certain calculations of energy requirements are dependent on height, such as the Harris–Benedict formula (Harris & Benedict, 1918) and Mifflin–St Jeor formula (Mifflin *et al.*, 1990).

A large, multicenter study in Latin America indicated that height at

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admission was only measured in 32.9% patients (Correia & Campos, 2003). Visual estimation of height was reported to be an inaccurate method with large potential errors (Frid *et al.*, 2013; Bojmehrani *et al.*, 2014). Furthermore, the self-reported height of elderly persons with poor cognitive performance has been shown to have significant errors (Sahyoun *et al.*, 2008).

Alternative methods for length measurements of body segments to estimate height in patients with difficulty standing upright have been developed over the years. These include the knee height equation (Chumlea, Roche & Steinbaugh, 1985; Shahar & Pooy, 2003), demi-span equation (Hirani *et al.*, 2010; Bassey, 1986) and arm-span equation (Shahar & Pooy, 2003; Kwok & Whitelaw, 1991). Other studies have used ulna length (Bonell *et al.*, 2017) and knee height (Maleki & Shariatpanahi, 2017) as surrogates for a specific Asian country or ethnic group with subjects drawn from healthy populations and outpatients.

The use of body segment measurements is not without limitations. The measurement of knee height, demi-span, arm span and ulna length require patients to be able to follow commands: knee height requires patients to be in the sitting position (Shahar & Pooy, 2003); demi-span and arm span measurements require patients to outstretch one or both of their arms laterally (Shahar & Pooy, 2003; Hirani *et al.*, 2010) and ulna length is measured with patients laying their left forearm across their chest and touching their right shoulder (Bonell *et al.*, 2017). Some bedridden patients may not be able to follow these simple commands due to their medical conditions. Moreover, these methods may not be applicable if fractures involving these body segments are present. In addition, the knee height method requires special tools such as callipers, which may not be available in many institutions.

There is growing interest in the measurement of recumbent length (RL), which is taken when lying down, to estimate the standing height (SH), which is the gold standard. RL requires less effort from patients and is easily done because it is measured in the supine position (Venkataraman *et al.*, 2015).

Some studies have compared SH with the RL (Gray *et al.*, 1985; Frid *et al.*, 2013; Luft *et al.*, 2008; Melo *et al.*, 2014; Bojmehrani *et al.*, 2014). These studies have reported that the RL overestimated the SH; furthermore, the reported difference between the values is variable. Gray *et al.* (1985) found that in 108 ambulatory patients, RL was significantly longer than SH by 3.68 cm. Another study by Frid *et al.* (2013) of 55 patients reported an overestimation of 1.9 cm on average compared with SH. They stated that the advantage of RL measurement was that it was direct and gave quick results. Luft *et al.* (2008) compared SH in 116 hospitalised adults with RL measurements using the Luft Ruler and reported that this method overestimated height by 1.6 cm, on the average, in patients > 60 years of age.

A comparative analysis of methods of estimating height in 142 hospitalised patients in Brazil by Melo *et al.* (2014) reported that RL overestimated the actual height by 3 cm in men and 4 cm in women. A quality improvement project by Freitag *et al.* (2010) in 13 staff members reported that a newly designed book-end method that measured height in the supine position resulted in an overestimation of 0.5–3.0 cm compared with SH. Venkataraman *et al.* (2015) reported that measuring height in the supine position was easy, accurate, and reproducible, and asserted that future

studies should focus on validating the supine method with SH as the gold standard.

Bojmehrani *et al.* (2014) evaluated 100 participants undergoing cardiac surgery to determine the accuracy of various methods in measuring the height of mechanically ventilated patients. They reported that the tape measurement method of patients lying supine was inaccurate, with a maximum error as high as 19.0 cm. The authors did not discuss the reasons for the large error; thus far, it is the only study that reported unfavourable results using RL to estimate height.

We noted that the firmness of the mattresses that patients lay on were different. Hospitalised patients lay on soft mattress in the ward and bedridden outpatients either from home or nursing home were transferred to a firm mattress on a trolley bed in the clinic once they arrived in ambulance. Most of the aforementioned studies had not stated the firmness of the mattresses that the participants had lain on. The book-end method by Freitag *et al.* (2010) required participants to lie on a hard aluminium plate, but their study had a small sample size of only 13 participants. In the clinical setting, it would be impractical to transfer bedridden patients to a hard aluminium plate to measure their RL.

The measurement of RL has not been validated in the Asian population and no equations have been proposed for the local population in Singapore. The aim of this study was to validate the method of measuring RL using mattresses of different firmness against SH in Singaporeans and to develop simplified equations to estimate SH from RL for practical use in a clinical setting.

We hypothesise that RL is always more than SH and that the RL measured on soft mattress and firm mattress would differ. We have designed the study to understand these differences.

MATERIALS AND METHODS

Participants

One hundred hospitalised participants (50 men and 50 women) were recruited from the general medicine, cardiac, nephrology, oncology, neurostroke and gastro wards. Another 100 healthy participants (50 men and 50 women) were recruited from hospital staff and visitors. Hospitalised participants used soft mattress in the wards and healthy participants used firm mattress on the trolley bed in the clinic. Postulating that the accuracy of estimation of SH from RL was 100%, 100 subjects were needed for the lower 95% CI to be 96.4%. An increment in the power would have required a larger sample size which may have increased the duration of recruitment. Hence, 100 participants were recruited over a period of 2 years for soft and firm mattress, respectively.

The inclusion criteria were adults aged ≥21 years and able to stand upright. The exclusion criteria were any degree of kyphosis, scoliosis, or leg and back deformities. Pregnant women were excluded for ethical reasons. The study received ethical approval from the National Health Group Domain Specific Review Board (DSRB reference: 2014/01004), and all participants provided informed written consent before participation.

The hospitalised participants were sampled from wards of different disciplines and all the participants fulfilled the inclusion criteria. We did not limit the participants to any particular ward or discipline because, eventually, we aimed to apply the equations developed for use in adult patients across all disciplines and medical conditions. On the other hand, it was challenging

to get the same hospitalised patients to come down to clinic for RL measurement on the firm mattresses due to infection control concerns and similarly it was not practical to push the trolley bed up to ward for each RL measurement; hence healthy participants were recruited to be the subjects for the firm mattresses. Hospitalised patients were recruited to be the subjects for the soft mattresses.

The measurer, who was a dietitian who attended to patients in the ward, screened prospective hospitalised participants based on the inclusion and exclusion criteria. The potential participants were asked if they were able to stand upright and walk to the stadiometer. Consent was taken prior to measurements. The healthy participants were sourced by recruitment posters placed strategically in the lifts and in clinics that were accessible to both staff and hospital visitors. Interested potential participants telephoned the measurer to arrange the time for measurement, which was conducted during office hours. Prospective participants were screened when they arrived at clinic based on the inclusion and exclusion criteria before recruitment.

Procedures

Standing height

Standing height was measured using the SECA stadiometer, model 703 (SECA, Germany) in the wards for hospitalised participants and in the dietetics clinic for healthy participants. The participants stood facing forwards, arms hanging loosely by the side and heels against the rod, with shoes removed. The participant's back was positioned as straight as possible but not leaning on the rod (National Institute for Health Research, Southampton Biomedical Research Centre, 2014). The head was adjusted so that the Frankfort plane was horizontal (i.e., parallel to the floor). Standing height was recorded in centimetres (cm) to one decimal point. Two measurements were taken, and the average was calculated to one decimal point.

Recumbent length

The participant lay supine on a soft mattress placed on a hospital bed for hospitalised participants or on a firm mattress on a trolley bed for healthy participants without any pillow and with feet together in a relaxed position. A hard board was placed perpendicular to the top of the head, and a point was marked using scotch tape. Subsequently, a 30-cm ruler was placed perpendicular to the heels to obtain another point, which again was marked with scotch tape. A flexible, non-stretchable 2 metre measuring tape was used to measure the length between the two points in cm to one decimal point. Two measurements were taken and the average was calculated to one decimal point.

Interrater reliability analysis

Separately, another 30 healthy participants were recruited for interrater reliability analysis. Two measurers were involved in the interrater reliability measurements. Each participant had their SH measured twice by measurer 1 and the average was calculated to one decimal point. Then measurer 1 and measurer 2 took turns to take two readings of RL and the average was calculated to one decimal point. The RL readings by measurer 1 were unknown to measurer 2 during the measurement.

Statistical analysis

The data were analysed using the IBM Statistical Package for Social Sciences (SPSS) Statistics Version 24 (IBM Corp.). The Bland–Altman analysis was used to investigate the agreement between the two methods (Bland & Altman, 1986). Two regression equations were derived to estimate SH, one for soft mattress

Table 1. Demographic characteristics of participants

Variables	*Hospitalised (soft mattress) n=99*	*Healthy (firm mattress) n=100*
Gender		
Male [n, (%)]	50 (50.5)	50 (50.0)
Female [n, (%)]	49 (49.5)	50 (50.0)
Age range (years)	21.0-80.0	21.0-77.0
Mean age (years±SD)	48.9±13.9	36.8±13.6

SD: standard deviation

and the other one for firm mattress. The validation process is based on study done by Luft *et al.* (2008) and Gray *et al.* (1985).

RESULTS

Of the 100 hospitalised participants, one was excluded from the data analysis because she was unable to position her ankle in a relaxed manner when lying down. This was an isolated case in which the participant fulfilled the inclusion criteria: she could stand upright but when she lay down, both her ankles were plantar-flexed, causing her forefeet to be protruded. We did not encounter similar issues with the other participants. The demographic characteristics of the 100 healthy and 99 hospitalised participants are summarised in Table 1.

In hospitalised participants, the mean±SD of SH was 161.2±9.7 cm and the mean±SD of RL using soft mattress was 163.7±9.5 cm. The SH and RL were significantly different (p <0.001). On the other hand, for the healthy participants, the mean±SD of SH was 164.6±7.7 cm and the mean±SD of RL using firm mattress was 166.7±7.7 cm. The SH and RL were also significantly different (p <0.001).

Bland & Altman (1986) suggested that 95% of the differences between the two measurements must lie within the mean difference±2SD ranges. Using Bland-Altman plot, 96% of hospitalised

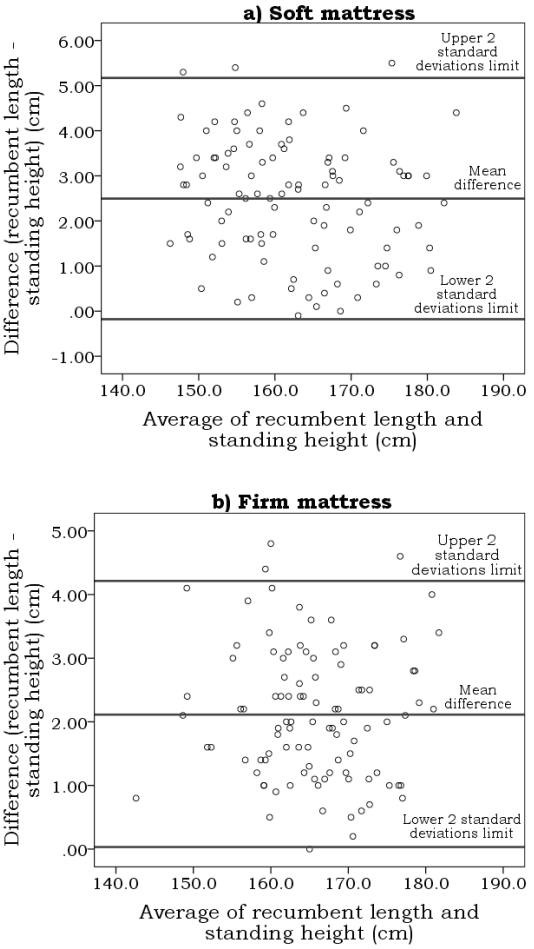

Figure 1. Bland–Altman plots for a) soft mattress and b) firm mattress. The difference in recumbent length and standing height is plotted against their average

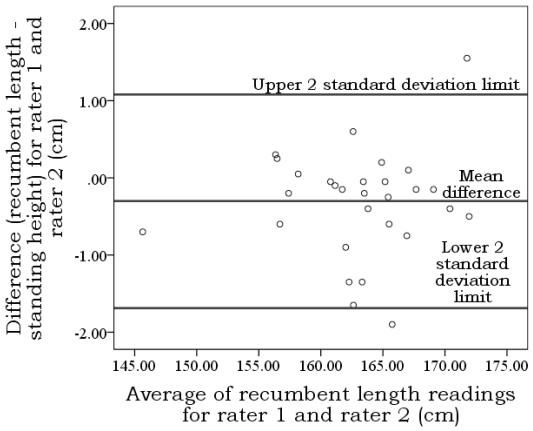

Figure 2. Bland–Altman plots for interrater reliability. The difference in recumbent length and standing height for rater 1 and rater 2 is plotted against their average

participants using soft mattress were within 2.5±2.7 cm whereas 97% of healthy participants using firm mattresses were within 2.1±2.1 cm (Figure 1). Both results were acceptable as there were more than 95% of the participants within the mean±2SD ranges.

For interrater reliability analysis, the Bland-Altman plot was chosen because it shows agreement between two measurers whereas intraclass correlation (ICC) shows agreement for a group of measurers. From the Bland-Altman plot, 93.3% of the participants were within -0.3±1.4 cm (Figure 2). Based on Figure 2, only two readings were out of mean±2SD but the percentage of outliers was high due to small sample size (n=30).

Linear regression equations were calculated for both RLs using soft and firm mattresses and presented in Table 2. Regression equations adjusted for age and gender were developed as well given the wide age range. Using paired t-test, we compared the difference of the SH calculated from adjusted and unadjusted equations for both groups. The mean difference of SH calculated from adjusted and unadjusted equations was 0.07±0.43 cm (p=0.11) for soft mattress and 0.03±0.26 cm (p=0.20) for firm mattress. We found that there was no significant difference between the SH calculated from adjusted and unadjusted equations for both groups. The scatter plots between SH and RL for soft and firm mattresses are shown in Figure 3.

DISCUSSION

Measuring height can be a challenge in bedridden patients. This is also the group who need nutritional support the most (Gray *et al.*, 1985). A reliable assessment of height is crucial for an accurate nutritional assessment, so as to deliver a tailored nutritional intervention that is specific to the patient. Many studies have been carried out in the past comparing RL and SH but none were done in the Asian population. We were interested in validating RL measurement against SH, using simple tools such as measuring tape and clip-board in our local population and to derive equations

Table 2. Unadjusted and adjusted equations for estimating standing height using soft and firm mattresses

Firmness	*Unadjusted and adjusted equations*	r^2	*Error rate (cm)*
Soft	SH = 1.012 RL – 4.477	0.981	-3.18 to 2.60
	†SH = 0.953 + 0.973 RL + 0.007 A + 1.076 G	0.983	-3.15 to 2.48
Firm	SH = 0.993 RL – 0.943	0.982	-2.71 to 2.11
	†SH= 2.746 + 0.973 RL – 0.017 A + 0.484 G	0.982	-2.53 to 2.07

RL, recumbent length; SH, standing height; A, age; G, gender (1= male, 0= female)
†Equations adjusted for age and gender

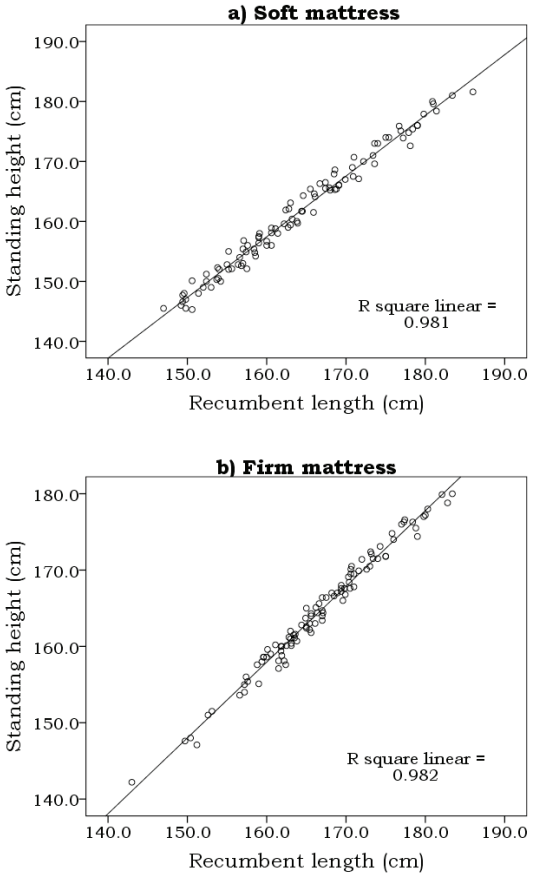

Figure 3. Scatter plots between standing height and recumbent length for a) soft mattress and b) firm mattress

to estimate SH. We hypothesised that RL overestimated SH and that the readings could be different depending on the firmness of the mattress that patients lie on. These were the reasons for our study.

The present study confirmed that RL was always greater than SH, a finding which was consistent with other similar studies (Gray *et al.*, 1985; Frid *et al.*, 2013; Luft *et al.*, 2008; Melo *et al.*, 2014). However, the aforementioned studies reported different values of overestimations of RL compared to SH and were carried out in non-Asians. The present study is valuable because it derived two predictive equations to estimate SH using RL on mattresses with different firmness i.e. on soft and firm, and was validated against SH in our local population in Singapore. To the best of our knowledge, this is the first study validating the RL equations against SH in an Asian population.

As reported by Gray *et al.* (1985), the difference observed in RL and SH is probably due to true difference of the body length and is not a consistent bias or inaccuracy in RL measurement. Keller & Nathan (1999) reported that axial loading of the intervertebral discs occurs in static and upright postures, which compresses them and leads to height loss, whereas in recumbent postures, discs unload and regain their original height. This explains why RL is longer than SH.

The studies discussed earlier used various tools to measure RL such as a measuring tape (Gray *et al.*, 1985; Melo *et al.*, 2014; Bojmehrani *et al.*, 2014; Venkataraman *et al.*, 2015), sliding callipers (Frid *et al.*, 2013), Luft Ruler (Luft *et al.*, 2008) and the book-end method (Freitag *et al.*, 2010). Some of the tools were expensive and not easily available because they were custom-made in their respective institutions. However, the measuring tape and clip-board that were used in this study are simple, inexpensive, easily available, and easy to be carried and cleaned. Therefore, our proposed measurement method is not only reproducible but also practical in routine clinical settings.

This study is the first to address the firmness of the mattress that subjects lie on during RL measurement. In this study, we observed that the firmness of mattress did affect RL and thus we included it as a variable represented by hospitalised participants for soft mattress and healthy participants for firm mattress. This study showed that the difference between RL and SH was greater when participants lay on

a soft material. The soft mattress was observed to sink with weight causing a longer curvature. Hence two regression equations were developed to correct the RL for estimating SH in patients lying on soft and firm beds respectively. Since there was no significant difference between SH calculated from adjusted and unadjusted equations for both soft and firm mattresses, we decided to adopt the unadjusted equations to reduce the complexity of the equation.

Our study has several limitations. This study did not take into account the reported diurnal variation of height which has been reported to be greater in the morning and gradually reduced towards the evening (Krishnan & Vij, 2007). In this study, SH was measured during office hours between 8.30am to 5.30pm. The age and other characteristics of hospitalised participants were not matched and may not be comparable with that of healthy participants as the recruitment for both groups was done concurrently. Another limitation of our proposed method was that it excluded patients with contractures who were unable to straighten their legs or body. This problem was addressed by Finch & Arumugam (2014) who developed and validated a simple bedside method using measuring tape but their study was done in only 24 participants. An alternative measurement method to estimate height must be developed for this group of patients.

Future studies may consider measuring RL at a specific time of the day to minimise diurnal variation and to match the age of participants of both groups to reduce variability. The exclusion criteria should be revised to disqualify those who could not position their ankle in a relaxed manner when they lie down for measurements before recruitment. A larger sample size is needed in future research to test the interrater reliability.

CONCLUSION

We concluded that RL is a valid clinical tool to estimate SH. Two linear regression equations were developed to estimate SH from RL measured on soft and firm material respectively.

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Authors' contributions

WWY, principal investigator, conceptualised and designed the study, collected and compiled the data, interpreted the data, prepared the draft of the manuscript and reviewed the manuscript; LSL, conceptualised and designed the study, interpreted the data, assisted in preparing the manuscript and reviewed the manuscript; CYH, calculated the sample size, performed statistical analysis, interpreted the data and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Identification of dietary patterns associated with characteristics of successful aging

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ABSTRACT

Introduction: This study aimed to identify dietary patterns (DPs) and their association with successful aging (SA). **Methods:** A comparative cross-sectional study was conducted among 579 elderly subjects recruited from four states in Malaysia through a multistage random sampling method. SA was defined as having no chronic illnesses, no functional limitation, normal global function, no depression, a good quality of life and good self-perceived health. Information on dietary intake was obtained using a diet history questionnaire. Cognitive functions were assessed using the Mini Mental State Examination (MMSE), depressive symptoms using Geriatric Depression Score-15 items (GDS-15) and a question regarding their perceived health and quality of life. Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) questionnaires were used to determine functional status. DPs were obtained using the principal component analysis (PCA) approach. An ordinal logistic regression model was used to examine associations between DP scores and SA. **Results:** Five DPs were identified namely 'sweet foods-beverages', 'meat-vegetables-rice and noodles', 'local snacks-fish and seafood-high salt foods', 'fruits-legumes', and 'tropical fruits-oats'. A higher score for 'tropical fruits-oats' DP was associated with SA [Adjusted OR=1.59 (95% CI: 1.08-2.32)]. However, the association diminished when the model was adjusted for education level. Further analysis indicated that this DP increased the chance of SA among those with secondary education and above [Adjusted OR=2.43 (95% CI: 1.09–5.42)]. **Conclusion:** 'Tropical fruits-oats' DP is associated with SA among elderly with secondary education and above. There is a need to investigate DPs among those with lower education.

Keywords: Cognitive function, dietary pattern, elderly, principal component analysis, successful aging

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INTRODUCTION

Successful aging (SA) ranges widely across the social, psychosocial and the medical sciences fields. It includes consideration of life satisfaction, well-being, the maintenance of cognitive and physical functions, as well as good mental and physical health (Bowling & Dieppe, 2005). Mild cognitive impairment (MCI) is a reversible condition between the normal and dementia state (Petersen *et al.*, 2014). Vanoh *et al.* (2017) have outlined a set of criteria for usual aging (UA) that includes having an average cognitive function, with no dementia, no physical limitation, but being at a higher risk of having major chronic diseases. Traditionally, food intakes with a wide range of nutrients have been studied for their role in health. However, since foods are eaten together, there is a growing interest in determining dietary patterns and their association with health, rather than a single nutrient. The original aim of a dietary pattern (DP) analysis was to capture the overall diet (Imamura & Jacques, 2011). A DP, which is a summary of an eating style, is able to increase the awareness of healthy eating by promoting suitable food choices (Freeland-Graves & Nitzke, 2002). The interest in DPs and cognitive functions has been growing rapidly because a DP is an alternative approach to addressing the complexity of the human diet and the synergistic effects of different foods and nutrients on the health of individuals.

There are two main approaches in deriving DPs. These are the *a priori* and the *a posteriori* methods (Hu, 2002). In the *a priori* method, a DP is created based on the knowledge about 'healthy' diet, dietary guidelines or predefined dietary scores for a specific DP, including the Mediterranean Diet and Dietary Approach to Stop Hypertension (DASH) Diet (Hu, 2002). A review by Roman-Viñas and Serra-Majem (2014) indicated a reduction in the overall mortality, incidence of cardiovascular disease, and functional capacity for individuals older than 65 years who followed a healthy lifestyle. Furthermore, compliance with such a DP, increased the chances for aging successfully by 58% after 10 years (Gopinath *et al.* 2016). On the other hand, the *a posteriori* method involved modelling dietary data through factor analysis, cluster analysis or reduced rank regression to derive a particular DP (Hu, 2002). *A posteriori* DPs or data-driven DPs do not require any hypothesis about the beneficial or detrimental effects of specific foods on health. So far little was known about specific DPs that prudently promoted SA and reduced risk of cognitive impairment among Asians, except for a study by Chan, Chan & Woo (2013) which was conducted among older Chinese adults in Hong Kong. However, this study did not use a comprehensive neuropsychological assessment method for cognitive functions and the subjects had a higher educational level.

The aim of this study was to identify a DP associated with SA among multi-ethnic elderly persons in Malaysia, using the *a posteriori* method. This study was part of a larger study designed for development of a neuro-protective model for healthy longevity named LRGS TUA, as published elsewhere (Fakhruddin *et al.*, 2016; Shahar *et al.*, 2016).

MATERIALS AND METHODS

Study design and subjects

A secondary analysis involving 579 out of 2,322 subjects from LRGS TUA study baseline database was conducted. LRGS TUA involved multistage random sampling of elderly from four states of Peninsular Malaysia, which had the highest numbers of elderly. These were Selangor, Johor, Kelantan and Perak which are approximately located at the centre, south, east and north of Peninsular Malaysia, respectively. The lists of elderly in these areas were given by the Department of Statistics, Malaysia. The study was conducted between May

2013 and February 2014. The inclusion criteria were Malaysian citizenship, aged ≥60 years. Those who were bedridden, had serious physical disabilities, mental problems such as depression and dementia, as well as those who were mute and deaf, were excluded from this study. In this secondary analysis, subjects from the primary analysis who had completed dietary assessment and classified as SA, UA or MCI aging groups and matched for age (± 10 years), race and sex were included as samples. This project was approved by the Research Ethics Committee of National University of Malaysia (UKM 1.5.3.5/244/NN-060-2013). Written consent was obtained from all participants before the interview session started.

Data collection

Information on sex, race, religion, age, marital status, education, living status, anthropometry, medical profile and dietary intake of the subjects was obtained through face-to-face interviews conducted at the respective community centres using a pre-tested questionnaire. The cognitive status of the subjects was neuropsychologically assessed. Their functional and psychosocial status, including depression, quality of life and self-perceived health status, were also measured.

Criteria of successful aging

All the aging subjects were classified into the three groups, namely SA, UA and MCI, based on the tests described by Shahar *et al.*, (2016). The tests for classification into the three groups included the Activity of Daily Living (ADL) (Katz *et al.*, 1970), Instrumental Activity of Daily Living (IADL) (Lawton & Brody, 1969), Mini Mental State Examination (MMSE) (Razali *et al.*, 2014), Geriatric Depression Symptoms-15 items (GDS-15) (Yesavage *et al.*, 1982), Rey Auditory Verbal Learning Test (RAVLT) (Schmidt, 1996), Digit Span (Wechsler, 1958) and two psychosocial questions that measured the quality of life and self-perceived health. The ADL test was used to assess the ability of the subjects to perform personal activities including bathing, dressing, eating, transferring and toileting. The IADL test involved the assessment of more complex activities including shopping, walking 200 metres, going around by car or using public transport by themselves, going up the stairs or doing heavy work around the house.

SA subjects were categorised based on six main criteria including (1) the absence of chronic diseases such as diabetes mellitus, hypertension, cancer, heart diseases, chronic lung disease and stroke, (2) no functional limitations, (3) normal global function, (4) no depression, (5) good quality of life and (6) self-perceived good health. Any participants who had MMSE score of >14 and did not meet any criteria of SA and MCI were categorised into the UA group.

In addition, MMSE was used as a tool to assess global cognitive functions with cut-off ≥22 to indicate SA and ≥19 for MCI. Depression was assessed using the GDS-15. Those with scores of >5 were excluded from this study as this indicated depression. Question 10 on the GDS-15 was used to measure subjective memory problems of the respondents. Subjective memory complaints were present if the subject answered 'Yes'. The quality of life was assessed by asking the subjects: 'In general, how do you perceive your quality of life?' Finally, self-perceived health was assessed using the single question: 'How would you describe your health status?' The answers to both these questions were rated using Likert scales. Subjects who were suspected of having dementia were referred to and further assessed by a psychiatrist.

Food intake

Information on food intake of the respondents was collected using the validated Diet History Questionnaire

Table 1. Food group classification

Food groups	*Food items*
Rice and noodles	Rice porridge, white rice, dried noodle and wet noodle
Oats	Oats
Flatbread	*Roti canai*[†]
Meats	Beef and pork
Fish and seafoods	Pomfret, tuna, Indian mackerel, round scad, red snapper, hairtail scad, trevally, sea perch, Spanish mackerel, cuttlefish and prawn
Dairy products	Full cream milk and butter
Legumes	Soy bean fermented cake, soy bean cake and yellow dhal
Tropical fruits	Papaya, orange, banana, duku and rambutan
Fruits	Red apple, green apple and grapes
Vegetables	Brinjal, okra, carrot, cucumber, broccoli, long bean, chilli, spinach, mustard leaves, tapioca shoots, *ulam raja*[‡], swamp cabbage, fern shoots, mung bean, cabbage and kale
Local snacks	Banana fritters, *cucur*[§], banana ball, curry puff, and *cakoi*[¶]
High salt foods	Salted fish, anchovy sauce, fermented durian and chilli shrimp paste
Sweet foods	Sweetened creamer, granulated sugar, egg jam and fruit jam
Beverages	Coffee, tea and malted drink

[†]Flatbread composed of dough containing copious amounts of fat (ghee-clarified butter), egg, flour and water
[‡]Malay traditional salad
[§]Fried bite-sized snack usually made from flour and anchovies
[¶]Long golden-brown deep-fried strip of dough commonly served with egg jam

(DHQ) of Fakhruddin *et al.* (2016). The subjects or caregivers were required to recall all foods and drinks that were consumed daily to obtain information on the usual dietary habits of the subject in a week. During the interview, the subjects were asked specific questions regarding the meals that they took such as type, portion size, frequency, time and place the foods were consumed. Portion size was estimated using household measurements such as a cup, a bowl, a spoon and a plate. Description of the cooking methods and home recipes were recorded as well. More than 350 types of food were reported by the subjects and were extracted from the DHQ. Food items were classified into 14 groups based upon their similarities or references from other studies (Table 1). There were some individual food items such as *roti canai* and oats being analysed individually either because it was inappropriate to incorporate them into a certain food group or because they were believed to represent a distinct DP. The evaluation of misreporting energy intake, i.e. the under and over-reporting of energy intake, was conducted during the primary analysis (Fakhruddin *et al.*, 2016). The under-reporters were excluded.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) IBM 21 to derive DPs on the basis of the original food group variables (consumption in g/day). The Bartlett test of sphericity (BTS) ($p<0.05$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (>0.50) were initially used to evaluate whether the data was suitable for a principal component analysis (PCA). The PCA method was used for the factor extraction, followed by a varimax rotation to assist in the interpretation of the results and to ensure that the factors were not correlated. Eigenvalues

>1 were used to determine the number of DPs that were retained. In this study, five main components were extracted, which accounted for 47.5% of the total variances. Specific DPs were labelled on the basis of the types of food exhibiting the strongest correlation and having the highest loading factors. Positive loading factors indicated that the food groups were positively correlated with the DP and negative values indicated that the food groups were inversely correlated with the DP. The food groups were retained in the DP if the factor loading value was ≥0.3 (Chan *et al.*, 2013). For each subject, the individual DP score was calculated by adding the intake of 14 food groups weighted by their factor loading. The factor scores that were obtained for each factor defined the position of each individual along a gradient. These were then ranked as tertile groups to indicate a low, medium or high intake, which indicated the degree to which the individual's diet conformed to the DP. The highest tertile was then compared with the lowest tertile of factor scores for each of the DP. Ordinal logistic regression (MCI = 0, UA = 1, SA = 2) was used to assess the association between the DPs and SA, with adjustments of age, gender, race, calorie intake, body mass index (BMI), marital status and smoking status as covariates. Further analyses were done using two models i.e. model 1, without educational level, and model 2 with educational level, in addition to other covariates mentioned above.

RESULTS

Dietary patterns

The flow-chart of the process for the identification of DP associated with SA is shown in Figure 1. PCA identified five DPs with eigenvalues >1. The factor loadings of specific food items on each of the five identified DPs are shown in Table 2. A 'sweet foods-beverages' pattern was defined by high loading of sweet foods including sugar, condensed milk, sweet spread and beverages such as tea, coffee and malted drink, as well as low intake of dairy products including low fat milk and butter. A 'meats-vegetables-rice and noodles' pattern consisted of high intake of meat including beef and pork, various types of vegetables and also rice and noodles. A 'local snacks-fish and seafood-high salt foods' pattern was defined as high consumption of Malaysian snacks, fish and seafood, sauces and condiments. Another DP was 'fruits-legumes', which was defined by a high intake of a wide range of fruits other than tropical fruits, and also legumes and legume-based products. The last DP was 'tropical fruits-oats', defined as high loadings of a wide range of tropical fruits that included papaya, orange, *duku*, banana and rambutan and oats.

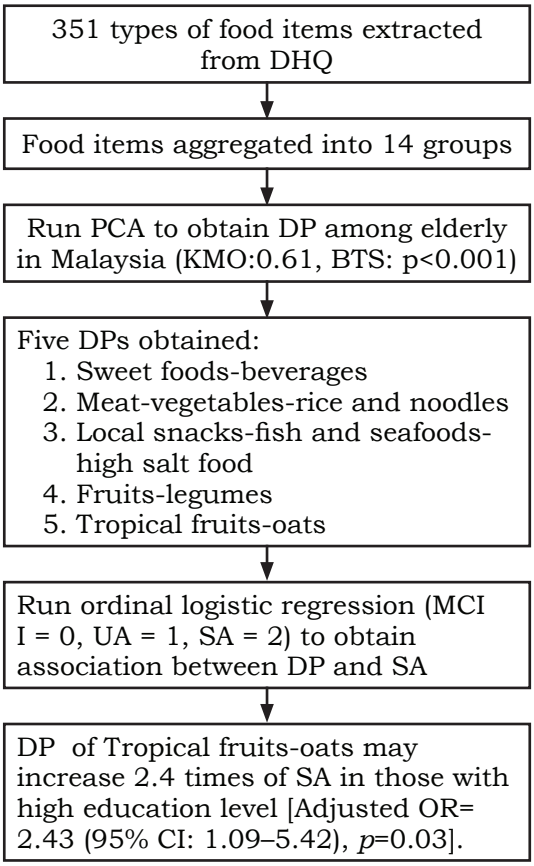

Figure 1. Flow chart of identification dietary patterns for SA

Table 2. Factor-loading matrix for five DPs identified by PCA (n = 579)†

Food groups	*Sweet foods-beverages*	*Meat-vegetables-rice and noodles*	*Local snacks-fish and seafoods-high-salt food*	*Fruits-legumes*	*Tropical fruits-oats*
Beverages	**0.65**	0.08	0.11	0.08	0.02
Sweet foods	**0.64**	0.04	0.22	0.32	0.04
Dairy products	**-0.62**	0.03	0.39	0.24	0.01
Vegetables	-0.01	**0.65**	0.10	-0.06	0.08
Rice and noodles	0.13	**0.58**	-0.10	-0.17	-0.24
Meats	0.02	**0.56**	-0.25	0.30	0.12
Local snacks	0.02	-0.21	**0.64**	0.11	0.09
Fish and seafoods	0.31	0.08	**0.58**	-0.19	-0.26
High salt foods	0.20	0.18	**0.53**	0.34	-0.06
Legumes	0.00	0.09	0.04	**0.58**	0.06
Fruits	-0.18	0.07	0.38	**0.43**	0.19
Roti canai	0.20	-0.28	0.03	**-0.41**	0.28
Tropical fruits	0.10	-0.04	-0.01	-0.20	**0.72**
Oats	-0.34	0.32	-0.05	-0.06	**0.51**
Total variance explained (%)	11.7	9.6	9.3	9.2	8.2
Cumulative variance explained (%)	11.7	20.8	30.1	39.3	47.5

DP, Dietary pattern

†Factor loadings with absolute value |>0.3| are shown in bold. For food group loads more than one dietary pattern, only the highest absolute value of loading is bolded.

Overall association between DPs and SA

According to Table 3, after accounting for various confounders such as BMI, calorie intake, smoking status and marital status, there was a positive association across the tertiles of 'tropical fruits-oats' DP and SA [Adjusted OR= 1.59 (95% CI: 1.08-2.32), p= 0.02]. After the addition of education level, the association for this DP across the tertile groups was diminished [Adjusted OR=1.30 (95% CI: 0.87-1.93), p=0.19]. Thus, further analyses were conducted according to educational level stratification which are low and high education. Subjects who had no formal education or only attended primary school were categorised as 'low education' group. Subjects who attended secondary school or college were classified as 'high education' group. It was found that 'tropical fruits-oats' DP increased chances of SA only among those with education background of secondary school and college level [Adjusted OR= 2.43 (95% CI: 1.09–5.42), p=0.03] (table not shown).

Characteristics of subjects with successful aging DP

Table 4 shows the characteristics of the subjects by tertile of 'tropical fruits-oats' DP. There was a significant difference between smoking status, calorie intake and education level between tertile groups of 'tropical fruits-oats' DP. Percentage of smoking decreased, whilst non-smoking increased in higher tertile groups. Calorie intake was significantly higher in T1 group as compared to T2 and T3 groups. However, there was no significant difference in calorie intake between T2 and T3 groups. In terms of educational level, subjects in T3 group obtained higher education level as compared to T2 and T1 groups.

Table 3. Ordinal regression models of DP and SA in tertiles

Dietary patterns (Tertiles)	*Model 1* ‡ *AOR (95% CI)*	*Model 2* § *AOR (95% CI)*
Sweet foods-beverages		
T1†	1.00	1.00
T2	1.14 (0.79-1.66)	1.26 (0.86-1.86)
T3	1.15 (0.77-1.72)	1.18 (0.78-1.78)
P trend	0.48	0.41
Meat-vegetables-rice and noodles		
T1†	1.00	1.00
T2	0.95 (0.66-1.40)	0.93 (0.63-1.39)
T3	0.72 (0.47-1.11)	0.83 (0.54-1.30)
P trend	0.13	0.42
Local snacks-fish and seafoods-high salt foods		
T1†	1.00	1.00
T2	1.01 (0.68-1.48)	1.01 (0.68-1.50)
T3	1.30 (0.87-1.97)	1.26 (0.83-1.93)
P trend	0.20	0.27
Fruits-legumes		
T1†	1.00	1.00
T2	0.78 (0.52-1.17)	0.85 (0.58-1.26)
T3	0.66 (0.41-1.07)	0.72 (0.48-1.10)
P trend	0.08	0.13
Tropical fruits-oats		
T1†	1.00	1.00
T2	1.35 (0.92-1.96)	1.29 (0.88-1.90)
T3	1.59 (1.08-2.32)	1.30 (0.87-1.93)
P trend	0.02*	0.19

AOR, Adjusted odd ratio; CI, Confidence interval; T, Tertile
†T1, T2 and T3 represent individuals in the lowest, intermediate and highest category of the dietary factor score
‡Model 1 adjusted for age, gender, race, energy intake, BMI, marital status and smoking status
§Model 2 further adjusted for education level
*$P<0.05$

DISCUSSION

In this analysis, we have used PCA instead of cluster analysis in deriving DP because it is a more "pragmatic choice" and provides a continuous score for each subject in all components (Crozier *et al.*, 2006). Furthermore, the score can be categorised as tertile, quartile or quintile to observe the conformity of the subjects with DPs and its association with SA. Using the *a posteriori* DP approach, five DPs have successfully been identified based on the regular food intake of 579 multi-ethnic elderly Malaysians. These are (1) sweet foods-beverages (2) meat-vegetables-rice and noodles, (3) local snacks-fish and seafood-high salt foods, (4) fruits-legumes, and (5) tropical fruits-oats. Two models were used to represent 'tropical fruits-oats' DP, which was found to be associated with SA, rather than UA and MCI.

The findings showed that the consumption of tropical fruits was associated with SA among those with a high level of education, which is defined here as receiving formal education up to secondary school and above. This finding was in line with other studies that reported the benefits of fruits consumption with healthy longevity. For example, a longitudinal study by Hodge

Table 4. Characteristics of subjects with successful aging dietary patterns, by tertiles

Tropical fruits-oats DP (Present as mean±SD and %)		*Tropical fruits-oats dietary pattern*			*p-value*
	n (%)	*T1*†	*T2*†	*T3*†	
Age (years)‡	68.2±5.4	68.2±5.5	68.4±5.4	67.9±5.4	0.66
Energy intakes (kcal)‡	1648±411	1735±418	1597±392	1611±408	0.00**
Body mass index‡	24.9±4.2	25.1±4.0	24.9±4.2	24.7±4.3	0.52
Male	321 (55.4)	36.4	30.8	32.7	
Female	258 (44.6)	29.5	36.4	34.1	
Race					0.05
Malay	345 (59.6)	35.1	33.6	31.3	
Chinese	213 (36.8)	32.9	33.3	33.8	
Indian and others	21 (3.6)	9.5	28.6	61.9	
Marital status					0.13
Married	432 (74.6)	34.3	31.0	34.7	
Not married/Widowed	147 (25.4)	30.6	40.1	29.3	
Smoking status					0.00**
Yes	114 (19.7)	50.9	28.1	21.1	
No	383 (66.1)	28.5	33.4	38.1	
Ex-smoker	82 (14.2)	31.7	40.2	28.0	
Education level§					0.04*
Low education	412 (71.2)	36.7	34.7	28.6	
High education	167 (28.8)	25.1	29.9	44.9	

T, tertile
†T1, T2 and T3 represent individuals in the lowest, intermediate and highest category of the dietary factor score
‡Values reportes as mean ± SD
§Low education (no formal education and primary school), High education (secondary school and college)
* p<0.01, ** P<0.001

et al. (2014) reported that higher intake of fruits together with a lower consumption of meat-based and other fatty food contributed to SA. Other than that, among older Chinese women in Hong Kong, the risk of developing cognitive impairment was also reduced with a DP consisting of a high intake of 'vegetables and fruits' and 'snacks, drinks and milk products' (Chan *et al.*, 2013). However, previous studies incorporated all fruits into one group as compared to our study that found only tropical fruits in the DP component contributed to SA but not the non-tropical fruits. Tropical fruits are rich in natural antioxidants such as vitamins C and E, polyphenols and carotenoids. The antioxidant properties of selected tropical fruits were studied by Lim, Lim & Tee (2007) who found that guavas, star fruits and papayas have high primary antioxidant potential compared to oranges. Bananas contain powerful secondary antioxidants. Antioxidant compounds act as scavengers to remove and reform the oxidized biomolecules (free radicals) (Ruszkiewicz & Albrecht, 2015) to protect cognitive functions (Letenneur *et al.*, 2007), thus promoting healthy aging and longevity. The occurrence of cognitive impairment increased with the reduction in intake

of total dietary fibre and soluble dietary fibre (Lee *et al.*, 2001). On the other hand, individuals with better cognitive function might have a better diet quality with higher carbohydrate and fibre intake including fruits, vegetables, vitamins and minerals (Rue *et al.*, 1997). A longitudinal assessment of protective role of a specific DP is needed to better outline the cause-effect mechanism.

This study also showed that oats contribute to SA. A DP that consists of dairy, cereals and eggs, has been shown to prevent cognitive decline among elderly. A previous study had defined the cereal group as whole grains and refined grains including oats (Ashby-Mitchell, Peeters & Anstey, 2015). Oats contain antioxidant components such as avenanthramides, tocopherols, tocotrienols, β-glucan, and phenolic compounds. Avenanthramide, which can be found abundantly in oats, blocks nucler kappa factor B (NF-κB) activities and leads to the decrease of inflammation-related cytokine production (Sur *et al.*, 2008). Thus, Lee *et al.* (2015) recommended that grains, which are high in antioxidants, have a positive role to play in preventing oxidative stress and inflammation-related chronic diseases. The findings of the study challenge the typical dietary habits of the local population, where rice is the staple food. The white rice, noodles and coffee DP has been identified by Kim *et al.* (2015) to be associated with lower cognitive function after adjusting for age, sex, educational level, alcohol intake, exercise and diabetes. However, current findings did not find any association between meat-vegetables-rice and noodles group with SA.

Education is one of the important confounders in the association between nutrition and cognition. In model 1, 'tropical fruits-oats' DPs were significantly associated with SA. When educational level was adjusted in model 2, the association between this DP and SA was not significant. A similar study by Akbaraly *et al.* (2009) found that after an adjustment for education in the studied models, the negative correlation between the 'whole food' pattern and the positive correlation between the 'processed food' pattern with cognitive decline were attenuated. Parrott *et al.* (2013) suggested that among individuals with an equivalent diet quality, the magnitude and characteristics of the diet-cognition relationship depended on their socioeconomic circumstances. The study found that adherence to the Western dietary pattern correlated positively with cognitive decline only among in those with low education. In the present, study 'tropical fruits-oats' DP correlated positively–with SA among those with high education. There is a need to further investigate the challenges faced by those with low education to age successfully.

One of the strengths of this study was that successful agers were compared with two other aging groups against which were UA and MCI rather than only one group such as MCI, as frequently done in other studies. On the other hand, this study used a comprehensive definition of SA as the outcome rather than looking into one element such as cognitive or health status. However, it should be noted that this was a cross-sectional comparative study, where the cause and effect cannot be elucidated. We also suggest identifying DP using other statistical methods such as cluster analysis or reduced regression rank, as each method would provide answers to different questions. There is a need to examine the effect of DP on the occurrence of successful aging in a longitudinal study design, with a larger sample size, and with a focus on the challenges faced by the low education group. Further assessment of biomarkers of DP should be conducted using novel method such as the metabolomic approach.

CONCLUSION

Principal component analysis allowed the identification of DPs based on data from habitual food intake. We have shown that 'tropical fruits-oats' DP increased the chances of SA by 2.4 times, as compared to UA and MCI, among those with secondary education and above. Promoting a healthy DP such as 'tropical fruits-oats' DP, is a cost-effective strategy to achieve healthy longevity.

List of Abbreviations

SA: Successful aging; MCI: Mild cognitive impairment; UA: Usual aging; DP: Dietary pattern; DASH: Dietary Approach to Stop Hypertension; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; MMSE: Mini Mental State Examination; GDS-15: Geriatric Depression Score-15; RAVLT: Rey Auditory Verbal Learning Test; DHQ: Diet History Questionnaire; SPSS: Statistical Package for the Social Sciences; BTS: Bartlett test of sphericity; KMO: Kaiser-Meyer-Olkin; PCA: Principal component analysis; BMI: Body mass index

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Authors' contributions

NNINMF, conceived and designed the study, performed the experiments, analysed the data and wrote the paper; SS, conceived and designed the study, contributed expertise and provided expert advice on dietary intake; RR, contributed expertise and provided expert advice on dietary intake; MAO, contributed expertise and expert advice on statistical analysis; NCD, contributed expertise and provided expert advice on aging groups criteria; RR, contributed expertise and provided expert advice on aging groups criteria; SH, contributed expertise and provided expert advice on dietary intake; HJJM contributed expertise and provided expert advice on dietary intake; BNAH, performed the experiments and analysed the data; all authors critically reviewed the papers and approved its submitted version.

Conflicts of interest

The authors declare that they have no conflict of interest. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data, in the writing of the manuscript, and in the decision to publish the results.

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Prevalence and factors affecting food insecurity among university students in Pahang, Malaysia

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ABSTRACT

Introduction: Food insecurity exists whenever people are unable to access sufficient food at all times for an active and healthy life. University students are a potentially vulnerable group of people to face food insecurity. This study aimed to identify the prevalence and determinants of food insecurity among a population of university students in Kuantan, in the state of Pahang. **Methods:** Food security status was identified using the United States Adult Food Security Survey Module (USAFSSM). Factors, which include demographic background, spending expenditure pattern and time constraints, were assessed. A total of 316 students were selected through stratified random sampling throughout six faculties of the International Islamic University Malaysia, of whom 307 successfully completed the survey. **Results:** The result shows that 54.4% of the students were experiencing food insecurity, from which 32.9% were sub-categorised as low food security and 21.5% as very low food security. Food insecurity was found to be significantly associated with time constraints ($p<0.05$), spending on books ($p<0.05$), miscellaneous items ($p<0.05$), parents' income ($p<0.001$) and scholarship type ($p<0.001$). **Conclusion:** Apart from the high incidence of food insecurity among the students, time and financial affordability appeared to be critical concerns in this study. Since food insecurity has become a significant issue with university students, it should be addressed and prioritised by the relevant authorities.

Keywords: Food insecurity, students, food security status

INTRODUCTION

The importance of food supply was first highlighted by Food and Agriculture Organization (FAO) and the US Department of Agriculture (USDA) when most of the world's communities were experiencing a global food crisis. Various efforts have been made in formulating the tools needed to measure food insecurity. Early direction was concentrated on the volume and stability of food supplies (United Nations, 1975). This coverage was expanded to include access to available supplies of food by vulnerable people, which in turn requires supply and demand to be balanced. In 1996, the World Food Summit stated that "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious

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food that meets their dietary needs and food preferences for an active and healthy life" (Palmer & Groppo, 2002). The process of understanding food security and the means to achieve it is still an ongoing debate worldwide, as it is a multi-dimensional and complex matter (Adeyeye, 2017; Norhasmah, Zalilah & Asnarulkhadi, 2010).

The disruption of optimal development have been associated with food insecurity (Alaimo, Olson & Frongillo, 2002; Cook *et al.*, 2004). Besides physical or physiological effects, Ramsey *et al.* (2011) reported that children living in food-insecure households were known to experience emotional problems and behavioural disorders. Furthermore, physiological and psychological changes resulting from nutrient deficiencies as an outcome of food insecurity may result in increased frequency of illness among children and therefore decreased participation in school and activities (Alaimo, Olson & Frongillo, 2001; Diette *et al.*, 2000).

Various findings have also reported that childhood food deprivation is associated with morbidity and mortality in adulthood in a range of diet-related causes such as cardiovascular diseases, type 2 diabetes and some cancers (Ness *et al.*, 2005; Van Der Pols *et al.*, 2009; Wright *et al.*, 2001). Che & Chen (2001) and Vozoris & Tarasuk (2003) agree in their studies that individuals living within food insecure households were at a higher risk of developing diabetes mellitus, heart disease and other chronic conditions. In the last decade, food insecurity has also been associated with obesity, making it higher as a public health concern (Pan *et al.*, 2012; Roselawati *et al.*, 2017).

Food insecurity occurs not just in low- and middle-income countries. Pockets of food insecurity also exist in developed countries. In Malaysia, a study conducted by Shariff & Khor (2005) among 200 rural women reported that 42.0% were food secure, 14.0% household-food insecure, 9.5% individual-food insecure and 34.5% suffered child-hunger. Another study done among urban welfare recipient households in Hulu Langat in the state of Selangor, Malaysia, disclosed that 26.3% of the households were food secure, while 39.8% experienced moderate food insecurity, and 34.0% severe food insecurity (Norhasmah *et al.*, 2012). A survey conducted in the district of Kuantan revealed that 77% of the households experienced food insecurity (Roselawati *et al.*, 2017). The Malaysian Adult Nutrition Survey (MANS), which was a nationwide study, discovered that the prevalence of food insecurity in terms of insufficient food quantity was 24.9%, while 21.9% reported reduction of meal sizes due to financial constraints (IPH, 2014).

Food insecurity has many consequences. It causes physical and mental health problems, and reduces academic achievements. Furthermore, its long term consequences not only affect the life choices of individuals and households, but also contributes additional burden to the health care system of the country. Given the likely association between chronic diseases, food insecurity and academic accomplishments, improving food security may have potential role in improving students' grade achievement.

While research on food security in the Malaysian context has been undertaken, the extent to which it exists among university students remain largely unexplored. A study of higher learning institutions done by Sulaiman, Md Jusoh & Ab Razak (2013) reported that 67.1% of the students faced food insecurity. However, the report mainly discussed coping strategies and the consequences of food insecurity, not its determinants. While many studies have looked at the

prevalence and the consequences of food insecurity, few have looked at the influencing factors and determinants of food insecurity. The objective of this study was to investigate the food security status and possible determinants of food insecurity among university students in Kuantan, Malaysia.

MATERIALS AND METHODS

This cross-sectional study employed the stratified random sampling method, which involved undergraduate students from six faculties, namely, Medicine, Dentistry, Allied Health Sciences, Nursing, Pharmacy and Sciences. A total of 316 subjects were selected into the study. Ethical approval was obtained from the International Islamic University Malaysia (IIUM) Research Ethics Committee. Consent from the participants was obtained prior to them answering the questionnaire.

A self-administered questionnaire was developed for this study. It was divided into five sections. The first section comprised the eight items of the USDA Adult Food Security Survey Module (USDAFSSM) which assesses the food security status of the subjects. The internal consistency (Cronbach's α) of the questionnaire was 0.79. The second section comprised items pertaining to the determinants of food insecurity, that included living arrangement and time constraints. In this section, the subjects were asked whether they felt that they had insufficient time to eat a balanced meal or even went hungry because of it. The third section gathered demographic information while the last section enquired about the spending patterns of the subjects. The questionnaire was piloted to evaluate the clarity, relevance and applicability of the questions. Data were analysed using Statistical Package for the Social Sciences version 12.0 (SPSS 12.0), which involved descriptive analysis and the chi-square test.

RESULTS

From the total of 316 samples selected, 307 completed the survey, making the

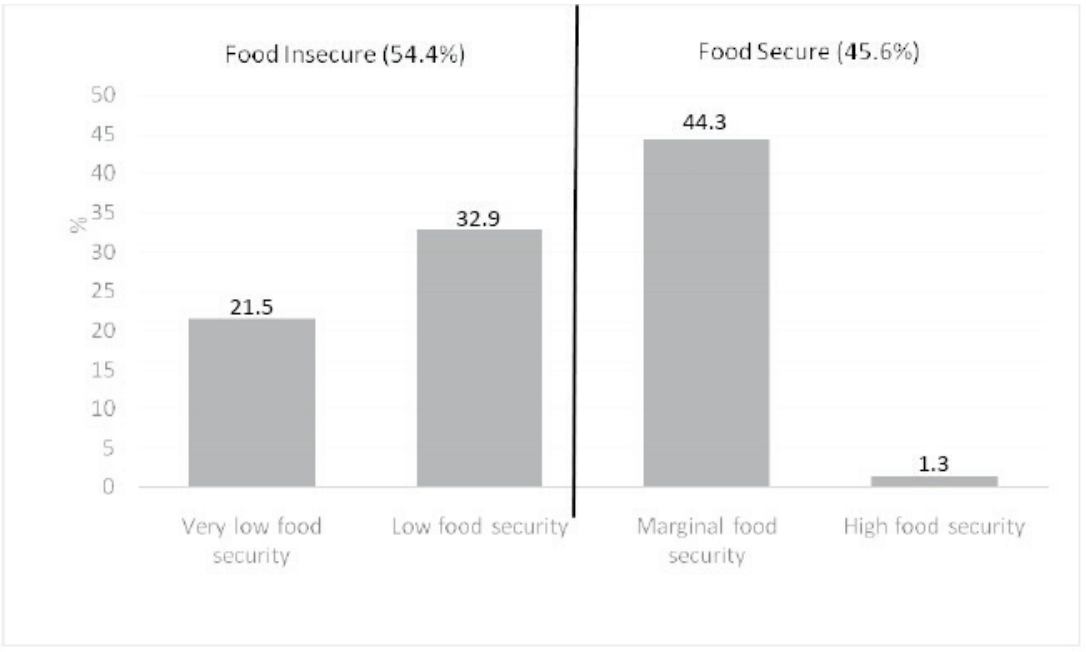

Figure 1. Food security status of the respondents

Table 1. Demographic characteristics of the respondents

Characteristics	*n*	*%*
Gender		
Male	95	30.9
Female	212	69.1
Living arrangements		
On-campus	246	80.1
Off-campus	53	17.3
With parents	8	2.6
Financial/loan sponsors		
PTPTN (loans)	92	30.0
JPA (scholarships)	132	43.0
MARA (loans)	8	2.6
Others sponsors	28	9.1
Non-recipients of any kind of sponsorship	47	15.3
Source of income		
Scholarship/Loan solely	172	56.0
Self-sponsored/Parents solely	37	12.1
Scholarship/Loan + Parents' support	97	31.6
Others/Part-time job	1	0.3

response rate 97.0%. Based on faculties, 107 (34.8%) were from Sciences, 61 (19.9%) Medicine, 53 (17.3%) Pharmacy, 46 (15.0%) Allied Health Sciences, 22 (7.2%) Nursing and 18 (5.9%) Dentistry. The majority of the students were females (69.1%, *n*=212) and males were 30.9% (*n*=95), proportions that reflect those of the general student body.

More than half of the students were food insecure giving a prevalence of 54.4% (*n*=167). Of this proportion, 21.5% (*n*=66) were placed into the category of very low food security and 32.9% (*n*=101) as low food security. For food secure category, marginal food security had largest percentage at 44.3% (*n*=136) and only 1.3% (*n*=4) were highly food secure, as shown in Figure 1.

Many students in the current study received financial support. Overall, 84.7% (*n*=260) were funded with scholarships

Table 2. Association of time constraint with food security status.

Description	*Food insecure*		*Food secure*		*Chi-square statistics (df)*	*p-value*
	n	*%*	*n*	*%*		
"I couldn't eat balanced meals because I don't have much time to buy and eat the foods." How often did this happen to you in the last 6 months?						
Often true	24	14.4	8	5.7	11.851	0.003
Sometimes true	104	62.3	78	55.7	(2)	
Never true	39	23.4	54	38.6		
In the last 6 months, were you ever hungry but didn't eat because there wasn't enough time to eat?						
Yes	94	56.3	62	44.3	4.389	0.036
No	73	43.7	78	55.7	(1)	

Table 3. Expenses and food security status

Spending items	*Food insecure*		*Food secure*		*Chi-square (df)*	*p-value*
	n	*(%)*	*n*	*(%)*		
Weekly						
Foods						
< RM 50	47	(28.1)	41	(29.3)	0.049 (1)	0.826
> RM 50	120	(71.9)	99	(70.7)		
Transportation						
< RM 50	133	(79.6)	114	(81.4)	0.155 (1)	0.694
> RM 50	34	(20.4)	26	(18.6)		
Study material						
< RM 50	84	(50.3)	84	(60.0)	2.892 (1)	0.089
> RM 50	83	(49.7)	56	(40.0)		
Cell phone						
< RM 50	137	(82.0)	114	(81.4)	0.019 (1)	0.891
>RM 50	30	(18.0)	26	(18.6)		
Monthly						
Shopping						
< RM 50	76	(45.5)	57	(40.7)	0.713 (1)	0.398
> RM 50	91	(54.5)	83	(59.3)		
Housing / Hostel fees						
< RM 50	8	(4.8)	3	(2.1)	1.545 (1)	0.214
> RM 50	159	(95.2)	137	(97.9)		
Entertainment						
< RM 50	121	(72.5)	99	(70.7)	0.114 (1)	0.736
> RM 50	46	(27.5)	41	(29.3)		
Books*						
< RM 50	80	(47.9)	89	(63.6)	7.554 (1)	0.006
> RM 50	87	(52.1)	51	(36.4)		
Miscellaneous*						
< RM 50	85	(50.9)	93	(66.4)	7.539 (1)	0.006
> RM 50	82	(49.1)	47	(33.6)		

*p<0.01

or received study loan [National Higher Education Fund Corporation (PTPTN) study loans 30.0%; Public Services Department (JPA) scholarships 43.0%; Majlis Amanah Rakyat (MARA) study loans 2.6% & other sponsors 9.1%] while another 15.3% (n=47) were self-sponsored. Further demographic characteristics are described in Table 1.

Table 2 shows the association of time constraints with food security status. More than half (56.3%, n=94) of food insecure students agreed that time restriction caused them to skip meals even though they were hungry. However, a lower percentage (44.3%, n=62) of food secure students did so for the same reason. A large percentage (76.7%) of the food insecure students agreed that time constraints as the reason for them not to eat balanced meals, compared to 61.4% among the food secure group.

Table 3 shows the expenses of the students in the current study. The major expenses among both groups were mainly for housing rent or hostel fees. The next largest expense was food. The students spent about RM50 to RM150 on foods weekly. When they were asked to specify their miscellaneous expenses,

Table 4. Demographic characteristics and food security status

Demographic characteristics	*Food insecure*		*Food secure*		*Chi-square statistics (df)*	*p-value*
	n	*(%)*	*n*	*(%)*		
Gender						
Male	58	(34.7)	37	(26.4)	2.456 (1)	0.117
Female	109	(65.3)	103	(73.6)		
Living arrangement						
On-campus	135	(80.8)	111	(79.3)	0.000 (2)	0.983
Off-campus	29	(17.4)	24	(17.1)		
Own-house	3	(1.8)	5	(3.6)		
Faculty of study*						
Medicine	21	(34.4)	40	(65.6)	17.755 (5)	0.003
Nursing	15	(68.2)	7	(31.8)		
Allied Health Sciences	32	(69.6)	14	(30.4)		
Dentistry	12	(66.7)	6	(33.3)		
Pharmacy	26	(49.1)	27	(50.9)		
Sciences	61	(57.0)	46	(43.0)		
Parents income*						
<RM 1000	32	(19.3)	13	(9.4)	18.641 (3)	<0.001
RM1000-RM3000	43	(25.9)	42	(30.4)		
RM3000-RM5000	53	(31.9)	26	(18.8)		
>RM5000	38	(22.9)	57	(41.3)		
Scholarship type*						
JPA	61	(46.2)	71	(53.8)	15.423 (2)	<0.001
PTPTN	66	(71.7)	26	(28.3)		
Others	17	(47.2)	19	(52.8)		

*p<0.01

most of them answered that they spent on supplements, medication, gadgets and broad-band internet access.

Table 4 addresses the relationship between some demographic characteristics of the respondents and their food security status. Significant association was found between food security status of the students with faculty of study, parents' income and scholarship type.

DISCUSSION

Majority of the students were found to be food insecure (54.4%). Those in the food secure category were mainly marginally food secure (44.3%) and only 1.3% were highly food secure. These findings are similar but slightly lower from what was reported by Sulaiman *et al.* (2013), who found that 67.1% of students from four universities in Malaysia were food insecure. Internationally, studies conducted in a midsize rural university in Oregon, and the University of Hawa'i at Manoa, both in the United States, reported that 59% and 45% of their students, respectively, were food insecure (Chaparro *et al.* 2009; Patton-lópez *et al.* 2014). This is an indicator that the students were facing financial and economic hardships up to a point that they may have compromised their food intake. Food insecurity can adversely affect health behaviour, including healthy eating habits and wellbeing, which subsequently influence

academic performance (Bruening *et al.* 2018).

The majority of the students agreed that time constraint had caused them to face the feeling of hunger and not able to eat balanced meals. This sentiment was more prevalent among the food insecure group. It demonstrates that coping strategy for time management and meal pattern among students play a crucial role in determining student's food security status. This finding is in line with that reported by Abdullah & Ali (2011) who explained that time management and financial problems played a crucial role in determining an individual's food intake. The study claimed that only 57.5% of students had meal at proper times while the rest did not take their meal at the appropriate times. The study further explained that improper meal times among students were caused by time and financial constraints which lead to restrictions on both expenses and irregular timetable, such as having 'brunch', the meal combination between breakfast and lunch. Even worse, when some of the students only had one meal per day often consuming unhealthy foods such as instant noodles or fast food. Abdullah & Ali (2011) in their study also found that 61.5% of students spent <RM10 per day for food in their daily expenditure, and the amount increased during weekends. This amount was low and not enough to have a healthy and balanced meal. However, this was not surprising because students were found to reduce their food expenditure in order to spend on other items such as their mobile phones, gadgets, computers and clothing.

Their financial situation is one of the factors that was consistently related to food insecurity among students (Bruening *et al.*, 2017). In our study, the largest proportion of PTPTN loan recipients was among the students of the Allied Health Sciences programmes, which also had the largest percentage of food insecure students. In contrast, students of Medical faculty where majority were JPA scholarship recipients, were at the lowest rank of food insecurity. In other words, these students were better off compared to the others. This is because students with PTPTN loans received less funding compared to the JPA scholarship recipients. The incomes of parents were also found to correspond with food security status of the students. These factors clearly demonstrate that food security status of the students was affected by their financial situation.

Although it is uncommon for Malaysian students to have a part-time jobs to support their living cost, the trend is growing due to financial reason. The students at this university also had no access to appropriate food storage and preparation facilities on campus to prepare their own meals which may have helped to reduce their food cost. Relying on insufficient financial resources may be difficult for them to achieve food and nutrition security. The prevailing conditions make it difficult for them to achieve stability for all the main components of food security, namely accessibility to, availability and utilization of food.

CONCLUSION

A significant association was found between food security status with financial affordability, time constraint, scholarship types, academic programme and parents' income. This study ascertained that most of the students at this institution were experiencing or at risk of food insecurity. Thus, financial affordability and time management together with other factors found to be critical in this study may need further attention in order to improve food security among university students.

Food insecurity seems to be a significant problem among university students, which influence not just

their wellbeing but also their academic performance. This study should be repeated at different institutions of higher learning around the country to better understand the issue and further strengthen the support system and introduce intervention programmes to improve access to adequate and nutritious foods for the student population. Hence, addressing food insecurity should be one of the priorities for university authorities and also relevant policy makers.

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Authors' contributions

WAMAB, principal investigator, conceptualised and designed the study, prepared the draft of the manuscript and reviewed it; SI, undertook the data collection and analysis, and reviewed the manuscript; SS, reviewed the manuscript and advised on the data interpretation; RAR, provided advice on the data interpretation and reviewed and proofread the manuscript.

Conflict of interest

There is no conflict of interest to declare.

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A feasibility study of multiple micronutrient supplement for home fortification of foods among *Orang Asli* children in Negeri Sembilan, Malaysia

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ABSTRACT

Introduction: The prevalence of child undernutrition and micronutrient deficiencies are higher in the *Orang Asli* (OA) than the general Malaysian population. The World Health Organization recommends the use of multiple micronutrient supplement (MMS) that is a blend of micronutrients in powder form that can be sprinkled onto foods for home fortification to prevent undernutrition among children. This pilot study aimed to assess the feasibility of using MMS among OA children. **Methods:** A total of 25 OA children (14 boys and 11 girls) aged 6-31 months (mean±SD = 15.7±7.2 months) in Negeri Sembilan were given three sachets of MMS weekly for 5 weeks. Caregivers were instructed to add MMS to three types of food from the same food group per week varying with a different food group weekly. Written instruction for using MMS in simple language was given prior to the supplementation. Caregivers were interviewed for information on socio-demographics, compliance, acceptance, preference and adverse effect of MMS. **Results:** A high level of compliance was observed (85%). All caregivers reported that the instructions for use were easy to read. No noticeable changes to the foods mixed with MMS were observed and no adverse effects were reported. **Conclusion:** This study demonstrated feasibility of the use of MMS for future trials among OA children. The easy to read information that comes with the MMS, frequent monitoring of MMS use and support to caregivers were required to ensure compliance. Cultural feeding practices and financial constraints may limit the types of food that can be mixed with MMS.

Keywords: Multiple micronutrients supplement, feasibility study, *Orang Asli* children, micronutrient powder, home food fortification

INTRODUCTION

It is estimated that there are more than 370 million indigenous people residing in 70 countries worldwide, representing 5% of the world's population (IWGIA, 2018). They live predominantly in remote and rural areas, although minority now live in urban areas. The indigenous people generally have high rates of poverty, low education levels, high food insecurity and less access to health services as compared to the general population (Leite *et al.*, 2013). Their morbidity rates are also higher. The prevalence of tuberculosis among indigenous population in Bolivia was 5 to 8 times

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higher compared to non-indigenous population, while gastrointestinal diseases were the main cause of death for children younger than 5 years of age (Montenegro & Stephens, 2006). The same report showed that in 2003, the national infant mortality rates in Brazil, Colombia and Mexico were 31, 19 and 40 per 1000 infants, whereas it was 106, 111 and 81 per 1000 infants, for the respective indigenous communities. The prevalence of underweight, stunting and wasting among indigenous children in India were 55%, 54% and 28% compared to the national level of 43%, 48% and 20%, respectively (IIPS & Macro International, 2007). In Australia, 14%, 11% and 10% of indigenous children under 5 years were underweight, stunted, and had wasting, respectively (Northern Territory Department of Health and Community Services, 2007).

In Malaysia, the indigenous people constitute about 13.8% of the total population of 31 million (IWGIA, 2018). Of this, The *Orang Asli* (OA) who are the indigenous people of Peninsular Malaysia, represent 0.7% of the approximately 24.5 million population of Peninsular Malaysia. Generally, the OA are of low socio-economic status and have poor health and nutritional status (Zalilah & Tham, 2002; Chua *et al.,* 2012). In Malaysia, the prevalence of child undernutrition and micronutrient deficiencies are also much higher in the OA than the general population. The national prevalence of underweight, stunting, wasting and anaemia among children under 5 were 12.4%, 17.7%, 8.0% and 32.0% respectively (IPH, 2015; WHO, 2015). Studies published since the 1980's on the nutritional status of OA children have consistently reported high prevalence of underweight (40-60%), stunting (50-60%), wasting (7-15%) and anaemia among 2-15 years old (41.5%) (Zalilah & Tham, 2002; Nor Aini *et al.*, 2007; Chua *et al.,* 2012; Oui & Razalee, 2015).

Many strategies such as food fortification and supplementation have been implemented in population-level programmes to prevent undernutrition and micronutrient deficiencies in developing countries (WHO & FAO, 2006). Although food fortification can improve micronutrient status with a reasonable cost (WHO & FAO, 2006), fortified foods require well-absorbed fortificants that do not change the sensory properties of foods and need to be consumed adequately. While food supplementation can supply nutrients quickly to deficient individuals, poor compliance to supplement dosing schedules and the side effects have been reported as the barriers to success (WHO & FAO, 2006). Evaluation of feasible and acceptable strategies to deliver multiple micronutrients is, thus, a priority (WHO, 2011). The Nutrition Guidance Expert Advisory Group (WHO, 2011) recommends the use of multiple-micronutrient supplements (MMS) as home fortification of foods consumed by infants and children aged 6-59 months of age to prevent child undernutrition. MMS is a blend of micronutrients in powder form that can be sprinkled onto home-prepared foods and has been used in many intervention trials among children aged 6-59 months in developing countries such as Kenya, Indonesia and Iran (Samadpour *et al.,* 2011; Inayati *et al.*, 2012; Jaeggi *et al.,* 2015).

Many factors have been found to be associated with the success of MMS programmes such as acceptance, compliance, preference, and adverse effects (De-Regil *et al.,* 2011; Kanashiro *et al.,* 2016). Acceptance and compliance can be enhanced by providing information on the use and storage of MMS that are clear, adequate and culturally appropriate (De Pee

et al., 2007; Jefferds *et al.*, 2010). A home visit is also important to ensure that correct information on the use of MMS is delivered to caregivers as confusion on the preparation, required consistency and optimum practices was common (Halati *et al.,* 2013; Kanashiro *et al.,* 2016). This study was undertaken to assess the feasibility in terms of compliance, parental acceptance, child preference and adverse effects of the use of MMS, for a randomised-controlled trial among OA young children in Selangor.

MATERIALS AND METHODS

Ethical approval

The study protocol was approved by the Ethics Committee for Research involving Human Subjects (JKEUPM) of Universiti Putra Malaysia (Project reference number: (FPSK-P077) 2017). Permission to conduct the study in OA communities was obtained from the Department of *Orang Asli* Development (JAKOA). Written informed consent to participate in the study was obtained from caregivers.

Design and participants

The study was conducted in the *Orang Asli Temuan* villages in Seremban and Port Dickson districts, in the state of Negeri Sembilan in Peninsular Malaysia. A list of 14 villages was obtained from the *Department of Orang Asli Development* (JAKOA, 2016). Two villages in the Seremban district (*Kampung Jeram Kedah* and *Kampung Tekir*) and one village in the Port Dickson district (*Kampung Bukit Kepong*) were randomly selected. The total number of households in these villages was 149 for *Kampung Tekir*, 145 for *Kampung Jeram Kedah* and 137 for *Kampung Bukit Kepong*.

Data collection was carried out from June until August 2017. Households with children aged 6-36 months were identified and invited to participate in this study. The children were recruited based on the selection criteria: (1) age of 6-36 months; (2) no history of chronic diseases e.g. failure to thrive and/or metabolic or endocrine disorders; (3) no history of congenital and/or acquired neurological condition; (4) not under treatment for communicable diseases such as tuberculosis and human immunodeficiency viruses (HIV). A total of 33 young children were screened for eligibility and from these, 25 children were selected based on the responses of their caregivers who consented to participate in the study.

Test treatment, dose and mode of administration

Children were paid weekly visits and given three sachets of MMS per week, each containing 1 g sachet, consisting of ten vitamins and five minerals (Table 1). The amount of each micronutrient provided by MMS was mostly ≥ 42% of the Malaysian Recommended Nutrient Intake, (RNI). This was adequate to meet the daily nutrient requirement of children in addition to nutrients provided by daily complementary foods (NCCFN, 2017). The MMS was manufactured by DSM Singapore Industrial Pte. Ltd. It was in powder form and consumed orally by being sprinkled onto foods that were prepared at home for the child, every other day for five weeks. Caregivers were instructed to mix the MMS in three different types of food from the same food group 3 days/week and different food groups in the five weeks (week one: rice, tubers and cereals; week two: fruits; week three: vegetables; week four: meat, poultry, fish and eggs; week five: milk, dairy products and other beverage e.g. formula milk/ chocolate malted/ malted beverage). Written instructions in simple language with visuals for using and storing the MMS were given to caregivers prior to the supplementation.

Table 1. The composition of multiple-micronutrient supplement used in this study

No.	*Nutrient*	*Amount per 1 g sachet*
1	Vitamin A, μg RE	400
2	Vitamin C, mg	30
3	Vitamin D, μg	5
4	Vitamin E, mg α-TE	5
5	Vitamin B1, mg	0.5
6	Vitamin B2, mg	0.5
7	Vitamin B6, mg	0.5
8	Vitamin B12, μg	0.9
9	Folic Acid, μg	90
10	Niacin, mg	6
11	Iron, mg	10
12	Zinc, mg	4.1
13	Copper, μg	560
14	Iodine, μg	90
15	Selenium, μg	17

Source: WHO, WFP, UNICEF (2007)

Measurements

Socio-demographic information such as household income, age of parents, their education and employment were obtained through face-to-face interview with caregivers using a pre-tested questionnaire and with the assistance of a local translator. The date of birth of the child was obtained from the birth certificate or child's health records. Data were collected prior to the supplementation.

Compliance, acceptance, child preferences and the adverse effects of MMS were assessed through a weekly face-to-face interview with caregivers. The caregivers were visited each week, and given three sachets of MMS for one week of supplementation. After a week, caregivers were required to return the empty sachets (including unused or half used) to the investigator. Compliance of MMS was measured by dividing the total number of empty sachets with a total number of distributed sachets. The acceptance of MMS by the caregivers was assessed based on the ease of reading instructions for use, ability to understand instructions for use, ease of mixing MMS with food and willingness to use MMS in the future. Changes in food taste, colour or odour, the child's appetite and acceptance of food mixed with MMS were assessed for child preference of MMS. Caregivers were also asked to report the types of food mixed with MMS in 3 d/week. Any adverse effect such as cough, diarrhoea, bloody diarrhoea, difficulty in breathing and fever including the admission to hospital due to these conditions was also assessed during a weekly visit.

Statistics

Data were analysed using SPSS version 22.0 (SPSS Inc.) software. Descriptive statistics were expressed as mean and standard deviation for continuous variables and as frequencies for categorical variables. Data on compliance, acceptance, child preference and the adverse effect of MMS were expressed as frequencies and percentages.

RESULTS

The subjects in this study comprised 14 (56%) boys and 11 (44%) girls, with a mean age of 15.7±7.2 months (Table 2). The mean monthly household income was RM864. Slightly more than half of the mothers (52%) and fathers (56%) had lower secondary education. The majority of the mothers were housewives (80%) while the fathers were mostly self-employed (88%).

Table 3 shows the compliance, acceptance, child preferences and adverse effects of the five-weeks of MMS supplementation. A high level of 85% compliance was seen in this study. All caregivers reported that the instructions for use, were easy to read and understand, and 92% reported a

Table 2. Demographic and socio-economic characteristics (N=25)

Variables	*n (%)*	*Mean±SD*
Gender of child		
Male	14 (56)	
Female	11 (44)	
Age of child (month)		15.7±7.2
Age groups of children		
6-8 months	5 (20)	
9-11 months	4 (16)	
12-14 months	4 (16)	
15-17 months	1 (4)	
18-20 months	5 (20)	
21-24 months	2 (8)	
25-31 months	4 (16)	
Household income (RM)		864±298
Age of mother (years)		26.2±5.4
Age of father (years)		28.4±5.9
Education of mother		
Primary level	12 (48)	
Lower secondary level	13 (52)	
Education of father		
Primary level	11 (44)	
Lower secondary level	14 (56)	
Employment of mother		
Housewife	20 (80)	
Employed	5 (20)	
Employment of father		
Self-employed	22 (88)	
Employed	3 (12)	

willingness to use MMS in the future. None of the caregivers reported changes in taste, colour, or odour of foods mixed with MMS. About 84% caregivers reported no change in appetite of the children. All caregivers mixed MMS in rice porridge or rice from the first week one to the fifth. In week five, only two caregivers (8%) reported they had mixed MMS in formula milk. No adverse effects were reported in this study.

DISCUSSION

Compliance among caregivers in this study was high. This was also observed in other trials using MMS in home-cooked food (Ogunlade *et al.,* 2011; Albelbeisi *et al.*, 2017). This could be attributed to the frequency of supplementation, where supplementation on alternate days is simpler to comply compared to other frequencies. A review by De-Regil *et al.* (2011) showed that children receiving intermittent iron supplementation had higher compliance compared to those receiving daily iron supplements. In this study, monitoring and support to caregivers were found to be necessary to ensure compliance. The caregivers were frequently reminded and encouraged to give the MMS as instructed during the weekly home visits by the investigator. This could explain the high level of compliance that we obtained (Lundeen *et al.,* 2010; Halati *et al.*, 2013). Pangaribuan *et al.* (2003) found that

the understanding of the importance of supplementation of caregivers increased the compliance of vitamin A capsule supplementation among pre-school children in Indonesia.

Similar to previous studies (De Pee *et al.*, 2007; Loechl *et al.,* 2009; Jefferds *et al.*, 2010; Albelbeisi *et al.*, 2017), this study also found that MMS was well accepted by caregivers. Several factors which could explain the acceptance of MMS by caregivers have been identified in this study. First, the printed material provided to caregivers contained simple written and visual instructions for use of MMS. Several studies have shown that locally appropriate written and visual instructions that are tailored to suit the local cultural context increases acceptance of MMS by recipients (De Pee *et al.,* 2007; Jefferds *et al.,* 2010; Kanashiro *et al.*, 2016). Second, the ease of use of MMS did not require caregivers to change their daily feeding practices as the MMS was given mixed in foods that were usually given to their children. It has been shown that MMS added into any semi-solid foods or commonly

Table 3. Compliance, acceptance, child preference and the adverse effect of five weeks MMS supplementation (N=25)

Variables	*n (%)*	*Mean±SD*
†Compliance (%)		85.0±25.5
Acceptance		
Easy to read instructions for use	25 (100)	
Understand instructions for use	25 (100)	
Easy to mix MMS with food	25 (100)	
Willing to use in the future		
Yes	23 (92)	
No	2 (8)	
Child preference		
No change in taste of food	25 (100)	
No change in colour of food	25 (100)	
No change in odour of food	25 (100)	
Change in child's appetite		
No change	21 (84)	
Increase appetite	2 (8)	
Reduce appetite	2 (8)	
Food mixed with MMS		
Week 1: Rice, tubers and cereals	25 (100)	
Week 2: Fruits	-	
Week 3: Vegetables	-	
Week 4: Meat, poultry, fish and eggs	-	
Week 5: Milk, dairy products and other beverages	2 (8)	
Adverse effect		
Cough	0 (0)	
Diarrhoea	0 (0)	
Bloody diarrhoea	0 (0)	
Difficulty in breathing	0 (0)	
Fever	0 (0)	
Admission to hospital due to these conditions	0 (0)	

†Compliance rate is calculated by dividing a total number of consumed sachets with the total number of distributed sachets, then multiplying it with 100%

taken food by children at home or at the point of use were well-accepted by caregivers (WHO 2011). Third, the home visits increased the acceptance as they provided opportunities for discussion between caregivers and investigator (Halati *et al.,* 2013; Kanashiro *et al.,* 2016).

Child acceptance of MMS in this study was good as all caregivers reported no noticeable changes in the taste, colour and odour of the foods mixed with MMS. This could be related to encapsulated ferrous fumarate with lipid (the source of iron in MMS) protects the interaction of iron with food and masks the metallic taste of the food upon adding MMS (Zlotkin *et al.,* 2005; De Pee *et al.,* 2007). There was no change in the appetite of the majority of the children. This could have been due to the short duration of the supplementation, as previous studies have shown that the appetite of the children increased in supplementation of longer duration such as two or six months (Loechl *et al.*, 2009; Kanashiro *et al.*, 2016).

In this study, caregivers were instructed to mix the MMS in five different food groups in each week. However, all caregivers only mixed MMS in rice or rice porridge from week one to week five as foods from other food groups were not affordable for them. Caregivers frequently feed their children with plain rice or porridge with a bit of salt and occasionally with a small quantity of fish. Several studies on dietary intake of OA children also reported that rice is the most frequently consumed food with limited intakes of fruits, milk and dairy products (Zalilah & Tham, 2002; Chua *et al.,* 2012). Low dietary diversity in OA children could be due to the limited household income as well as cultural feeding practices. Such low food variety was also observed in the diets of OA adults (Haemamalar, Zalilah & Neng Azhanie, 2010). In generally, the diets of poor people are often monotonous and based on cereals, roots and tubers. Micronutrient-rich foods such as meat, fish, chicken, eggs, milk and dairy products are usually consumed only in small amounts (WHO & FAO, 2006).

Only two caregivers reported that they mixed MMS with formula milk. Other caregivers who did not mix MMS with formula milk or other beverages reported that their children were still fully breastfeeding, or not taking formula milk or malted beverages. The children usually consumed tea or coffee, neither of which is recommended for mixing with MMS. The low intakes of milk and dairy products among the children could be because of the higher price of formula milk as compared to tea or coffee. Giving tea or coffee to the children was easier for parents as these beverages were routinely prepared for other family members. Chua *et al.* (2012) also found that OA children did not commonly take milk or malted beverages and about 69% of them took tea or coffee in their daily diets. The present study reported no adverse effect of MMS use and this finding was in line with previous studies (Samadpour *et al.,* 2011; Inayati *et al.,* 2012; Albelbeisi *et al.,* 2017).

This study was not without limitations. Low variety of foods in the diets of the children may have contributed to the limitation of assessing acceptance and preference of MMS when combined to foods. In addition, the short duration of MMS supplementation could be a limiting factor in this study.

CONCLUSION

This study found that simple and easy to read information on MMS, frequent visits and communication to monitor MMS use and support to caregivers were essential to ensure compliance and acceptance of MMS. Cultural feeding practices, education level and knowledge

of nutrition among the OA community, as well as financial constraints should be considered when designing an intervention. This study demonstrates the feasibility of using MMS for future trials among OA young children (6-24 months) to prevent undernutrition and anaemia.

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Authors' contributions

NDS, designed the study, collected and analysed the data and prepared the manuscript; ZMS, conceptualized and designed the study, supervised the project, reviewed and finalized the manuscript; GWY, supervised the project and reviewed the manuscript; Loh SP, supervised the project and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Linguistic validity and reliability of cariogenic food frequency and oral health knowledge, attitude and practice questionnaires for parents of 6-11 years old children in Kota Bharu, Kelantan

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ABSTRACT

Introduction: Cariogenic food intake and oral health knowledge, attitude and practices (KAP) of parents are contributing factors that influence the oral health status of children. As there is lack of a validated questionnaire in Bahasa Melayu (the Malay language) to measure the factors, this cross-sectional study was carried out to establish a linguistically valid and reliable cariogenic food frequency questionnaire (M-CFFQ) and oral health KAP questionnaire (M-OHKAPQ) in Bahasa Melayu, for parents of children aged 6-11 years in Kota Bharu, Kelantan. **Methods:** Relevant questionnaires in English were selected and translated to Malay language. This process included forward translation, synthesis, backward translation and consolidation to produce the preliminary drafts of M-CFFQ and M-OHKAPQ. Pre-testing was conducted on ten parents of children from a primary school in Kota Bharu by face-to-face interview. The findings were reviewed to produce the final versions of M-CFFQ and M-OHKAPQ. A test-retest reliability study was undertaken involving 49 parents. The participants were asked to answer the final M-CFFQ and M-OHKAPQ versions twice, within a 7-14 days interval. Data collected were entered into IBM SPPS version 22 software and analysed using the Intraclass Correlation Coefficient (ICC) test. **Results**: Semantic, idiomatic, experiential, conceptual as well as content and face validity issues were successfully resolved. Fifteen categories of food/drinks for M-CFFQ and 26 items/questions M-OHKAPQ were produced. The total ICC values achieved for M-CFFQ and M-OHKAPQ were 0.887 and 0.807, respectively. **Conclusion:** The M-CFFQ and M-OHKAPQ appeared to be linguistically valid and reliable with excellent test-retest reliability (ICC>0.80).

Keyword: Linguistic, cariogenic, oral health, questionnaire, test-retest reliability

INTRODUCTION

Good oral health in children is essential. In children, it affects their general health (physical, mental, psychological) and social well-being, especially in later life (Schroth, Brothwell & Moffatt, 2007). Yet, dental caries remains a major public health problem in children worldwide (Peres *et al.*, 2016). Dental caries can be defined as the localised destruction

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of susceptible dental hard tissues by acidic by-products from the bacterial fermentation of dietary sugar (Fejerskov, 2004). Many children have experienced dental caries as soon as teeth erupt. Petersen *et al.* (2005) reported that about 60-90% of school-aged children are affected by dental caries in most industrialised countries in America and the Europe. In the developing countries of Africa and Asia, prevalence rates of dental caries and dental caries experience tend to escalate due to the increasing consumption of sugars and inadequate exposure to fluorides (Petersen *et al.*, 2005). In Malaysia, the latest national oral health survey showed a high prevalence of caries at 71.3% in 5 years old children and 60.0% of them had visible plaque (Oral Health Division Malaysia, 2015). In addition, 33.3% of 12-year old school children had caries on their permanent teeth (Oral Health Division Malaysia, 2017).

Mani *et al.* (2012) found that the occurrence of caries in children may be influenced by poor dietary habits. In addition, the poor knowledge of oral health, attitude and practices (KAP) of parents contributed to the problem. Children spend much of the time with their parents or primary caregivers when growing up. Most of their early childhood routines such as dietary habits and oral health behaviour are acquired from them at this stage (Naidu & Davis, 2008). It is crucial for parents to have basic knowledge of diet, nutrition and oral hygiene as a contributory factor to dental caries and to understand their significance, so as to instil good dental practices in their children (Tinanoff & Reisine, 2009). These include choosing a diet with low or non-cariogenic foods, limiting sweet foods to mealtimes, and brushing teeth after exposures to sugar (Tinanoff & Reisine, 2009). Parents also play a major role in ensuring the general wellness of their children. Therefore, the KAP of oral health of parents should impact the oral health of their children. The assessment of these factors is essential for the successful delivery of appropriate oral health knowledge programmes or promotions to the parents. This could help them to understand, create awareness and change their attitudes and practices towards the oral health care of their children.

The Malay language or Bahasa Melayu is the official language for Malaysia. Questionnaires in Bahasa Melayu will benefit the majority of the Malaysian population, cater to respondents who are not proficient in English, particularly those with a lower socio-economic and educational background, and people from rural areas. In addition, there is a lack of an established Bahasa Melayu version of the cariogenic food frequency questionnaire (CFFQ) and oral health knowledge, attitude and practice questionnaire (OHKAPQ) which are linguistically valid and reliable. These may then be used in measuring cariogenic food intake and oral health KAP in the Malaysian population, specifically for parents of preschool and primary school children**.** Previous local studies had used the translated questionnaires that applied to other age groups, namely secondary school children, infants and toddlers (Cheah *et al.*, 2010; Mani *et al.*, 2010; Zahara *et al.*, 2010: Mani *et al.* 2012; Ruhaya *et al.,* 2012). The reliability and validity of these questionnaires were only partially reported. On the other hand, designing a new questionnaire may be a demanding, time-consuming and costly task (Epstein, Santo & Guillemin, 2015). This study was carried out to establish a linguistically valid and reliable Bahasa Melayu version of CFFQ and OHKAPQ questionnaires for parents of children aged 6-11 years old in Kota Bharu, in the state of Kelantan in Malaysia.

MATERIALS AND METHODS

Research tools

The CFFQ used in this study was adapted from Habibian *et al.* (2001). Initially, it was a food list established from a three-day food diary to describe the dietary habits and oral hygiene behaviour in infants and toddlers over the first 18 months of life, in Mid-Surrey, United Kingdom. It consisted of 18 categories of foods and beverages, namely, all cakes, chocolate, crisps, sweets, sugared cereal, fruits, sugared milk, cow's milk, formula milk, soya milk, formula milk with non-milk extrinsic sugar (NMES), sugared drinks, sugared beverages, fruit juices, water, drinks no sugar, milk desserts and non-milk dessert. The food list had been adapted in Malaysia by Ruhaya *et al.* (2012) and Rathmawati *et al.* (2017) in their studies related to dietary habit and oral health in young children and disabled children. For this study, a formula for food intake frequency was adapted from Chee *et al.* (1996) and added to the CFFQ. The food intake frequencies were categorised into 7-point scale rating, in which '1' represented the never or rarely response, '2' represented once a month, '3' represented 2-3 times a month, '4' represented once a week, '5' represented 2-3 times a week, '6' represented once daily and '7' represented 2-3 times daily.

Meanwhile, OHKAPQ was adapted from the Oral Health Promotion Evaluation Toolkit by Watt *et al.* (2004). This toolkit was produced from a project that aimed to critically review, test and publish a set of appropriate age-specific oral health promotion evaluation outcome measures for parents and carers of pre-school children, 12 year-old children and people over 65 years of age in the United Kingdom. For the purpose of this study, 28 questions or outcome measures that are relevant for parents of children aged 6-11 years were selected from the toolkit. These questions were then categorised into three sections, namely, oral health knowledge, attitude and practice in regard to plaque control, fluoride use, diet behaviour and dental attendance.

Process

This study was conducted from February to May 2017. Ethical approval to conduct this study was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia (JEPem Code: USM/JEPem/17010067) and National Medical Research Register, Ministry of Health Malaysia (NMRR ID Number: NMRR-17-706-35129). It was divided into two phases, namely linguistic validation and test-retest reliability. Figure 1 and Figure 2 show the translation or linguistic validation process and flow charts of both phases.

Phase I: Translation/linguistic validation

The linguistic validation process in this study was adapted from the guidelines proposed by Beaton *et al.* (2000), with slight modifications. Initially, CFFQ and OHKAPQ that were selected underwent a translation process involving forward translation, synthesis, backward translation and consolidation to produce a preliminary Bahasa Melayu version of CFFQ and OHKAPQ which were called M-CFFQ-P and M-OHKAPQ-P. Following the pre-testing stage, ten parents of school children aged 6-11 years old from a primary school in Kota Bharu were selected using quota sampling and invited for a face-to-face interview. The sample size that was decided was based on the process of translation and adaptation guideline recommended by WHO (2001). The inclusion criteria were Malaysian citizens, able to read and write in Bahasa Melayu. All participants gave their consent. During this stage, each participant was informed about the purpose and procedure of the study by a single interviewer. They were asked for their opinions, suggestions and comments regarding the M-CFFQ-P and M-OHKAPQ-P. Any word or expression in these questionnaires that was difficult

for the participants to comprehend or inappropriately used was probed in detail. A meeting was then held to review and resolve the issues in the pre-test study, to eventually produce the final versions of M-CFFQ and M-OHKAPQ. Members of the expert review committee involved in this phase were a nutritionist specialist, a dental public health specialist, a dental public health (doctorate) student and the researcher.

Phase II: Test-retest reliability

In test-retest reliability study, the sample size was calculated using a Microsoft Excel spreadsheet file developed by Arifin

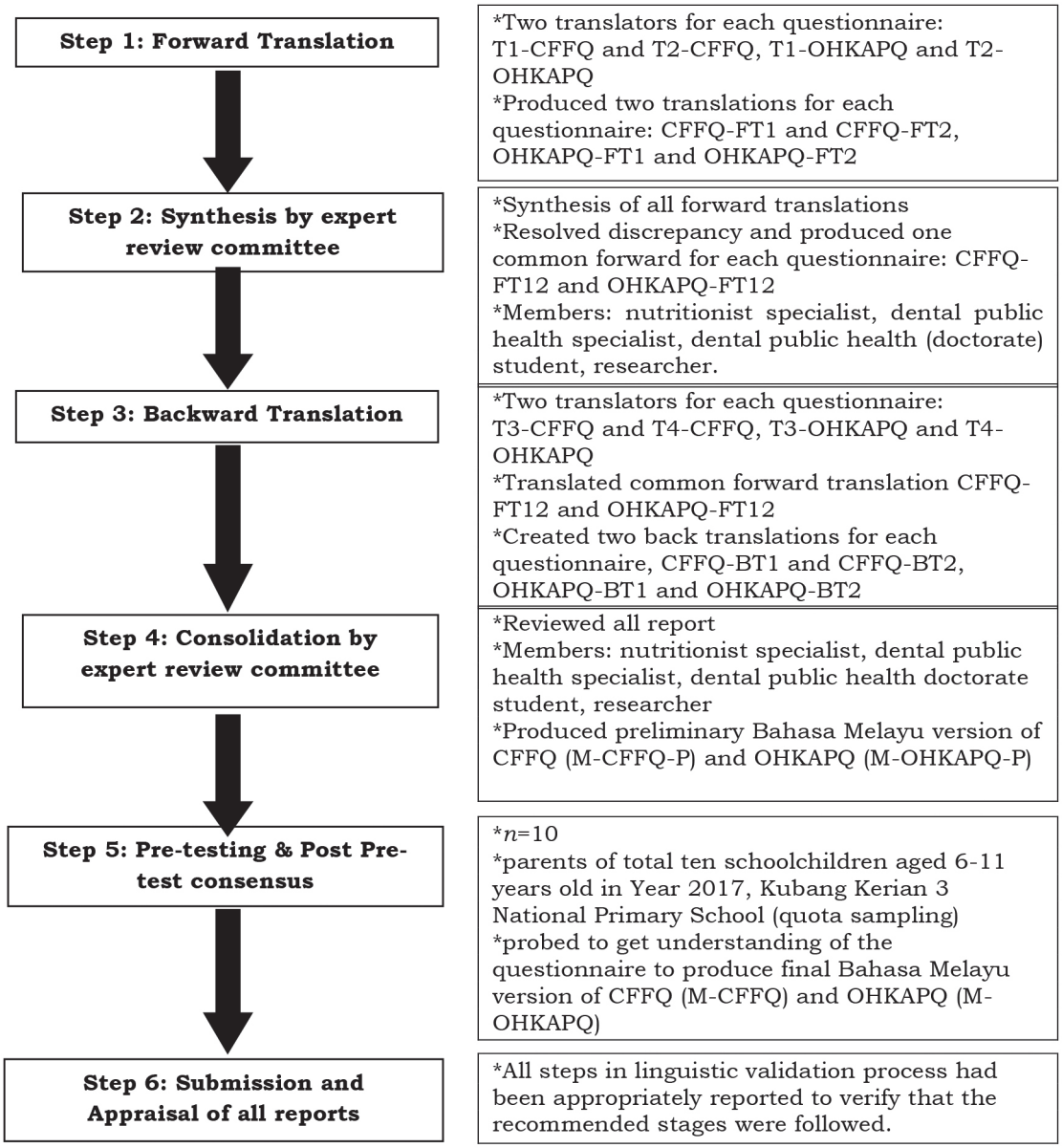

Figure 1. Flow chart of phase I - linguistic validation process of M-CFFQ and M-OHKAPQ (adapted from a guideline proposed by Beaton *et al.* (2000) with a slight modification)

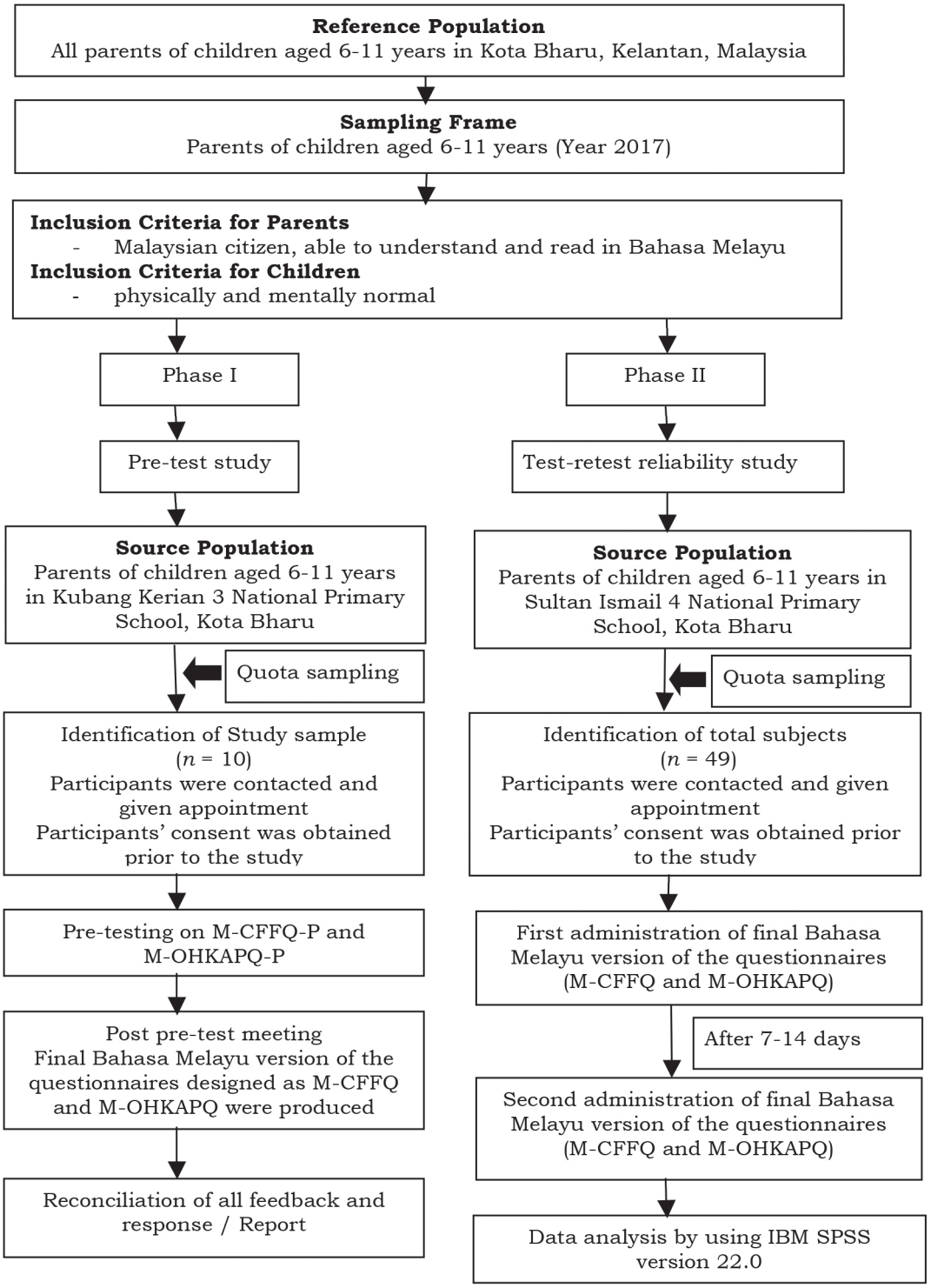

Figure 2. Sampling and flow chart of pre-test study (in phase I) and test-retest reliability study (phase II)

Table 1. Names of foods and beverages in English (CFFQ) and Bahasa Melayu (M-CFFQ) versions of cariogenic food intake questionnaire

No	*English version (CFFQ) [from Habibian et al. (2001)] domains and items*	*No*	*Bahasa Melayu version (M-CFFQ) domains and items*
1	Cake Cakes, pastries, bun, breadstick, biscuits	1	Kek, Pastri dan Roti Semua jenis kek, Semua jenis pastri (contoh : tart, pai, krim paf, roti canai), Semua jenis roti dan ban Lain-lain. Sila nyatakan
		2	Biskut Semua jenis biskut Lain-lain. Sila nyatakan
		3	Kuih tradisional Semua jenis kuih tradisional Lain-lain. Sila nyatakan
2	Chocolates Including various types of chocolate bars and wafers	4	Coklat Coklat bar dan biskut bersalut coklat Lain-lain. Sila nyatakan
3	Crisps Crisps and savoury snacks	5	Kerepek Semua jenis kerepek, Snek berperisa (contoh: makanan ringan atau jajan) Lain-lain. Sila nyatakan
4	Sweets Chewable sweets, boiled sweets, lollies	6	Gula-gula Gula-gula boleh kunyah, Gula-gula keras, Lolipop Lain-lain. Sila nyatakan
5	Sugared cereals All breakfast cereals, baby cereal, rusk	7	Bijirin bergula Semua jenis bijirin sarapan bergula Lain-lain. Sila nyatakan
6	Fruits All fresh fruits and dried fruits	8	Buah Semua jenis buah kering, Semua jenis jeruk buah, Semua jenis buah yang disira Lain-lain. Sila nyatakan
7	Sugared milk Milk with added sugar/ honey (milkshake)	9	Susu segar bergula atau susu UHT bergula Susu segar yang ditambah gula atau madu Susu UHT yang ditambah gula atau madu Lain-lain. Sila nyatakan
8	Soya milk All soya bean-based milk	10	Susu soya Semua susu berasaskan soya Lain-lain. Sila nyatakan

9 Formula milk All formula milk containing only lactose	11 Susu formula dengan gula tambahan Semua susu formula dengan gula tambahan Lain-lain. Sila nyatakan.
10 Formula milk with NMES All formula milk containing non-milk extrinsic sugars	
11 Sugared drink Squash,baby drinks, herbal drinks, fizzy drinks	12 Minuman bergula/ susu pekat manis Minuman bercoklat Minuman berperisa buah/kordial (contoh: jagung, laici, anggur, oren dan lain-lain) Minuman dalam kotak (contoh: teh bunga, coklat , oren, laici dan lain-lain) Minuman bergas, Teh ditambah gula/susu pekat manis (contoh: teh tarik) Kopi ditambah gula/susu pekat manis Minuman herba Lain-lain. Sila nyatakan.
12 Sugared beverages Tea with added sugar, coffee with added sugar	
13 Fruit juices All fruit juices and drinks	13 Jus buah-buahan Semua jus buah-buahan yang; Tanpa gula Ditambah gula Ditambah susu pekat manis Lain-lain. Sila nyatakan.
14 Milk dessert Yogurt, fromage frais, custard	14 Pencuci mulut Semua jenis pencuci mulut Yogurt dengan gula tambahan Dadih dengan gula tambahan Semua jenis aiskrim, cendol, air batu campur. Lain-lain. Sila nyatakan.
15 Non-milk dessert Baby dessert, pureed fruits with added sugar, preserves, honey, table sugar, ice lollies, baby dessert	
16 Cow's milk Cow's milk, goat's milk	*Excluded as not relevant to the content of the CFFQ* *Fresh Cow's and goat's milk are categorised as cariostatic. Meanwhile, water and sugar-free drinks are not cariogenic.*
17 Water Water as drink	
18 Drinks no sugar Sugar-free drinks	
	15 Lain-lain Madu Semua jenis jem Kaya Semua jenis colek/ sos/ kicap (untuk buah, rojak, lok chen, keropok dan lain-lain) Lain-lain. Sila nyatakan

(2015), based on a formula designed by Walter, Eliasziw and Donner (1998). The lower limit of accepted reliability (P_0) was set at 0.6, whereas expected reliability coefficient (P_1) was decided at 0.8 (Zulkifli, Tin-Oo & Saddki, 2015), with 80% power and alpha 0.05. The sample size obtained was 39 subjects. After assuming a 20% drop-out rate, the sample size was increased to 49 subjects. Thus, 49 eligible parents of children aged 6-11 years of age were recruited via quota sampling from another primary school in Kota Bharu. The selected parents were contacted and asked to complete the M-CFFQ and M-OHKAPQ forms twice with 7-14 days intervals between the first and second administration of the questionnaires. Appointments were made with the parents and the interviews conducted accordingly. All participants gave their informed consent. Data collected in this study was entered into the IBM SPPS version 22 software. The intraclass Correlation Coefficient (ICC) test was used to check for test-retest reliability by assessing the agreement of the responses in the time interval. The level of significance was set at $p<0.05$.

RESULTS

Phase I: Linguistic validation

The Bahasa Melayu versions of CFFQ (M-CFFQ) and OHKAPQ (M-OHKAPQ) showed satisfactory equivalence with the respective English versions of CFFQ (Table 1) and OHKAPQ (Table 2). Some modifications were made by the expert committee to achieve better semantic, idiomatic, experiential as well as conceptual equivalences. Meanwhile, content validity and face validity of M-CFFQ and M-OHKAPQ were obtained through expert committee review in the synthesis, consolidation and post pre-test stages. Some domains and items in M-CFFQ and M-OHKAPQ required modifications to suit common Malaysian cariogenic foods/drinks and to be properly translated into local language and culture. Common Malaysian foods/drinks include traditional delicacies, spicy and sweetened soy bean sauce (*colek)*, coconut-spread (*sekaya* or *kaya*), tea drinks with sweetened creamer (*teh tarik*), and *cendol* which is an icy dessert with glutinous pellets, coconut milk, palm sugar, and sometimes with added coloured syrup, sweet corn and black beans. None of the intended objectives and concept of the questionnaires was compromised in the process. At the end of this phase, 15 categories of foods/drinks for M-CFFQ and 26 items/questions for M-OHKAPQ were produced. Sociodemographic profile of participants in the pre-test stage is shown in Table 3.

Phase II: Test-retest reliability

The socio-demographic profile of respondents in test-retest reliability is shown in Table 3.

Table 4 shows the ICC analysis of M-CFFQ and M-OHKAPQ for each domain. Total ICC value of M-CFFQ and M-OHKAPQ are 0.887 and 0.807, respectively. Using the guideline of interpretation of the ICC by Cicchetti (1994), these findings indicate that M-CFFQ and M-OHKAPQ showed excellent agreement between test and retest study and both are stable between the two different occasions or time.

DISCUSSION

Phase I: Translation/Linguistic validation and equivalences

Both M-CFFQ and M-OHKAPQ achieved semantic, idiomatic, experiential and conceptual equivalences as in original sources through the translation/linguistic validation process (Karthikeyan, Manoor & Supe, 2015; Beaton *et al.*, 2000). The content validity and face validity of the questionnaires were assessed, as suggested by Karthikeyan *et al.* (2015). Amendments in both questionnaires were made in accordance with the comments received

Table 2. Questions in English (OHKAPQ) and Bahasa Melayu (M-OHKAPQ) versions of KAP questionnaire

No	*English Version (OHKAPQ)*	*Bahasa Melayu version OHKAPQ (M-OHKAPQ)*
	Section: Knowledge	Bahagian: Pengetahuan
1	Sugary snacks/drinks are best limited to meal times. Yes No Do not know	Makanan/minuman bergula paling sesuai dihadkan pada waktu makan utama (sarapan, makanan tengahari dan malam) sahaja Ya Tidak Tidak tahu
2	If your child had a bag of sweets, would it be better for his/her teeth to eat them All in one go A few now and rest later Do not know	Jika anak anda mempunyai sejumlah gula-gula (satu peket atau sebungkus), adalah lebih baik untuk mereka sekiranya dimakan: Semua sekaligus Sedikit demi sedikit Tidak tahu
3	Fruit drinks designed specially for children are safe to teeth Yes No Do not know	Minuman berperisa buah-buahan (contoh: laici, anggur , oren dan lain-lain) adalah selamat untuk gigi anak anda Ya Tidak Tidak tahu
4	Most medicines are sugar-free Yes No Do not know	Kebanyakan ubat-ubatan dalam bentuk cecair mengandungi gula. Ya Tidak Tidak tahu
5	At what age do you think that you should start to brush your child's teeth? At birth When first teeth come through 1 - 2 years Over 2 years Do not know	Pada pendapat anda bilakah umur yang paling sesuai untuk mula menjaga kebersihan mulut anak anda? Selepas lahir Apabila gigi pertama telah tumbuh 1-2 tahun Lebih dua tahun Tidak tahu
6	You should brush your child's teeth after each meal to prevent decay Yes No Do not know	Anak-anak perlu memberus gigi atau berkumur setiap kali selepas makan untuk mengelakkan kerosakan gigi. Ya Tidak Tidak tahu
7	How often each day should children's teeth to be brushed? Once Twice Three times Never Do not know	Berapa kali sehari gigi anak anda perlu diberus? Sekali Dua kali Tiga kali Tidak pernah Tidak tahu

8	How much toothpaste should be used for each brushing of a child's teeth? Blob, the size of a pea ½ brush head length Whole brush head length Does not matter Do not know	Berapa banyak ubat gigi yang diperlukan setiap kali memberus gigi anak anda? Sekecil saiz kacang pis Setengah saiz kepala berus gigi Keseluruhan saiz kepala berus gigi Tidak penting. Tidak tahu
9	Fluoride strengthens tooth enamel True False Do not know	Florida menguatkan enamel (permukaan luar) gigi. Betul Salah Tidak tahu
10	At what age should you start taking your child to the dentist? 0 - 12 months 13-24 months 25-36 months When at school When they have a toothache Do not know	Pada umur berapakah anda perlu mula membawa anak berjumpa doktor gigi? 0-12 bulan 13-24 bulan 25-36 bulan Apabila mula bersekolah Apabila sakit gigi Tidak tahu
11	For what reason should you take your child to the dentist? Because they have a toothache For a checkup To get them used to go Do not know Others	Mengapakah anda perlu membawa anak berjumpa dengan doktor gigi? Sebab sakit gigi Untuk pemeriksaan Untuk membiasakan anak Tidak tahu Lain-lain
	Section: Attitude	Bahagian: Sikap
12	There is no need to be concerned about baby teeth. Strongly agree Agree Undecided Disagree Strongly Disagree	Adalah perlu untuk mengambil berat berkenaan gigi susu. Sangat setuju Setuju Tidak pasti Tidak setuju Sangat tidak setuju
13	It is not worthwhile to get cavities in baby teeth filled because those teeth fall out anyway Strongly agree Agree Undecided Disagree Strongly Disagree	Adalah berbaloi menampal gigi susu yang berlubang walaupun gigi tersebut akan diganti dengan gigi kekal. Sangat setuju Setuju Tidak pasti Tidak setuju Sangat tidak setuju
14	Regular visits to the dentist are very important. Strongly agree Agree Undecided Disagree Strongly Disagree	Pemeriksaan berkala oleh doktor gigi adalah sangat penting Sangat setuju Setuju Tidak pasti Tidak setuju Sangat tidak setuju

15	If your child had a bad back tooth and it was not a baby tooth, but a second tooth, would you rather it was filled or taken out? Filled Taken out Do not know	Adakah anda mahu jika gigi geraham kekal anak anda yang rosak untuk.....? Ditampal Dicabut Tidak tahu
16	If your child had a bad front tooth and it was not a baby tooth, but a second tooth, would you rather it was filled or taken out? Filled Taken out Do not know	Adakah anda mahu jika gigi depan kekal anak anda yang rosak untuk.....? Ditampal Dicabut Tidak tahu
17	Brushing my teeth twice a day for 2 -3 minutes will keep the gums health Extremely likely Likely Neither likely nor unlikely Unlikely Extremely likely	Memberus gigi dua kali sehari selama 2-3 minit dapat mengekalkan kesihatan mulut, gigi dan gusi. Sangat setuju Setuju Tidak pasti Tidak setuju Sangat tidak setuju
18	Some children insist on brushing their own teeth from a very early age. Does your child: Brush his/ her own teeth? Has it done for him/her (adult always assists and repeats)? Sometimes do it alone and sometimes have it done for him/her?	Sesetengah anak-anak hendak memberus gigi sendiri di usia awal kanak-kanak. Adakah anak anda Memberus giginya sendiri? Memberus gigi dengan dibantu orang dewasa? Ada masanya memberus sendiri dan ada masa dibantu orang dewasa
	Section: Practice	Bahagian: Amalan
19	How often does your child brush his/her teeth or have them brushed? Less often than once a week At least once a week but not every day Once a day Twice a day More than twice a day	Berapa kerap anak anda memberus gigi? Kurang dari sekali seminggu Sekurang-kurangnya sekali seminggu tetapi tidak setiap hari Sekali sehari Dua kali sehari Lebih dari dua kali sehari
20	Has your child started using toothpaste? Yes No	Adakah anak anda telah mula menggunakan ubat gigi? Ya Tidak
	(If 'Yes', answer Q21 onwards) (If 'No', the questionnaire ends here)	Jika Ya, sila jawab Soalan 21dan seterusnya. Jika Tidak, sila jawab Soalan 23 dan seterusnya.

21	Does the toothpaste your child uses contain fluoride? Yes No Do not know	Adakah ubat gigi anak anda mengandungi fluorida? Ya Tidak Tidak tahu
22	The amount that my child usually use during tooth brushing : Blob, the size of a pea 1/2 brush head length Whole bush head length Does not matter Do not know	Semasa memberus gigi anak saya menggunakan ubat gigi……? Sekecil saiz kacang pis Setengah saiz kepala berus gigi Keseluruhan saiz kepala berus gigi Tidak penting Tidak tahu
23	What drink do you usually give to your child before bed or during the night? Tap/still mineral water Fizzy mineral water (not flavoured) Fizzy mineral water(flavoured) Herbal drink Milk drinks (not flavoured) Flavoured milk (eg: Horlicks, Ovaltine, milkshake) Non-diluted fruit juice Fruit drink/squash Diluted fruit juice Fizzy drink Tea or coffee Something else Do not know If yes, answer Q24 onwards If never, Stop here	Apakah minuman yang sering anak anda ambil sebelum tidur atau pada waktu malam? Jika ya untuk pilihan jawapan ini, sila jawab Soalan 24 dan seterusnya Susu dengan gula tambahan Minuman bercoklat Jus buah-buahan Minuman berperisa buah-buahan (contoh laici, oren, anggur dan lain-lain) Minuman dalam kotak (contoh : teh bunga, coklat, anggur dan lain-lain) Minuman bergas Teh/kopi dengan susu pekat manis atau gula Minuman herba Lain-lain. Sila nyatakan: Jika ya untuk pilihan jawapan ini, sila terus ke soalan 25 dan seterusnya Air kosong/mineral Tidak tahu Tidak minum
24	Nowadays, how often does your child take something to drink before bed or during the night? Every night 4-6 nights a week 1-3 nights a week Less often than once a week Never	Berapa kerap anak anda minum minuman tersebut dalam tempoh seminggu? Setiap malam 4-6 malam 1-3 malam Kurang dari sekali
25	How often does your child have something to eat between meals during the day? Most of the time Some of the time Once in the while Rarely Never Do not know	Berapa kerap anak anda makan makanan bergula di antara waktu makan utama dalam sehari? (makan utama: sarapan, makan tengahari dan malam) Pada kebanyakan masa Beberapa kali dalam sehari Sekali dalam sehari Jarang-jarang Tidak pernah Tidak tahu

26	How often does your child have something to eat between meals in the evening or in weekend?	Berapa kerap anak anda makan makanan bergula di antara waktu makan utama pada hujung minggu? (makan utama: sarapan, makan tengahari dan malam)
	Most of the time	Pada kebanyakan masa
	Some of the time	Beberapa kali dalam sehari
	Once in the while	Sekali dalam sehari
	Rarely	Jarang-jarang
	Never	Tidak pernah
	Do not know	Tidak tahu

Table 3. Socio-demographic profile of the respondents

Variables	*Pre-test stage (n=10)*	*Test Retest Reliability (n=49)*
Respondents, n (%)		
Fathers	2 (20.0)	9 (18.4)
Mothers	8 (80.0)	40 (81.6)
Sex of child, n (%)		
Boy	4 (40.0)	24 (49.0)
Girl	6 (60.0)	25 (51.0)
Age (years), Mean±SD)		
Child	8.5±1.6	8.6±1.8
Respondent	40.4±5.9	40.2±6.4
Respondent's race, n (%)		
Malay	10 (100.0)	49 (100.0)
Chinese	0 (0.0)	0 (0.0)
Indian	0 (0.0)	0 (0.0)
Others	0 (0.0)	0 (0.0)
Respondent's education level, n (%)		
No formal education	0 (0.0)	0 (0.0)
Primary school	0 (0.0)	0 (0.0)
Lower secondary school	1 (10.0)	3 (6.1)
Upper secondary school	5 (50.0)	11 (22.5)
Diploma or equivalent	1(10.0)	11 (22.5)
Degree/Master/PhD	2 (20.0)	24 (48.1)
House income per month (Ringgit Malaysia), Median (IQR)	1100 (2600)	5000 (6100)
Oral health information sources, n (%)		
None	0 (0.0)	0 (0.0)
Doctor/Nurses/ Healthcare workers	8 (80.0)	37 (75.5)
Television/Radio	8 (80.0)	29 (59.2)
Newspaper/Article	9 (90.0)	29 (59.2)
Internet	8 (80.0)	31 (63.3)
Family/Friend	7 (70.0)	24 (49.0)
Others	0 (0.0)	0 (0.0)

Table 4. Intraclass Correlation Coefficient (ICC) of M-CFFQ and M-OHKAPQ

No	*Domains*	*Test-Retest Reliability*† *(ICC)*	*95% CI*
M-CFFQ			
1	Cake	0.719	0.542, 0.834
2	Biscuits	0.803	0.676, 0.884
3	Traditional delicacies	0.608	0.400, 0.758
4	Chocolate	0.729	0.550, 0.841
5	Crisps	0.768	0.624, 0.862
6	Sweets	0.801	0.669, 0.883
7	Sugared cereals	0.872	0.785, 0.926
8	Fruits	0.663	0.472, 0.794
9	Sugared fresh /UHT milk	0.687	0.504, 0.811
11	Formula milk with added sugar	0.815	0.694, 0.892
10	Soya milk	0.703	0.530, 0.821
12	Sugared/Sweetened drink	0.699	0.488, 0.826
13	Fruits Juice	0.767	0.622, 0.862
14	Dessert	0.718	0.550, 0.830
15	Others	0.866	0.775, 0.922
Total ICC Value of M-CFFQ		0.887	0.788, 0.938
M-OHKAPQ			
1	Knowledge (K)	0.714	0.542, 0.829
2	Attitude (A)	0.858	0.759, 0.918
3	Practice (P)	0.876	0.790, 0.928
Total ICC Value of M-OHKAPQ		0.807	0.680, 0.887

†ICC was calculated using two way mixed model with absolute agreement type option (IBM SPPS version 22)

from the participants, taking into consideration the characteristics and socio-demographic profile of the target population (Table 3) can influence the feasibility, readability, consistency, formatting, and clarity of language (Vyas *et al.*, 2016).

Content validity

Content validity is defined as the extent to which a measurement reflects the specific intended domain of content. The evidence for content validity was obtained from previous literature, the views of experts and from local target groups, as there are no objective measurements to test content validity (Laaksonen, 2012). With regard to M-CFFQ, there were some issues encountered during forward translation, concerning particular words and items that are uncommon in Malaysian population or which could not be translated into Bahasa Melayu. Otherwise, the words and items were translated into terms that had similar meaning without compromising the content. These included words such as 'breadstick' which was replaced with 'bread' (*roti*) and 'squash' which was redefined as 'fruit flavoured drinks' (*minuman berperisa buah-buahan*). However, 'fromage fraise' and 'baby dessert' items were excluded from M-CFFQ as these foods were not familiar or relevant to these preschool and primary school children. These changes

were consistent with those of Shinga-Ishihara *et al.* (2014) who had excluded the items 'applesauce' and 'breakfast drinks' from their FFQ which was adapted from a western study, as these were not familiar to the Japanese.

In our study, the expert committee also agreed to omit the items that were not relevant to the intended content for the M-CFFQ. These were the 'water' and 'drinks no sugar' domains, which were identified as not cariogenic. In addition, the domains on 'cow's milk' and 'formula milk that contains only lactose' were excluded based on the report by Rugg-Gunn and Woodward (2011) which stated that these types of milk are virtually non-cariogenic. The sugar present is lactose, which is the least cariogenic of all mono- and disaccharides. Milk also contains calcium phosphate, fat and casein that protect against demineralisation of enamel and overcome the cariogenicity of the milk (Rugg-Gunn & Woodward, 2011). Furthermore, Rugg-Gunn and Woodward (2011) concluded that milk and milk products such as cheese and yoghurt without added sugars were safe and possibly beneficial for teeth. Therefore, the item 'yoghurt' in the CFFQ was substituted with 'yoghurt with added sugar' in the M-CFFQ as the latter is better in representing the intended content of the questionnaire.

In addition, the item 'fresh fruit' in the original CFFQ was omitted since its cariogenicity is considered very low, unless it was consumed at least 17 times per day (Moynihan & Petersen, 2004). Besides, data from epidemiological studies largely showed that fresh fruit is non-cariogenic and its consumption had been reported to have a negative correlation with dental caries (Arora & Evans, 2012). However, the consumption of fresh fruits is encouraged by Malaysian Dietary Guidelines and health reports from Australia recommend at least two servings of fresh fruits per day (NCCFN, 2010; Arora & Evans, 2012). Fruit consumption is also supported by The Eatwell Plate, the United Kingdom national food guide that recommends that one-third of dietary volume should be provided by fruits and vegetables (Arora & Evans, 2012). The general opinion appears to favour the consumption of whole fruits, as they benefit overall health and stimulate salivary flow (Arora & Evans, 2012).

In order to include more potential cariogenic foods in Malaysian population, our expert committee decided to add the domains, 'traditional delicacies' and 'others' as they captured miscellaneous local foods such as 'honey', 'coconut spread' (*sekaya* or *kaya*), and 'sweet sauce' (*colek*). The items 'sugared/ sweetened drinks' and 'packet drinks' (*minuman dalam kotak*) were introduced as these were commonly available in retail outlets. This, again, is in agreement with Shinga-Ishihara *et al.* (2014), who added five new items of traditional fresh and semi-dry confectioneries that are common in Japan to their adapted food questionnaire. These were bread filled with bean jam or fruit jam (*An-pan* or *Jampan*), rice cracker (*Senbei*), bun with a bean-jam filling (*Manju*), rice cake (*Mochi*), and bar of sweet jellied adzuki-bean paste (*Youkan*).

As for M-OHKAPQ, there was a challenge in defining, in Bahasa Melayu, 'often', which means '*kerap*' (frequent) or '*selalu*' (always or consistent) and other terms related to the frequency measurement such as 'some of the time', 'once in a while' and 'rarely'. However, the expert committee managed to address these issues by using suitable local terms. The same idea was applied by Hammond *et al.*, (2014) who undertook the linguistic validation of the Evaluation of Daily Activity Questionnaire (EDAQ) for use in rheumatoid arthritis from the Swedish language to British-English. They made several changes in the forward translation, for example, for 'high' and 'low spirited.' As these terms are not in everyday use in British-English and they decided to replace them with 'happy' and

'unhappy', respectively (Hammond *et al.*, 2014).

Otherwise, there were minor changes regarding the use of appropriate nouns, words and expression as well as rearrangement of the questions in M-CFFQ and M-OHKAPQ. These were done for better understanding and, eventually, to increase content validity (Shinga-Ishihara *et al.*, 2014).

Face validity

Face validity of the M-CFFQ and M-OHKAPQ was achieved through pre-test and test-retest reliability. The main purpose of pre-testing was to determine whether all the items were comprehensive and acceptable. In this study, cognitive interview/debriefing approach was used to assess whether the concepts, questions and response alternatives were clearly conveyed to the participants by the questionnaires, as intended (Laaksonen, 2012). Generally, there were no serious difficulties encountered by the participants in understanding the words and sentences used in the M-CFFQ and M-OHKAPQ.

Minor amendments and modifications were done following the pre-test study. Some of the participants suggested that certain domains and items in M-CFFQ and M-OHKAPQ should provide a few examples or explanation for better understanding. This involved the items 'pastries', 'snack' and 'sugared milk' (*susu bergula*) in the M-CFFQ and the terms 'snack', 'main meal', 'enamel' and 'fruit drinks' in the M-OHKAPQ. This matter was successfully resolved by the expert committee by adding the examples as suggested by the participants. On other hand, some phrases that could potentially cause confusion were substituted with other terms with a similar meaning. These included 'a bag of sweets', replaced with '*sepeket atau sebungkus gula-gula*', 'a few now and the rest later' (*makan sedikit demi sedikit*), 'after meals' (*selepas makan*), and 'blob, the size of a pea' (*sekecil saiz kacang pis*).

Our undertaking of the face validity of M-CFFQ and M-OHKAPQ was in line with that of study of Hammond *et al.* (2014). They received recommendations from their cognitive debriefing participants that requested simplification of some part of the adapted questionnaire, combining items where possible and deleting uncommon items. There were also suggestions to add relevant items and to omit some inappropriate items which were not relevant to their target group. All changes were made through a consensus approach (Hammond *et al.*, 2014). The words and phrases used in M-CFFQ and M-OHKAPQ were carefully chosen to avoid any misunderstanding. Content validity was again obtained through post pre-test meeting of the experts to resolve the issues that were identified during the face validation process.

Test-retest reliability

Test-retest reliability of M-CFFQ and M-OHKAPQ were examined through ICC. The ICC value showed the degree of reproducibility of the questionnaires in repeated measurements. The high test-retest reliability could be attributed to the acceptable face and content validity of the translated questionnaire (Vyas *et al.*, 2016). It also indicated the questionnaires were stable, in terms of the ability to reproduce measures, assuming that variables that were to be tested did not change over time (Streiner, Norman & Cairney, 2014).

In our study, total ICC values of M-CFFQ and M-OHKAPQ showed excellent agreement between test and retest. The overall ICC value of M-CFFQ was 0.887 (95% CI; 0.788, 0.938). As for specific domains, values of ICC ranged from 0.608 (traditional delicacies) to 0.872 (sugared cereal). The total ICC value of M-OHKAPQ was 0.807 (95% CI; 0.680, 0.887). The ICC value for the Knowledge domain was 0.714 (95% CI; 0.542, 0.829), the Attitude domain was 0.858 (95% CI; 0.759, 0.918) and the

Practice domain was 0.876 (95% CI; 0.790, 0.928). The smaller ICC value was noted for the Knowledge domain was due to the lower agreement for the two occasions the questionnaire was administrated. It is possible that the first administration may have induced the participants to seek the right answers which then led to the changes of responses in the second administration.

CONCLUSION

The content validity and content face validity of the Bahasa Melayu version of CFFQ (M-CFFQ) and OHKAPQ (M-OHKAPQ) for parents of children aged 6-11 years old in Kota Bharu, Kelantan were satisfactorily established in the translation process. M-CFFQ and M-OHKAPQ also successfully achieved semantic, idiomatic, experiental and conceptual equivalences. They showed excellent results in test-retest reliability (ICC >0.800). Both M-CFFQ and M-OHKAPQ have been proven to be linguistically valid and reliable in this study.

This study was a first attempt to adapt the questionnaires from the original sources. Therefore, the findings could not be compared with any previous studies. Further studies on psychometric testing of M-CFFQ and M-OHKAPQ are suggested to assess other aspects of validity and reliability. The studies should be conducted in a larger Malaysian population with different ethnic variations and sociodemographic backgrounds. They could be improved with the establishment of a user's guide, which could include features such as the mode of administration, references, scoring and interpretation of the scores, to help future researchers using the questionnaires. The cariogenicity index and quantity measurement of the foods or drinks could be incorporated in M-CFFQ, to produce a more meaningful and valuable assessment for dental studies.

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Authors' contributions

RN, the principal investigator, conducted the study, data collection and data analysis and drafted the manuscript; RH, undertook data analysis, interpretation of data, assisted in drafting and review of the manuscript; NAR performed the data analysis and interpretation of data, and assisted in the drafting and review of the manuscript.

Conflict of interest

The study was internally funded. The authors declare no conflict of interest.

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Module development and its effectiveness for improving the competencies of voluntary health workers in communicating safe complementary feeding to caregivers in Indonesia

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ABSTRACT

Introduction: In Indonesia, most training modules for health paraprofessionals have been adapted from existing foreign modules without assessment. In addition, there have been few studies on training development for this group. We aimed to develop, using a systematic tool, implement and evaluate a training module to improve the competencies of voluntary health workers (cadres) in communicating safe complementary feeding practice to caregivers of young children in Indonesia. **Methods:** A mixed methods approach was used. A qualitative study employing in-depth interviews, focus group discussions, mini-workshops, documentary reviews and expert validation was used to develop the training module, following a systematic approach. The module's effectiveness for improving the health workers' competencies was evaluated using a quantitative study with a non-equivalent pre-test and post-test control group design that included 70 (intervention group) and 68 (comparison group) voluntary health workers from a peri-urban district. Changes in the workers' cognitive, affective and psychomotor competencies were tested before and after attending a 3-day training module (intervention group) or a half-day event (comparison group). **Results:** A 24-hour learning session module on communicating safe complementary feeding was developed and used to train voluntary health workers. After the training, a significantly higher proportion of workers in the intervention group than in the comparison group were assessed as competent in the psychomotor and composite domains (psychomotor: 67.1% vs. 20.6%; composite: 74.3% vs. 36.8%; $p<0.001$). **Conclusion:** This systematically developed module was effective in improving the competencies of voluntary health workers regarding communicating safe complementary feeding practice to caregivers in Indonesia.

Keywords: Competencies, complementary feeding, communication, training, voluntary health workers

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INTRODUCTION

The high prevalence of stunting (37.2%) among young children in Indonesia may be due to suboptimal breastfeeding and the poor quality of complementary feeding during the first six months of life (MOH Indonesia, 2013; WHO, 2009). Only 37% of children aged 6-23 months in Indonesia are fed in accordance with the WHO's recommendations for infant and young child feeding practices (MOH Indonesia, 2013). The practices followed by a child's caregiver contribute to the child's nutrient intake, health status and cognitive and psychosocial development. The resources available for care may influence the capacity of the caregivers to provide appropriate care (Engle, Menon & Hadad, 1997), including feeding. Poor hygienic practices and poor sanitation may lead to high exposure of children to unsafe food (MOH Indonesia, 2013). In addition, diarrhoea can lead to serious consequences for the growth and immune system of infants and children (Motarjemi, 2000), resulting in the child being underweight in about 61% of cases (Black, Morris & Bryce, 2003).

Community health centres (*Puskesmas*) in Indonesia use the existing social network of community Integrated Health Posts (*Posyandu*) to help increase the coverage of areas receiving health services, among other aims, with a view to reducing mother and infant mortality rates. Routine *Posyandu* activity includes monthly monitoring the growth of children aged under-five and promoting good care practices. The *Posyandu* are run by small trained groups, referred to as cadres, who comprise non-professional female voluntary health (cadres) workers from the community. As part of their monitoring and promotional activities, cadres are expected to communicate with as well as educate and inform caregivers about nutrition (Anwar *et al.*, 2010; Becker, 2004). However, studies have shown that most cadres in Indonesia (53%) have never received any training. Consequently, many of the workers have poor communication skills and poor skills in growth curve interpretation (Mudjianto *et al.*, 2003; Sukiarko, 2007). It is crucial that cadres have the basic knowledge and skills that enable them to provide appropriate advice and counselling to caregivers.

Communication has been identified as the most essential factor for effective primary healthcare teams (Sargeant, Loney & Murphy, 2008), especially for the promotion of good nutritional practices and dietary changes (Pelto *et al.*, 2004; Bhandari *et al.*, 2004; Bassichetto & Rea, 2008). Studies among health professionals, physicians and caregivers have shown that improving the communication skills of the health professionals contributes to positive behavioural changes among caregivers.

However, most training modules for local voluntary health workers have been adapted and translated from the existing modules that were prepared in developed or rich countries. They are not always effective in improving the competencies of the targeted participants. Furthermore, there has been limited investigation into the development of such training modules based on the application of systematic, scientific tools. One such approach that had previously been applied to education programmes is Kemp's model, an instructional design model that was developed by Morrison, Ross & Kemp (2004). The model comprises nine interrelated elements (Figure 1); most of these are depicted in an oval arrangement to indicate that the design and development process is a continuous cycle that requires constant planning, design, development and assessment to ensure effective instruction. The model has been applied to various educational programmes, including those for nursing and technology (Kemp & Rodriguez, 1992; Summerville & Reid-Griffin, 2008), but its use for nutritional education and

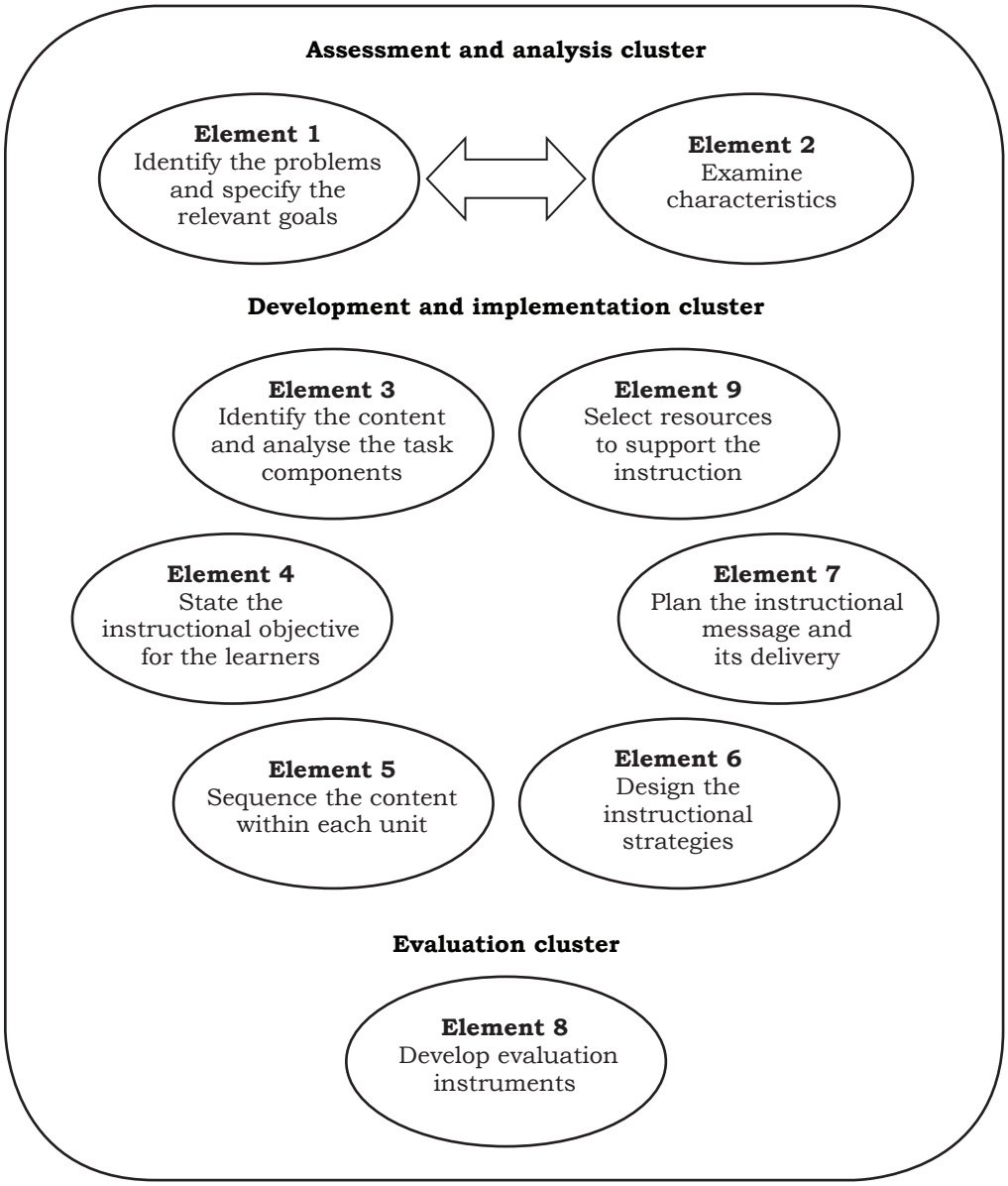

Figure 1. Elements of Kemp's model used for the development of the training module

for training paraprofessionals is limited, particularly in Indonesia.

The aim of this study was to develop, implement and evaluate a training module to improve the competencies of voluntary health workers (cadres) in communicating safe complementary feeding practice to caregivers of young children in Indonesia. Kemp's model was used to facilitate the development process.

MATERIALS AND METHODS

Study design and location

The study involved two phases: phase one was the development of the training

module using Kemp's model and phase two was the implementation of the training using the developed module, which was evaluated using intervention (attended a 3-day training) and comparison groups (attended a half day event). A mixed methods approach was adopted, with a qualitative analysis of the interview material that was obtained during phase one and a quantitative assessment of the results of the phase two evaluation. The study took place in Bekasi District, Indonesia, which is about 20 km from Jakarta. This study was conducted with approval from the Human Ethics Committee of the Faculty of Medicine of Universitas Indonesia. All participants were informed about the purpose of the study and gave their written consent for voluntary participation.

Phase one: Training module development

According to Kemp's model, each element of the training programme development process (Figure 1) should be considered independently but iteratively. The elements required different methods of gathering information, such as literature reviews, discussions with three relevant experts, focus group discussions (FGDs) with cadres (four times), caregivers (twice), mini workshop with health office staff (once), and in-depth interviews (IDIs) with district health staff (11 times) (Table1). The FGDs or IDIs were discontinued when the researcher did not obtain anymore new issues. The respondents representing government workers were staff of the Bekasi Regional Health Office and its associated community health centres. The respondents representing the community were cadre workers and caregivers of children aged 0–23 months in the North Bekasi sub-district. The study also recruited several experts from various backgrounds, including nutritionists, communication specialists, educational technologists and a media designer who designed the communication media or learning materials.

The training module involved various instruments, including slides, videos, brochures, posters, booklets and questionnaires. These were pretested on suitable respondents, such as caregivers, cadre workers and health staff, from different areas with similar community characteristics. The local health polytechnic, health centres, health research and development centre and the Nutrition Directorate of the Ministry of Health (MOH) were approached to identify potential trainers, who were then recruited on the basis of their curriculum vitae and an interview. Eleven potential trainers were invited to participate in the training of the trainers (ToT) programme and underwent further assessments.

The final draft of the training module with all the training instruments was sent for validation to three external reviewers: a senior nutritionist, an educational technologist and a certified national trainer. The reviewers validated the module according to a list of criteria that was developed by the health human resource section of the MOH, which included the sequence and appropriateness of the chosen topics, conformity between the topics and objectives, the clarity and accuracy of the information, the consistency of terminology, time allotment, the appropriateness of the chosen method and the appropriateness of the chosen instruments. The training module was revised according to the reviewers' comments. It was then used for the ToT, which was delivered by four facilitators and overseen by one external evaluator. As well as allowing the trainers to practise and gain mastery of the training content, this activity served as a formative evaluation of the module. The ToT programme lasted five days, with all 11 potential trainers taking part. The external evaluator assessed the whole

training process. The potential trainers attained a score >70% for their training mastery and were considered qualified as trainers.

Quality control

Suitably experienced personnel were recruited and trained to act as FGD moderators, in-depth interviewers, observers and note-takers and technicians for video- or audio-recording. The experts invited to assist in training module development were required to have at least ten years of experience in their field. These experts were nutritionists, communication specialists, education technologists and a certified national trainer. The training facilitators were national master trainers in nutrition and health with at least five years' experience.

Several manuals were developed to ensure that the data and information collection procedures were standardised. The instruments for the FGDs and IDIs were pretested prior to use. Logbooks and photos were prepared to record progress with each step of the study. In addition, pictures and videos were taken and filed (Smith & Ragan, 2005).

Data analysis

Audiotapes of all of the interviews, including the FGDs, IDIs and unstructured interviews, were transcribed verbatim. The transcripts were read repeatedly by a single researcher and then analysed systematically according to content analysis procedures by coding responses and identifying common themes. A matrix was constructed of the themes and notable quotations for each interview question.

Phase two: Implementation of training

The second phase of the study was carried out in two selected sub-districts that were located about 30 km from each other: Bekasi Timur (for the intervention group) and Pondok Gede (for the comparison group). These sub-districts were comparable in terms of the prevalence of underweight children, number of cadres and coverage of *Posyandu* activity (Linn & Gronlund, 1995).

Sample size and enrolment

The implementation was evaluated using a pre–post design with a comparison group (Lemenshow *et al.*, 1993). The required sample size was calculated to be 70 cadre workers for each group to achieve a confidence level of 95%, power of 80%, anticipated proportions of cadre workers competent in communicating safe complementary feeding of 20% before the intervention and 60% after the intervention (Mudjianto *et al.*, 2003), a design effect of 1.5 and an expected 10% loss to follow-up. The inclusion criteria for cadre workers were age 25–60 years, senior high school graduates and willingness to be followed-up for endline assessment.

Seventy cadres were randomly selected and enrolled, out of the 147 eligible cadre from the 35 *Posyandu* in the intervention area. Seventy-one cadres were randomly selected and enrolled out of the 147 eligible workers from the 36 *Posyandu* in the comparison area. However, three of the latter were unable to attend the seminar because of illness or family matters, leaving a total of 68 participants in the comparison group.

Training

The training module was delivered in two training formats, a 3-day training course for the intervention group and a half-day seminar for the comparison group. The 3-day courses were presented in three batches, each with 22–25 participants. Each session was facilitated by one instructor and one or two assistants; in total, nine trained instructors delivered the training. The class environment was carefully prepared to ensure a conducive

learning atmosphere. The half-day seminar for the comparison group was delivered once by four trained instructors, with all 68 participants in attendance. It was held in a multi-purpose room of the village office, according to the existing practice of the study area.

Competency assessment

The cognitive and affective competencies of the participants were assessed 2-4 weeks before they attended the training or seminar (baseline) and again after it (endline), using pretested, structured questionnaires administered by trained evaluators. Communication sessions with caregivers were also arranged to assess each participant's psychomotor competency. It was video-recorded, and the recordings were viewed independently by two trained evaluators, who assessed the participant's psychomotor competency according to a pretested structured checklist. The evaluators received prior training from the communication specialist, and the video recordings were coded using a double-blind randomised method in which the researcher and the two evaluators were unaware of whether the recordings were acquired during the endline assessments, for both the intervention and comparison group.

Quality control

The collected competency assessment data were peer-reviewed by trained evaluators and regularly checked by field coordinators for correctness of coding, completeness, clarity and consistency of the information. The field coordinator then re-interviewed 10% of the entire sample. The assignments of the evaluators were rotated according to the type of group and time (baseline/ endline) of the assessment (Smith & Ragan, 2005).

To ensure content validity, the content of the structured questionnaires and observation checklists was carefully prepared, and verified by experts. Face validity was checked by pre-testing the instruments to ensure their clarity and acceptability by both the evaluators and the respondents. Cronbach's alpha coefficients for the cognitive and affective components were 0.791 and 0.900, respectively. A logbook was used to record the conduct of the try-out training. Pre- and post-tests were employed to assess learning achievement during training for cadres or trainers.

Data analysis

In the cognitive competencies instrument which comprised 27 items, each correct answer was scored 1 point. In the affective competencies instrument which comprised 14 items, each statement was answered as 'strongly agree' (4 points), 'agree' (3 points), 'neither agree nor disagree' (2 points), 'disagree' (1 point) and 'strongly disagree' (0 points). In the psychomotor instrument, each of the ten items was scored as 0 points for no performance or an incorrect performance, 1 for an irregular performance and 2 for a correct and complete performance, with the results from the two evaluators added together. Each type of competency was assessed as the participant's total score as a percentage of the total possible score. The participant's total scores for each type of competency were combined into a composite score by applying weightings of 30% each for the cognitive and affective competencies and 40% for the psychomotor competencies. Participants whose composite scores exceeded a cut-off point of 70% were considered to have mastered the competencies (Azhar, 2010).

Data from the questionnaires were analysed using SPSS for Windows version 16.0 after randomly rechecking 10% of the entered data for errors against the completed questionnaires. The data distributions were checked for normality using the Kolmogorov–Smirnov test. Differences between and within the intervention and comparison

groups in the scores for each competency were tested using independent *t*-tests and McNemar's test respectively with a significance level of 5%. Differences between the two groups in the proportion of participants considered competent in each competency category were tested using Fisher's exact test with a significance level of 5%. Further analysis using multivariate logistic regression was performed to assess the association between each type of competency and other potential personal factors, including the participants' ages, experience, education level, household monthly income, other nutrition training received and competency at baseline.

RESULTS

Phase one: Module development

Initially, while developing the training module, the researcher used the nine elements of Kemp's instructional model (Figure 1) in sequence. However, to ensure content conformity and completeness, almost all of the elements were revisited two or three times. Table 1 summarises the results related to each element of Kemp's model.

The FGDs revealed that the young children in the study area were frequently exposed to chemical hazards from street-vendor foods (which relates to Element 1 of Kemp's model, 'Identify the problems and specify the relevant goals'). Items on the nature of chemical contamination and the impact of chemical hazards on children's health were therefore added to the training materials (Element 4, 'State the instructional objective for the learners'). In addition, further in-depth interviews with local health staff were conducted to redefine the topic priorities (Element 1).

The initial draft module contained material for a 5-day course. While assessing this draft (Element 4), the researcher reviewed existing problems (Element 1) and characteristics of the cadres (Element 2, 'Examine characteristics'). Because of the limited time available to the cadre workers and trainers, the researcher decided to reshape the training into a 3-day course, while taking into consideration the required competencies (Element 3, 'Identify the content and analyse the task components').

The results of the interviews and discussions with health staff and cadre workers showed that they were aware of the problems that exist regarding nutrition and of the underlying factors that can lead to under-nutrition among young children in their areas (Element 1). Given the characteristics, preferences and challenges of the cadre workers, such as their work overload, management responsibilities, their age (the majority were aged 40–50 years) and their preference for listening to the material rather than reading it, it was decided that the format of the training should be interactive and use adult learning methods (Elements 2 and 3). The training included learning objectives in the cognitive, affective and psychomotor domains. These were formulated to meet the following criteria: (a) the cadre workers would understand the basic concept, principles and facts regarding safe complementary feeding and the communication of this; (b) they would be able to analyse existing feeding practices and to compare them with other relevant practices or evaluate them using guidelines provided in the training; (c) they would be aware about the problems in their community and willing to respond to these by providing information to caregivers and (d) they would be able to apply the theory of safe complementary feeding and to implement the communication steps correctly.

Hence, the instructional objectives for the cadre workers (Element 4) were that they should be able to communicate with caregivers and advise them consistently on implementing correct and safe complementary feeding practices. The 'What are?' content of the

Table 1. Outputs during training module development following Kemp's model elements

Kemp's model elements	*Resource materials/ sources of information*	*Methods*	*Results*
1. Identifying existing problems	Cadre workers, regional health staff, health centre staff	Mini-workshop, FGDs, in-depth interviews, documentary review	The targets/participants: • were aware of and understood that poor care and complementary feeding practices among caregivers were the causes of young children being underweight in their area. • realised that the food safety issue was commonly one of poor feeding practice among caregivers. • understood that training in chemical hazards in complementary feeding was needed but was rarely received by the cadres. • understood that the way they communicated with caregivers was crucial and that communication skills were necessary to support the cadre workers' performance.
2. Examining characteristics of the cadres	Cadre workers, regional health staff, health centre staff	Mini-workshop, FGD, in-depth interview	• Most cadre workers had extensive work experience; most were housewives over 40 years of age, had many tasks and actively participated in various social activities in the community. • The motivation for joining a cadre was to gain knowledge, experience and personal development. They worked in the *Posyandu* voluntarily and were delighted to receive positive support from their families and community. • Cadre workers were not able to leave their daily duties for a long period; they preferred to listen to training materials rather than read them.
3. Identifying subject content and analysing task components	Information obtained from the previous elements, scientific references, health centre staff	Documentary review, in-depth interview	Eight topics were defined: (1) Introduction to the training (building learning commitment); (2) The role of cadres and the function of a child growth chart; (3) Complementary feeding and child growth; (4) Food to fulfil the energy, iron and vitamin A needs of children; (5) The safety of complementary feeding and sources of contamination and their impact on children's health and nutritional status; (6) Complementary feeding practices; (7) Feeding practices during illness and recovery; (8) Communication about safe complementary feeding to caregivers

Kemp's model elements	*Resource materials/ sources of information*	*Methods*	*Results*
4. Developing instructional objectives	Information obtained from the previous elements, manuals, guidelines, scientific references, input from cadres, health staff and experts	Documentary review, experts' review	• General and specific objectives of the training were defined. • Detailed specific objectives were developed for each topic and session. • Learning objectives were defined for the training covering: cognitive competencies (knowledge, comprehension, application); affective competencies (receiving, responding, valuing); and psychomotor competencies (perception, set, guided response)
5. Sequencing subject content	Information obtained from the previous elements, manuals, guidelines, scientific references, inputs from experts	Documentary review, experts' review	• The training begins with a building learning commitment session to improve awareness and commitment to the training. • The sequence of contents starts from the basic concept of the cadre worker's role, includes the principal concepts of complementary feeding, food safety and feeding practices and ends with the training about communication. • The 'what are' content was discussed in topics 2 to 7 and the 'how to' content of communication skills in topic 8.
6. Designing the instructional strategy	Information obtained from the previous elements, manuals, guidelines, scientific references, input from caregivers, cadre workers and experts	FGDs, in-depth interviews, documentary review, experts' review, personal discussion	• The classroom learning process was defined, with the following training materials to support effective activities: trainers' handbook, participants' handbook, workbook, booklet and take-home brochure. • Multimedia training tools for delivering interactive instructions were slides, posters, four videos on compact discs, take-home brochures, manual guidelines and role-play cards.

Kemp's model elements	*Resource materials/ sources of information*	*Methods*	*Results*
7. Developing training delivery	Information obtained from the previous elements, manuals, guidelines, scientific references, input from experts	FGDs, in-depth interviews, documentary review, experts' review, personal discussion	• Detailed messages and instruction contents were developed. • Various instruction delivery modes were determined, including brainstorming, interactive discussion, watching videos, group work, presentations, demonstration, role play, individual practice sessions and field practice. • The split between lectures and practice was set as 38% and 62%, respectively. • Five-day training of trainers and three-day training for cadre workers were developed.
8. Developing evaluation instruments	Manuals, guidelines, scientific references, input from experts	Documentary review, experts' review	• Revised versions of the training materials, module contents, training instructions, pre- and post-test instruments were obtained as a result of the formative evaluation activities. • Summative evaluation multiple-choice instruments covering cognitive competencies (27 items), affective competencies (14 items) and psychomotor competencies (10 items).
9. Selecting resources to support learning activities	Curriculum vitae, scientific references, input from experts	Documentary review,interview, visit, micro-teaching	• Facilitators and trainers with appropriate expertise, interests and relevant responsibilities were recruited from training and education centres, the Ministry of Health, municipal health offices and health centres.

training module was discussed in topics 2–7, followed by the 'How to' content about communication skills in topic 8 (Element 5, 'Sequence the content within each unit'). The training was intended to be a classroom learning process, so it was decided that training materials should be developed in addition to the training instruments to support effective learning activities using adult-learning principles (Element 6, 'Design the instructional strategies'). The training used various delivery methods, including lectures, brainstorming, role-play, presentations, demonstrations, problem-solving exercises, watching videos and practice (Element 7, 'Plan the instructional message and its delivery'). Summative evaluation was performed to assess the achievement of competencies and formative evaluation to maintain the reliability of the training development process (Element 8, 'Develop evaluation instruments'). Eleven regional health office and community health centre staff with responsibilities in nutrition and health promotion programmes were selected as the trainers, and four national master trainers in communication and/or nutrition were recruited as the facilitators of ToT (Element 9, 'Select resources to support the instruction').

An expert panel validated the accuracy of the following aspects of the training module: the sequence and appropriateness of the chosen topics; conformity of the topics to the objectives; the clarity and accuracy of the information; the consistency of terminology; the time allotment to each activities within the module; the appropriateness of the chosen methods and the appropriateness of the chosen instruments. An external educational expert performed the training validation during the ToT process by, evaluating the implementation of the use of structured and unstructured evaluation guidelines. The purpose of the ToT was to produce trained instructors with the optimum level of knowledge and mastery to deliver the training module in a consistent way and to verify the consistency between the learning process and the developed module.

Phase two: Training implementation

In general, the characteristics of the participants were similar in the two groups (Table 2). Most of the participants were housewives with a household monthly expenditure above the minimum wage rate. The median times spent as the cadres workers by

Table 2. Characteristics of the participants

Variables	*Intervention group (N=70)*	*Comparison group (N=68)*	*p-value*
Age (year), *Mean±SD*	47.7±5.8	42.9±8.0	0.006*
Education (%)			
10–12 years (high school)	88.6	77.9	0.074
≥13–15 years (diploma and university)	11.4	22.1	
Time spent as cadres (years)			
Range	1–24	1–23	0.321
Median	8.0	5.0	
Previous training in nutrition (%)	38.6	50.0	0.230
Monthly expenditure			
>IDR† 1,275,000 (%)	90.0	95.6	0.326
Occupation (%)			
Housewife	88.6	82.4	0.282
Others (vendor, entrepreneur)	11.4	17.6	

†1 US$ = 9600 IDR

*Significant at $p<0.05$ using independent samples *t*-test

Table 3. Proportion of the participants in the intervention and comparison groups assessed as competent for each competency type and overall

Competencies	*Intervention group, N=70 (n) %*	*Comparison group, N=68 (n) %*	*p-value between groups*‡
A. Cognitive			
Baseline	(29) 41.4	(27) 38.2	0.417
Endline	(53) 75.7	(49) 70.6	0.313
p-value within group†	<0.001**	<0.001**	
B. Affective			
Baseline	(34) 48.6	(28) 39.7	0.190
Endline	(43) 61.4	(30) 42.6	0.021*
p-value within group†	<0.001**	<0.001**	
C. Psychomotor†			
Baseline	(0) 0	(0) 0	-
Endline	(47) 67.1	(14) 20.6	<0.001**
p-value within group	-	-	
D. Composite (30%A+30%B+40%C)			
Baseline	(8) 11.4	(4) 5.9	0.197
Endline	(52) 74.3	(26) 36.8	<0.001**
p-value within group†	<0.001**	<0.001**	

†*p*-value within the groups using McNemar's test, at a significance level of 5%
‡*p*-value between the groups using Fisher's exact test, at a significance level of 5%
*significant, $p<0.05$
**significant, $p<0.001$

the participants in the intervention and comparison groups were eight and five years, respectively. The participants in the intervention group were significantly older than those in the comparison group.

Table 3 summarises the proportions of the participants in the intervention and comparison groups who were assessed as competent for each competency type and overall. In both groups, the proportion of participants assessed as competent in the cognitive competencies at endline increased significantly compared to baseline, but with no significant difference between the groups. For the affective competencies, a similar proportion of participants in both groups were assessed as competent at baseline, but a significantly higher proportion of the intervention group than the comparison group were assessed as competent at endline ($p=0.021$). The psychomotor competencies were not assessed at baseline. At endline, the proportion of participants who were assessed as competent in the psychomotor competencies was significantly higher in the intervention group than in the comparison group (67.1% vs. 20.6%; $p<0.001$). The proportion of participants with overall competence, as assessed by the composite score, increased in both groups, but the intervention group had a significantly higher proportion than the comparison group (74.3% vs. 36.8%; $p<0001$).

Table 4 summarises the results of the multivariate analysis. The intervention was the only variable that significantly influenced the changes in psychomotor and composite competencies, with odds ratios of 9.13 (95% CI: 3.20–26.02) for the

Table 4. Multivariate analysis of factors that potentially influenced the proportions of participants assessed as competent at endline (*N*=138)

	Cognitive			*Affective*			*Psychomotor*			*Composite*		
Variables	*OR*	*95% CI*	*p-value*	*OR*	*95% CI*	*p-value*	*OR*	*95% CI*	*p-value*	*OR*	*95% CI*	*p-value*
Age	1.70	0.61-4.78	0.310	0.84	0.37-1.91	0.674	1.22	0.49-3.01	0.672	0.48	0.20-1.14	0.095
Years of experience	1.04	0.36-3.04	0.944	0.44	0.18-1.09	0.075	0.48	0.17-1.34	0.160	0.94	0.39-2.29	0.891
Education	1.21	0.33-4.45	0.775	0.77	0.27-2.16	0.614	0.46	0.14-1.45	0.190	0.92	0.31-2.71	0.875
Previous nutrition training	1.17	0.42-3.27	0.764	1.27	0.55-2.95	0.572	1.92	0.75-4.92	0.175	1.24	0.54-2.85	0.614
Income	1.60	0.35-7.45	0.546	0.89	0.21-3.90	0.882	0.64	0.13-3.26	0.595	0.67	0.16-2.75	0.580
Intervention/ comparison	0.50	0.17-1.42	0.190	0.64	0. 28-1.49	0.305	9.13	3.20-26.02	<0.001**	6.93	2.82-17.02	<0.001**
Competency at baseline	0.35	0.13-0.94	0.036*	0.15	0.07-0.34	<0.001**	0.35	0.09-1.36	0.130	8.02	0.95-67.78	0.056

Covariates: competence at baseline; age ≤45 years; service period in the cadre>5 years; previous nutrition training; education>12 years; income>IDR 1,275,000 (the regional minimum wage rate, approximately equivalent to USD 127).
OR, odds ratio; *CI*, confidence interval
*significant at $p<0.05$
**significant at $p<0.001$

psychomotor competencies (p<0.001) and 6.93 (95% CI: 2.82–17.02) for being assessed as competent according to the composite score (p<0.001).

DISCUSSION

This study showed that the development of a training module requires considerable and thorough work with solid teamwork (Smith & Ragan 2005). Designing a new instructional module is not simple. While developing the module in this study, each element was carefully reviewed in order to obtain relevant and consistent instruction with logical flow. The development and revision of the elements of the Kemp model was iterative because all were interrelated and described a continuous process. The team members including the media designers and printers who were involved in producing videos, booklets, posters, brochures and other instruments. The recruitment of the facilitators and trainers was undertaken with care to ensure that they were effective and committed. Tests and retests of individual targets or groups were performed to assess the accuracy, clarity and consistency of the materials. Expert reviews were conducted to assess the congruence of the instruction materials with the identified learning objectives. The development of this training module required adequate time, a good record-keeping system and a team with various experts. The instructional module designer should also consider the cost of the production of training materials and tools (Smith & Ragan, 2005).

The content and face validities of the instruments were established through intensive discussions with related experts and re-testing with different target groups. Valid and reliable instruments are crucial to ensure the reproducibility of a study as well as to judge the effectiveness of the training (Smith & Ragan, 2005; Linn & Gronlund, 1995; Brown, 2007). The Cronbach's alpha coefficients of the cognitive competencies, affective competencies and caregiver questionnaires were high (0.791, 0.900 and 0.866, respectively), showing good reliability of these instruments (Portney & Watkins, 2009). The self-administered questionnaires for cognitive and affective competencies were tested on cadre workers to gain insight into the questions and to reduce the bias of the evaluators. The respective evaluators closely supervised the process.

A previous study on communication training for midwives demonstrated that self-assessment was a reliable measure for evaluating their skills (Basuki, 2003). In the present study, the assessment results confirmed that the instruments had high reliability in terms of measuring the motivations and self-efficacy of the cadres. However, indirect observation by a trained evaluator sometime after the implementation of training can provide a more reliable method for assessing retention of the learning (Linn & Gronlund, 1995).

Cognitive competencies

The statistical analysis showed that no personal factors (other than the initial level of competence) influenced the cognitive competencies of the participants. Most of the participants had extensive experience as cadres and had received some prior training in nutrition, as a result of which the baseline knowledge scores of the participants were quite high. Even though the cognitive competencies in both groups improved significantly, the final scores and number of participants assessed as competent were slightly higher in the intervention group than in the comparison group that received only a seminar. The change in the competencies scores among the training group was considered high: 18.5 and 19.5 points, respectively, during the training (pre–post-test) and two to four

weeks after the intervention period (baseline–endline)(data not shown).

The improvement in the recall and comprehension levels of the participants after attending the seminar was not significantly different from those of their counterparts in the comparison group. This shows that information dissemination via seminars is a good way to enhance the lowest level of cognitive competency. It also suggests that the slides, video, booklets and posters that were used in the seminar were clear, consistent and efficient in terms of enabling knowledge acquisition, particularly at the lowest levels, such as for knowledge/recall and comprehension.

The seven learning issues in which the participants had the lowest score at the beginning of the study but the highest achievement score after the training were as follows: (1) the correct combination of age, type and frequency of complementary feeding; (2) the portion sizes for complementary feeding; (3) the benefit for children of food with a thick consistency; (4) the optimal temperature range for microbial pathogen growth; (5) the symptoms of children with foodborne illnesses; (6) the definition and examples of open-ended questions and (7) the correct body language during communication. Coverage of these issues should be mandatory in any training curricula.

Affective competencies

The proportion of participants who were assessed as competent in the affective competencies was significantly higher among those who received the training compared with their counterparts, perhaps because the training allowed them to share their experiences and learn how their colleagues solved problems (Coon, 2006; Bourgeois *et al.*, 2004). They shared their experience regarding complementary feeding, feeding practices, the risk of unsafe food and communication issues, and they learned how to deal with difficult situations, raising their awareness of problems that exist in their communities. The case studies on child growth monitoring, complementary feeding, critical hygiene practices and communication practice during training influenced the motivation and risk perception of the participants. Frequent and intensive exposure through multimedia might have further increased the confidence and motivation of the participants (Gregory & Chapman, 2007; Coon, 2006).

The enjoyable training environment, resourceful trainers and well-organised training and materials resulted in the participants responding positively to the learning process. They also met their colleagues, which motivated them to learn and share with each other (Linn & Gronlund, 1995; Coon, 2006; Gregory & Chapman, 2007). By the end of the training, they acknowledged that all the topics were useful and easy to understand. They were grateful for the knowledge and skills they had been given and indicated their desire to share the information with other colleagues as well as implement it within their *posyandu*. It was clear that implementation of this training module produced a conducive learning environment, as well as effective methods and instruments, which influenced the effectiveness of the training (Smith & Ragan, 2005). However, there was no opportunity for the comparison group participants who attended the seminar to share and discuss the topics that were presented during the sessions. Most of the activities covered in the seminar were lectures, with limited discussion. As a result, the participants had no opportunity to internalise the material properly and this was confirmed by the lack of significant improvement in their affective competencies. The comparison group participants were advised to learn from the materials that were provided

before implementation. However, the intensity of their implementation would depend on their readiness to do so.

Psychomotor competencies

The psychomotor competencies of the participants in communicating safe complementary feeding improved with training. The communication practice sessions during the class gave them opportunities to apply their skills. Practice in the field by visiting the homes of caregivers gave the participants experience in a real-life setting. The participants were used to dealing with a wide range of problems related to complementary feeding in the community (Coon, 2006). Repeated watching of a video increased their opportunity to learn the appropriate gestures, capture the appropriate expressions and improve their understanding of the principles of non-verbal communication (Gregory & Chapman, 2007).

Overall competence in communicating about safe complementary feeding

Any practice that an individual performs consistently and repeatedly becomes closely related to their character. Character comprises three interrelated parts, namely moral knowing, moral feeling and moral behaviour. These parts do not function independently but interrelate and influence each other in a variety of ways. The cognitive and affective competencies of the participants were reflected in their psychomotor competencies as well as in their composite scores. The psychomotor and composite scores of the participants in the intervention group significantly improved after the training. In addition, the increase in the cognitive competencies scores of the intervention participants was quite high, at 14.2, although not significantly different from that in the comparison group. The overall competence of the participants in communicating information about safe complementary feeding was indicated by the composite scores that were based on the cognitive, affective and psychomotor competency scores. Change in the competencies of the participants in the cognitive domain will influence their attitudes and so would be reflected in their behaviour (Lickona, 1992).

To turn competencies in communication into a behaviour or habit requires follow-up training to refresh them. A study using pre- and post- surveys on communication skills training for nurses of elderly people with dementia showed that their skills could be maintained for more than three months, with a high level of performance maintained for up to 22 weeks after the training (Bourgeois *et al.*, 2004). However, communication skills can decrease over a 6-month period, with a loss of the improvement in the skills after 12 months (Ripich, Ziol & Lee, 1998).

CONCLUSION

This study used systematic and scientific methods to develop a training module for voluntary health workers to improve their communication of safe complementary feeding to caregivers of young children. A detailed evaluation demonstrated that the developed training module was effective in improving the competencies of those who attended the training.

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Authors' contributions

IDN, principal investigator, conceptualised and designed the study, conducted data collection, analysis and interpretation, and prepared the draft of the manuscript; MS, conceptualised and designed the study, read and reviewed the manuscript; BE; conceptualised and designed the study, read and reviewed the manuscript; HA, conceptualised and designed the study.

Conflict of interest

The authors declare that they have no conflicts of interest. The study was supported by Nestle Foundation, which had no role in the design, analysis or writing of this article.

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Breastfeeding knowledge among indigenous Temiar women: a qualitative study

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ABSTRACT

Introduction: The benefits of breastfeeding for both mothers and infants are widely recognised. Breastfeeding confirms a woman's unique ability to care for her infant in the best way possible and promotes optimum infant and maternal health. **Methods:** A qualitative research method involving five focus group discussions (*n*=33) was chosen in this study to compare and contrast the breastfeeding practice in two different locations: the communities of Pos Pulat and the regroupment scheme settlement at *Rancangan Pengumpulan Semula* (RPS) Kuala Betis in Kelantan, Malaysia which represents different lifestyle experiences of indigenous Temiar population. **Results:** The benefits of breastfeeding to the infants reported by some Temiar women (42.4%) were for the infant's health and growth. Responses from urban RPS Kuala Betis women include breast milk contains antibodies (3.0%), delays in the return of regular ovulation (6.1%), thus lengthening birth intervals and bonding between maternal-baby (6.1%). In general, respondents from Pos Pulat seemed to have little knowledge regarding this issue, except for a woman who mentioned that maternal milk contains vitamins. Based on the narrative analysis, knowledge gap was observed between these two communities. **Conclusion:** Although all the women interviewed had the experience of breastfeeding their infants, most of them lacked the knowledge regarding the benefits of the breastfeeding either to the infants or to the mothers. The findings from this study are crucial for the preservation of breastfeeding culture among the Temiar women and can be used to improve promotion of breastfeeding to other Orang Asli groups in Malaysia.

Keywords: Breastfeeding, knowledge, health, indigenous, qualitative

INTRODUCTION

The Malay term Orang Asli that translates as "original people" or "first people" is the term given to indigenous people (Masron, Masami & Ismail, 2013). Anthropologists, economists and planners describe the livelihoods of these indigenous peoples as "poor and marginalised minority groups" (Habibah, Hamzah & Mushrifah 2010) because they exist on the fringes of highly developed areas. The Orang Asli is generally classified under three main groups: Negrito, Senoi and Proto Malay, with each group comprising six sub-groups with ethno-linguistic differences. The Temiar is one of the sub-ethnic groups of the Senoi people that can be found in the highest interior mountains

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and at the headwaters of various rivers with limited access to civilisation (Domhoff, 2003). Nowadays, although most still live a traditional life, others have moved out of the forest to settle in more accessible locales. Some live in villages while others have migrated to towns and cities. They live by various combinations of swidden farming ('slash and burn' agriculture and crop rotation), hunting, gathering, fishing, and trading forest products. More recently, some men have started to undertake waged employment as day labourers. A few have successfully become lawyers, teachers, doctors or government employees.

The World Health Organization (WHO) recommends that all infants be exclusively breastfed from birth until six months of age and it be continued until two years of age or longer along with complementary foods (WHO, 2001). In the first six months of life breast milk should be an infant's sole and optimal source of nutrition as it is superior to all supplementations. The International Convention on the Rights of the Child 1990 endorsed by the United Nations, in Article 24, has recognised breastfeeding as one of the child's right (United Nation, 1990). Breastfeeding within the first one hour of life has been shown to reduce neonatal mortality by almost 22% (Edmond *et al.*, 2006; Debes *et al.*, 2013; NEOVITA Study Group, 2016).

A systematic review by Victora *et al.* (2016) indicates that there are no differences between rich and poor mothers in exclusive breastfeeding rates, in low and middle-income countries. They suggested that this was because rich mothers are adopting exclusive breastfeeding at a much faster rate than are poor mothers, although only 20 years ago, the poorer mothers had substantially higher rates of exclusive breastfeeding. Continued breastfeeding is still more common in poor than in wealthy mothers, but the rates seem to be dropping among the former while remaining stable in rich mothers. The protection of breastfeeding in the world's poorest populations is therefore a major priority. They also emphasised the importance of breastfeeding for all women and children, irrespective of their economic background.

As most mothers are able to breastfeed, they should be provided with accurate information and support from their families, communities, and healthcare providers. Currently, only limited data is available on the breastfeeding practices among the Orang Asli Senoi, and particularly for the Temiar sub-group. An earlier study conducted among 189 Semai women (other sub-ethnics of Senoi) found that the mean breastfeeding duration was up to 23 months (Khor, 1985). A study done a decade later found that although 95% of Semai women had breastfed their infants, the average duration was found to be reduced to 17.9 months (Osman & Zaleha, 1995). Similar study conducted on another Senoi sub-ethnic (the Mah Meri group) revealed that the mean period of breastfeeding was calculated to be around 11 months, although all the mothers in the study had started lactation within one hour of delivery (Wan Norlida *et al.*, 2007).

Many studies have utilised quantitative methods such as knowledge, attitude and perception questionnaires to gain information on breastfeeding. However, in recent years, the use of qualitative methods such as interviews and focus group discussions has gained recognition in providing a better understanding of the feelings of individuals, their perceptions and misconceptions regarding breastfeeding information and issues (Tengku Alina *et al.*, 2012). Furthermore, underlying beliefs are better captured through this type of qualitative studies (Rashidian, Eccles & Russell, 2008). In view of

this, this study aimed to investigate the knowledge among Temiar mothers regarding the breastfeeding practices in their cultural context.

MATERIALS AND METHODS

This was an exploratory investigation conducted in 2015, using qualitative methods via five focus group discussions. The two different locations chosen for this project represented the different lifestyle experiences and practices of the Temiar. The communities of Pos Pulat in Kelantan (a state that is located in the north-east of Peninsular Malaysia) represent the experiences of Temiar who live in the forest or close to it, approximately 2 km away. On the contrary, the communities in the Rancangan Pengumpulan Semula (RPS) regroupment settlement scheme, located in Kuala Betis in Gua Musang, Kelantan, represented those in transition from forest to urban living.

The participants in the project were women in the various households who were responsible for feeding the infants. An appropriate sample size for a qualitative study is one that adequately answers the research question. In practice, the number of required subjects usually becomes obvious as the study progresses, as new categories, themes or explanations stop emerging from the data (i.e. having achieved data saturation) (Marshall 1996).

In each location, participants were identified using a snowball approach. This sampling technique was chosen by taking into consideration the shyness and sensitivity of indigenous people. The Temiar were best approached by people that they already knew or familiar with rather than by outsiders or strangers. First, the local staff of the Department of Orang Asli Development (JAKOA) and *Tok Batin* were contacted. The researcher explained the research project to the contact person and asked to identify potential participants. Each contact person was a local person who was active within or had connections to the Temiar community in that location. They knew of the best means to approach the target population and of any possible obstacles that might occur. The inclusion criteria were women of any age group who had breastfed a child in each location. Those who willingly consented to the study were enrolled and the times for focus group discussions were arranged.

Focus group discussion was selected as a suitable method for this project in order to gain in-depth understanding on a specific topic of interest (Nyumba *et al.*, 2018). In this instance, focus group discussions helped to reveal the benefits of breastfeeding through active and live discussion between the participants and a trained facilitator. An "ice-breaker" or introduction was conducted before commencing each discussion session to create a friendly environment. Firstly, the facilitator introduced herself and broadly outlined the aims of the research and the protocols. The participants then introduced themselves and were asked to respond to the first question from the focus group schedule. According to Peterson & Barron (2007), encouraging participants to become involved in an interactive, open discussion is one of the major challenges for the focus group facilitator.

Focus group discussions in Pos Pulat took place on a veranda of the home of one of the participants, while in RPS Kuala Betis it was conducted in the childcare centre (Taska) during weekend. All focus group discussions took place in a familiar comfortable environments in order to motivate participants, with the hope that the best possible responses could be obtained.

The questions for focus groups were developed to ensure consistency in responses according to project themes while allowing for flexibility of later

interpretations. They were also designed to be culturally compatible and general rather than personally probing in nature. Research was conducted in ways that were appropriate for Orang Asli Temiar. It is important that participants felt at ease and not threatened by the researcher or the data-collection instruments. The focus group discussions started with a general discussion about the demographic profiling, followed by a discussion on benefits of breastfeeding to both baby and mother, their decision to breastfeed the baby and the women's expectation regarding breastfeeding practices.

There were five focus group discussions, of which two groups were conducted in Pos Pulat (n=12) and three (n=21) groups took place in RPS Kuala Betis. Each focus group discussions took about 45 minutes to one hour to complete. All participants were given false names for anonymity. Narrative analysis was done after every recording. All focus group discussions were audio-taped and video recorded (with permission) to allow the facilitator to focus on the group responses and non-verbal behaviour and these were then transcribed from oral recordings to written text. The aim was for participants to ignore the recording so the interaction would be natural. All the transcripts were coded and categorised as either a main or sub category and then 'thematised' using the software package for handling qualitative data, NVivo 10. The protocol of this study has been approved by the Human Research Ethics Committee of the Universiti Sains Malaysia (approval code FWA Reg. No.: 00007718; IRB Reg. No.: IRB00004494).

RESULTS

Four key themes emerged from the analyses of this study. These were the perception of benefits of breastfeeding to the infants and to the mothers, the decision of mothers to breastfeed their babies and the expectation of Temiar women pertaining to breastfeeding issue. Below are summaries of responses from women in both locations for each of these themes. Where relevant, some excerpts are provided to illustrate the responses and reflect the way of thinking of these women.

Perception of the benefits of breastfeeding to the infants

The perceived benefits of breastfeeding to the infants reported by some of the Temiar women in Pos Pulat and RPS Kuala Betis included the protection against a variety of infections as well as for infant health and growth. Below are some excerpts of the responses from women in both locations:

> "*For example the infection of disease was lesser... sometimes if the baby suck on breastmilk (sic), the occurrence of diarrhoea is less...*" (Along, 36 years old, RPS Kuala Betis).
>
> "*Healthy... for baby's health*" (Saadiah, 32 years old, RPS Kuala Betis).
>
> "*If we give milk such as formula milk there will be problem of diarrhoea... but if we give breastmilk, if we really do that, the baby will be fine*" (Halimah, 45 years old, RPS Kuala Betis).
>
> "*For the baby's health... he will grow healthily. He will become clever*" (Anum, 25 years old, Pos Pulat).

One woman from RPS Kuala Betis even mentioned that breast milk contains antibodies to fight diseases. Another woman from Pos Pulat also stated that mother's milk was the best food for the baby as it contained vitamins. She further added that she obtained the information from a pamphlet found at the hospital.

The practice of discarding colostrum was also discussed. The women from both locations were also asked whether

they provide the first milk or colostrum to the baby. Most women from RPS Kuala Betis mentioned that they had given colostrum to their babies. In contrast, mothers from Pos Pulat agreed that colostrum needed to be discarded and thus revealed their limited knowledge about its nutritious and anti-infective properties. They believed that it was dirty and contained bacteria. Nevertheless, some of the women from Pos Pulat did mention that they will discard the colostrum when they gave birth at home, but gave it to the baby if the delivery was at a hospital.

Perception of the benefits of breastfeeding to the mothers

The women in the two locations responded differently when asked regarding benefits of breastfeeding to mothers. The women in RPS Kuala Betis spoke of the various advantages. One woman mentioned the delay in the return of regular ovulation, thus lengthening birth intervals as one of the benefits. Another woman said that "*it was much easier to breastfeed the baby compared to bottle feeding since it was not necessary to boil the water, because cleanliness was guaranteed with mother's milk*". This view was also supported by another woman who stated that "*moreover, we think why we need to pay for something that is already there? No need to buy bottle (formula) milk, no need to think. God has given everything complete in our body*".

On the contrary, most of the women in Pos Pulat had no idea when asked about the benefits of breastfeeding to mothers. Only one woman responded that breastfeeding is to strengthen the bond between the mother and baby.

Decision to breastfeed

When the women were asked regarding their decision to breastfeed the baby, all of the women from both locations stated that they choose to breastfeed their babies when they realised that they were pregnant. Kinah from Pos Pulat said that "*for example myself... aahhh... for me if someone... for example myself... if I am pregnant, when I deliver the baby... of course I will give breast milk... my own milk.... and no formula...*".

A woman from RPS Kuala Betis said "*I feel that when breast milk is given, the affection between us and the baby is more*". Another woman added "*this is how our mother did for us... their sacrifices... how a mother scarifies... now we feel it*". This was supported by another woman from RPS Kuala Betis who mentioned that she herself decided to give breast milk "*when the baby was born, immediately start to breastfeed, it is compulsory, to give breast milk*".

Expectations regarding breastfeeding

The majority of the mothers in Pos Pulat revealed that information about breastfeeding and infant formula was rarely provided by their obstetricians during prenatal visits. One respondent expressed the hope that health practitioners would give them some information regarding breastfeeding besides conducting vaccinations or routine check-ups:

> "*If it is okay we want the health people to come to give talk, talk regarding breastfeeding... because we only know how to give breast milk but we have no idea what the milk is good for... we know it is to cease hunger, to make the baby feels full and to make them healthy... and that's all... other than that we do not know...*" (Kinah, 33 years old, Pos Pulat).

DISCUSSION

It has been well documented that the general health of the indigenous people is disproportionately lower than that of other communities. Although Orang Asli in Malaysia comprise only 0.6% of the

total Malaysian population (Tan, 2016), they lag behind in almost all socio-economic indicators (Nicholas, 2007). Numerous studies in Malaysia have reported these health inequalities. The Orang Asli, *inter alia*, have high infant mortality rates and lower life expectancy compared to the national standards. Compared with other communities, they are more malnourished and have a higher prevalence of persistent infectious diseases such as malaria, tuberculosis and skin diseases (Nicholas, 2007; Khor & Zalilah, 2008).

Breastfeeding is a natural practice that has been shown to have numerous benefits not only to babies, but also to the mothers, society, economy and environment (Binns, Lee & Low, 2016; U.S. Department of Health and Human Services, 2011). In this study, the Temiar women in RPS Kuala Betis, a semi-urban setting, seemed to have more knowledge regarding the benefits of breastfeeding compared to the mothers from the more rural setting of Pos Pulat due to their amenities and location. There was one Mothers and Child Clinic that can be found in RPS Kuala Betis, while there was none in Pos Pulat. The nurses in this clinic had a routine weekly or monthly talk on various topics that involved mothers and child health issues. Thus women in RPS Kuala Betis had better opportunities to gain more information and knowledge compared to their counterparts in Pos Pulat. In contrast to this, the health practitioners visited Pos Pulat only once a month and only performed routine check-ups. According to the participants of this study, there were no talks or information given on breastfeeding and its benefits or on any other general health topics. In this particular case at least, the healthcare provider had overlooked the need for disseminating such basic but vital information to this community. The lack of physical support such as this had a negative impact. Since it is far-fetched to expect this rural community to gain online information, they are dependent on support programmes such as health talks, discussions, pamphlets and hardcopy materials. Indigenous people are known to have low self-esteem and are shy and timid (Louth, 2012). As such, it is very unlikely that they will initiate any discussion and enquiries, despite their curiosity and eagerness to learn. Gaps in breastfeeding knowledge will thus remain unfilled among them.

Studies have suggested that mothers who are knowledgeable about the health benefits of breastfeeding are more likely to breastfeed (DiGirolamo *et al.*, 2005; McCann, Baydar & Williams, 2007). Research has shown that mothers still believed that breastfeeding is the best practice for their babies, despite knowing less about the specific reductions in health risks that occur through breastfeeding and the consumption of breast milk (McCann *et al.,* 2007). This study found that despite having limited or almost no knowledge of the benefits of breastfeeding, most women, particularly those in Pos Pulat still nursed their babies. For them, breastfeeding was a cultural norm which had been entrenched in their society. It also revealed that the Orang Asli women still held on firmly to their values and trusted the knowledge that was passed on to them from family members and women within their community, which included the practice of breastfeeding. In addition, the desire to give the best for their babies was the key driving force for these women throughout their decision-making process. Even though breastfeeding is often described as natural, it is actually an art that has to be learned by both the mother and the newborn. Skills on how to hold and position a baby at the breast, how to achieve an effective latch, and other breastfeeding techniques may need to

be taught (U.S. Department of Health and Human Services, 2011) in order to achieve effective lactation. Women and their families need to be informed fully on the health benefits of breastfeeding for infants and their mothers (Sridhar & Salcedo, 2017). Furthermore, it is essential to impart additional knowledge about the need for patience, the difficulties associated with beginning of breastfeeding and the acceptance of these difficulties as a normal part of the process (Giugliani, 2004). This will ensure that the practice is sustainable for optimal periods. Maternal knowledge, understanding, confidence, self-efficacy and being proactive in seeking support and education have a positive correlation with the longer duration and exclusivity of breastfeeding (Brown, 2014).

It is also known that breastfeeding provides a sense of bonding, wellbeing, and improved self-esteem for many women (Labbok, 2001). Breastfeeding too is associated with increased child spacing in women who practised breastfeeding compared to those who did not. Fertility is not immediately recovered with the return of regular menstrual cycles. The length of postpartum amenorrhea varies greatly and depends on several factors, including maternal age and parity as well as the duration and frequency of breastfeeding (Chao, 1987). However this alone cannot provide a means of reliable and adequate contraception for most women.

Breast milk is the perfect source of nutrition for infants, both in its nutritional composition and in the non-nutritive bioactive factors that are needed for infant survival and healthy development (Ballard & Morrow, 2013). The first fluid produced by mothers after delivery (colostrum), is rich in immunologic components such as secretory of immunoglobulin A (IgA), lactoferrin, leucocytes, as well as developmental factors such as epidermal growth factor (Castellote *et al.*, 2011). There are various cultural practices with regard to discarding or feeding colostrum to the newborn. In our study, all women in Pos Pulat agreed that they needed to discard the colostrum because they believed that it is dirty and contaminated with bacteria. Other studies have also reported on the avoidance of giving this substance to the infants due to the cultural beliefs and taboos. A study in Chandigarh found that majority of the mothers considered colostrum as 'dirty, yellow, smelly, stagnant milk' which should not be given to the infant because of its impurity as it is produced during the antenatal period (Walia, Kalia & Chopra, 2009). The reasons for discarding colostrum vary with different cultures, but most societies believe that colostrum is dirty, poisonous and contaminated (Liamputtong, 2007). Domestic data have shown that more than 60% of Mah Meri women discarded their colostrum because of tradition, the perception that it was filthy and could cause illness to the baby, discomfort and fullness of the breasts, advice by others or for no reason at all. Some respondents also claimed that besides being told by close families and friends to discard the colostrum, they also received similar advice from some of the professional health workers (doctors and nurses) (Wan Norlida *et al.*, 2007).

In the present study, the women in Pos Pulat who delivered at the hospital gave colostrum to their babies following encouragement from the hospital staff and the information that they had gained from reading the available pamphlets. Knowledge pertaining to benefits of giving first milk to the babies for women in RPS Kuala Betis had been communicated to them by nurses at the clinic. Given that the knowledge and benefits of breastfeeding are sub-optimal among the rural Orang Asli, there is a pressing need for the health authorities

to play an active role in promoting the practice to help bridge the gap in the health and social disparities between rural and urban communities. Moreover it is also imperative that healthcare workers are equipped with accurate knowledge and appropriate standards, and provide equitable delivery of it, so that conflicting advice can be avoided.

In our study, all women from both locations were confident with their decision to breastfeed. Confidence in breastfeeding is an indication that she possesses the knowledge and skills to successfully breastfeed her infant. It is based on information gained from prior experience, the observations of other women who had breastfed, support and encouragement from individuals whose opinions are respected, and the physiological reaction to the prospect or act of breastfeeding (Dennis & Faux, 1999). Since confidence is enhanced through knowledge, breastfeeding education, particularly when it is skills-based or observational, may be an important strategy for improving breastfeeding rates (Chezem, Friesen & Boettcher, 2003). Although the women in this study were confident enough to breastfeed their babies, the lack of knowledge regarding the benefits of the breastfeeding may result in decreasing rates of it in the future. Maternal awareness can be compromised if important information is not received. Moreover, many people, including some health professionals, believe that because commercially prepared formula has improved in recent years, this form of sustenance is equivalent to breast milk in terms of its quality and health benefits (U.S. Department of Health and Human Services, 2011; Martin, Ling & Blackburn, 2016).

This can be quite alarming since this disadvantaged group would never question the actions of health professionals, they can easily be influenced and accept any advice from promoters of formula-feeding (MacVicar *et al.*, 2015). Furthermore, it was also noted that mothers from low socioeconomic and education background may require substantial input and support surrounding the breastfeeding issues. As such, it is highly critical for health practitioners to possess good interpersonal communication skills, as well as to master some basic fundamental knowledge on breastfeeding, while tackling some misconception of this practice in cultural context in order to ensure optimal breastfeeding practice. Inaccurate and contradictory information can easily cause early cessation of this practice in this community (MacGregor & Hughes, 2010).

The WHO International Code of Marketing Breastmilk Substitutes was adopted in 1981 by the World Health Assembly (WHA) to contribute to the provision of safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of breast-milk substitutes, when these are necessary (WHO, 1981). In order to protect, support and promote breastfeeding practices in Malaysia, Ministry of Health (MOH) first formulated a Code of Ethics for Infant Formula Products in 1979 based on 1975 International Council of Infant Food Industries (ICIFI) Code. A revised version of the Code was launched on August 1, 2008 and was renamed Code of Ethics for the Marketing of Infant Foods and Related Products (MOH, 2019). The goal of the Code of Ethics' is to contribute to the promotion of safe and optimal nutrition for infants by protecting and promoting breastfeeding and by ensuring the use of correct breast milk replacement products where this is necessary, by providing adequate

information using a controlled marketing and distribution method.

Although Malaysia has some of the strictest regulations that protect the practice of breastfeeding, some companies which market formula milk continue to circumvent the Code. This has resulted in numerous violations of the International Code of Marketing of Breast-milk Substitutes and subsequent resolutions by IBFAN (2014) that have been documented over the years. A compilation of violations includes direct promotion and selling of their formula milk products to parents at Parenthood Expos. Other violations are more subtle. These include attracting parents with lucrative packages with every purchase of their formula milk products, encouraging parents to submit videos of their kids with product logos and reviews. The promotion of formula milk with includes comprehensive programmes that cover the entire period of pregnancy to the toddler stages with the recommended company's products in every developmental stage, and promotion in a form of goodie bags, coupons and prizes. Events related to bottle-feeding are heavily promoted through social media such as Facebook. In clinics in Malaysia, particularly at private practices, formula names and brand logos are promoted in the form of decorative accessories, toys and formula milk tester size.

Besides skilful marketing strategies to promote formula-milk feeding, some bottle-feeding accessories such as teats are sold without any indication that its use will interfere with the breastfeeding practices as required by the Malaysian Code. Such items are often wrapped in attractive packaging with claims and comforting words that the products are "ideal for babies", are "anti-colic teats", "natural breast-shaped teats", "natural latch", etc.

The old tradition of breastfeeding among Temiar women can easily be eroded if marketing that favours bottle-feeding reaches them. This, together with their limited knowledge of the benefits of breast milk can result in a decrease or even cessation of their breastfeeding practices. This would be unfortunate since Orang Asli groups have more to gain from extended breastfeeding and where breast milk is the most secure and economically advantageous way to feed infants.

CONCLUSION

This study analyses the descriptions of past events and provides insights into the thoughts, emotions, interpretations and lived experiences of the Temiar women regarding breastfeeding. Our study has revealed that there is a knowledge gap between rural and semi-urban Temiar women despite originating from the same sub-ethnic background. Mothers from semi-urban setting of RPS Kuala Betis seem to have better awareness of the vast array of the benefits of breastfeeding compared to those from the rural Pos Pulat location. Besides these, inequalities in the healthcare services provided to both locations were also noted in this study. There was inadequate support for those in Pos Pulat, where dissemination of breastfeeding knowledge or on any other health topics was neglected by the healthcare provider. Fortunately, due to the strong cultural norms within this community, the practice of breastfeeding has continued despite having limited awareness of the benefits of such a tradition. It is vital to inculcate strong fundamental knowledge and reinforce beliefs of benefits of breastfeeding practice among the Temiar for preservation of their breastfeeding culture, in the face of subtle and direct pressures for bottle/formula-feeding from outside. Policy makers and healthcare providers should

ensure that accurate information on breastfeeding is disseminated and made accessible to Orang Asli women through qualified health practitioners in order to make breastfeeding practice sustainable.

This study had a limited number of participants and was carried out only among the Temiar, a sub-ethnic group of the Orang Asli. Therefore it is suggested that more research should be carried out to explore the breastfeeding practices among other 17 sub-ethnic groups of Orang Asli in Peninsular Malaysia. The findings from this study can be used to improve promotion of breastfeeding to mothers of other Orang Asli groups in Malaysia.

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Authors' contributions

SZSA, principal investigator who conceptualized and designed the study, led the data collection, data analysis and interpretation, prepared the draft of the manuscript and reviewed the manuscript; RMS, assisted in the drafting of the manuscript, review of the data analysis and interpretation and also reviewed the final manuscript.

Conflict of interest

The authors declare that there was no conflict of interest in the publication of this paper.

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Workplace support and exclusive breastfeeding practice: a qualitative study in Jakarta, Indonesia

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ABSTRACT

Introduction: The primary reason that compels working mothers to decrease their ability to continue to breastfeeding successfully is their return to work. Attempts to continue breastfeeding at work encounters several difficulties. This study aims to provide an overview of the workplace environment and how facilities at the workplace affect breastfeeding in Indonesia. **Methods:** We used a qualitative approach to provide a detailed picture of the influence of workplace support for working mothers to perform breastfeeding. We enrolled working mothers (n=18) in Jakarta, as participants and obtained the following information from them: parity, type of family and type of work. **Results:** The findings provided the general overview of the workplace environment and identified three factors that affected breastfeeding: seeking information during pregnancy, expression of breast milk at office facilities and the problem faced by working mothers. **Conclusion:** Although the breastfeeding performance of most working mothers in this study comprised exclusive breastfeeding, some fed their infants with formula milk. This study suggests that working mothers who continue to breastfeed after returning to work need the support of their employers, co-workers and others in the workplace to ensure the provision of health facilities and the protection and dissemination the rights of breastfeeding working mothers that might lead them to discontinue their breastfeeding practice.

Keywords: Breastfeeding performance, workplace support, qualitative study, Jakarta, Indonesia

INTRODUCTION

For the first 6 months of life, breast milk alone is the optimal way to feed infants as it provides all the necessary nutrients for growth, and protection by way of antibodies from the mother (UNICEF, 2011). In addition, exclusive breastfeeding (EBF) is the most effective preventive intervention to improve children's health and survival (Black *et al.*, 2008; Kramer *et al.*, 2003). Several studies have established the benefits of breastfeeding for mothers. Prolonged breastfeeding might may also provide protection from ovarian cancer, rheumatoid arthritis, endometrial cancers, osteoporosis in the future and also help mothers regain normal

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weight quicker (500–640 calories loss whilst breastfeeding); it provides economic benefit for the family because breastfeeding does not cost anything (Rea, 2004; Wen *et al.*, 2009).

In developing countries, the prevalence of breastfeeding for <6 months is only 37%. There has been with little progress in the breastfeeding rate since the early 1990s (UNICEF, 2011). The Indonesia Demographic and Health Survey (2012) revealed that only 27% of infants aged 4–5 months received exclusive breastfeeding in Indonesia (Statistics Indonesia *et al.,* 2013). Statistics Indonesia (2008) revealed that the prevalence of working women in the Special Capital Region (*Daerah Khusus Ibukota,* DKI) Jakarta was 56.71%. Recently, Basrowi *et al.* (2015) reported that proportion of working mothers in Jakarta who exclusively breastfed their children was only 32.2%.

Ong *et al.* (2005) reported that the primary obstacles amongst working mothers were because of the breast milk supply. Working mothers encounter several challenges to breastfeeding such as the lack of knowledge about breastfeeding practices, insufficiency of time needed to breastfeed or express breast milk, short maternity leave, breastfeeding problems during the first 6-month period, the lack of breastfeeding facilities and programmes at workplaces, management of expressed breast milk and the impact of media about formula feeding (Ryan, Zhou & Arensberg, 2006; Basrowi *et al.*, 2015; Fauzie *et al.*, 2007; Manjilala, 2012; Marinelli *et al.*, 2013). Another study reported that a breastfeeding plan could help working mothers anticipate the pumping schedule by considering where and how frequently breast pumping could be performed, break schedule and work hours, and barriers they encounter in their workplaces (Biagioli, 2003). Likewise, some working mothers stated not preparing breast milk stocks during the maternity leave because of the lack of knowledge and delay in saving breast milk adversely affected their breastfeeding performance. A qualitative study in Lebanon reported that preparing future mothers for successful breastfeeding later in life might augment their determination and self-confidence to overcome breastfeeding problems (Nabulsi, 2011).

The role of workplace support for working mothers as a vital factor that could affect breastfeeding frequency has scarcely been investigated in Indonesia, especially Jakarta. A qualitative approach was deemed the most appropriate way to explore the understanding of mother's experiences related the workplace environment and facilities to support their exclusive breastfeeding practice. A qualitative approach is focused on the experiences, knowledge and understanding of a given issue, meanings, and explanations and rationale given by people to justify their decisions and actions of some behaviour (Kielmann, Cataldo & Seeley, 2012).

MATERIALS AND METHODS

Study design and participants

This qualitative study used the grounded theory approach which is an iterative process, requiring a steady movement between concept and data. The data is then consolidated and analysed to produce the theory (Lawrence & Tar, 2013). We enrolled working mothers aged 24–45 years in this study. The inclusion criteria comprised white-collar workers (government/private/United Nations, UN/Non-Governmental Organisation, NGO) with full-time working status (8–12 h/day), working mothers who had returned to work after maternity leave, had a child aged <6 months and who were willing to participate. White-collar workers were chosen because the facilities and the time of working status usually were similar in each workplace. A study in Taiwan mentioned that the

white-collar working mothers had more control over their environment and schedules than blue-collar working mothers (Tsai, 2013). The exclusion criteria comprised mothers who lived separately from their child. In order to obtain data from a variety of participants, the following features were used to select them, namely, parity, type of family, and type of work. These characteristics considered the factors that influenced the result of in-depth interviews among working mothers (Table 1).

Twenty-four offices in Jakarta (government/private/UN/NGO) were randomly selected for this study. Letters requesting permission to interview some of their employees were sent to them. Only 14 offices gave permission to conduct the interviews. The participants were recruited by the contact person within the organisation who selected the working mothers who had fulfilled the inclusion criteria, ensuring that there

Table 1. Type of working mothers in this study and sample size (total *n*=18)

Type	*n*
Parity	
Primiparous	9
Multiparous	9
Type of family	
Nuclear family	6
Extended family	12
Type of work	
Government	7
Private	8
UN/NGO	3

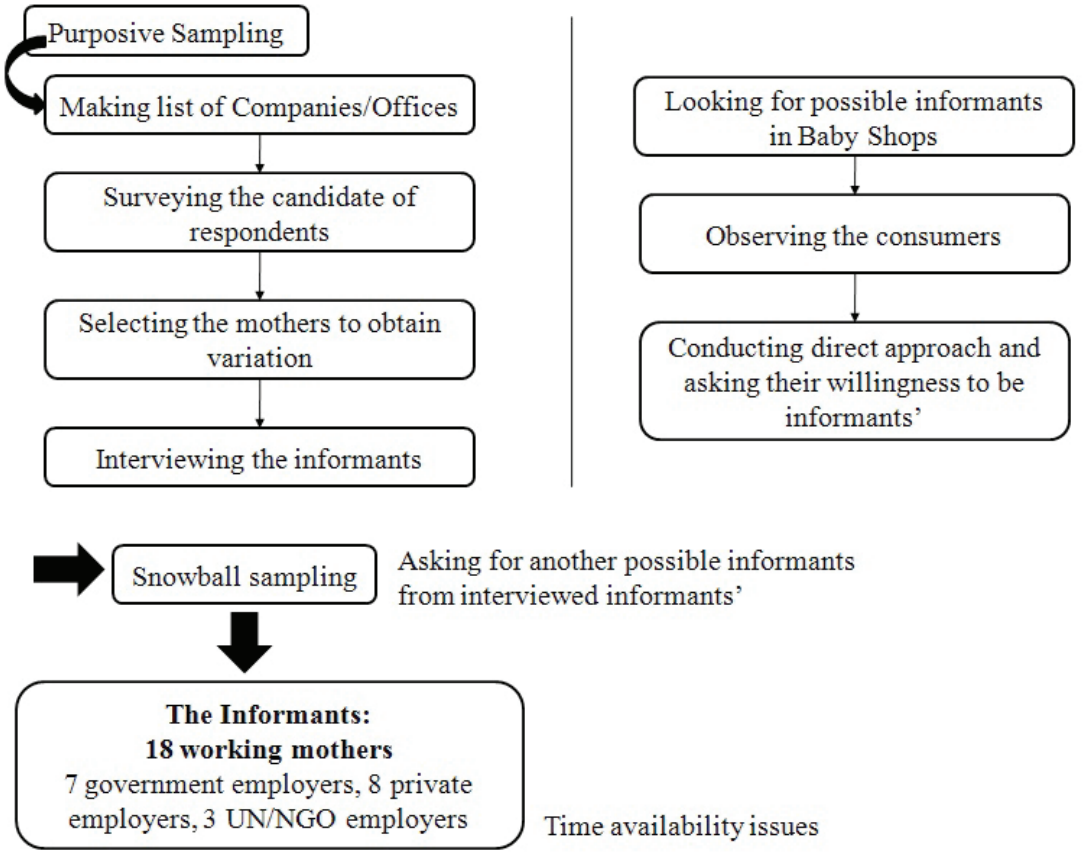

Figure 1. Sampling procedure of the study

was adequate variation of data based on parity, type of family, and type of work could be obtained. The participants comprised 18 working mothers to reach theoretical saturation. Theoretical saturation is the point when additional data collected from other participants is going to develop or add to the concepts that have been drawn from the previous interviews (Lawrence & Tar, 2013). The snowball sampling technique was used as it enables previous participants to recommend potential participants to obtain the study variation (Marshall, 1996). The flow of the study sampling procedure is described in Figure 1.

Data collection

We conducted the interviews in offices, canteens, restaurants, lactation rooms and meeting rooms. In the first meeting, interviews were conducted hastily because of the limited time that was available during office hours. However, some participants provided additional insights either through second visits or telephone calls. The questions served as a guide to those that would be asked and covered topics such as their current exclusive breastfeeding practices; the workplaces environment factors that affected exclusive breastfeeding; and the experiences of working mothers that were related to breastfeeding practices such as previous success and failure experiences and observation of others encouraging or discouraging messages from others, and emotional issues related to breastfeeding. Eighteen mothers completed the interviews. The small number of participants was deemed sufficient as they had adequately responded to the research questions (Marshall,1996). Also a similar number was used in a previous qualitative study by interviews of 17 mothers of their experiences, the challenges they faced and the coping mechanism to overcome those challenges (Wilson *et al.*, 2012).

To validate our findings, we undertook conducted triangulation which is the process of verification to increase the validity of information from in-depth interview results and it offered a comprehensive picture by combining several perspectives and approaches (Yeasmin & Rahman, 2012). This was done through four interviews with key participants (managers, breastfeeding counsellors and co-workers) and five observations of lactation room in workplaces. In this study, the instruments used were 24-h recall (to estimate exclusive breastfeeding amongst mothers by asking about the feeding practice for the day, 24 h before the interview), in-depth interviews and guidelines for investigating workplace facilities for the practice of breastfeeding/ breast-milk expression amongst working mothers. The areas covered by triangulation comprised workplace facilities and the environment that affected breastfeeding at the workplace.

Data analysis

At the end of each interview a de-briefing was undertaken to consolidate and analyse in-depth the data, to ensure the questions guide were relevant. The questions were pre-tested in different places which had the same characteristics as the study area. In the pre-testing phase, three working mothers were interviewed. Data from the pre-testing ascertained the flow of the interview, the suitable topics of conversation that could be used for interviews of working mothers to build rapport. If there were any difficulties in understanding the terms used in the guidelines, appropriate revisions were made to it. The characteristics of the interviewees were assessed in the beginning of the interview. The primary steps of data analysis in this qualitative study were transcribing, coding, analysis and data display. Firstly, a trained transcriber transcribed verbatim the interview recordings and all crucial points

relevant to the research question were underlined. Secondly, data were coded. Coding is an interpretive technique to organise the data. After transcripts were coded they were checked for consistency to ensure that researchers used coding consistently in the same text individually (Kielmann *et al.*, 2012). Then, codes were grouped into themes to decrease the number of categories. Finally, the results of interviews were presented in the form of themes and quotations to support the pattern identified in this study.

Ethics

This study protocol was approved by the Ethical Committee of Medical Faculty of University of Indonesia (Jakarta, Indonesia; number 124/H2.F1/ETIK/2014). Permission from local governments (provincal, district and sub-district level) and local authorities was obtained before the data collection. We obtained written informed consent from all informants prior to data collection.

RESULTS

Characteristics of the study participants

The mothers in this study had a high level of education with 14 of the 18 having either postgraduate or first degrees. Most of them (11 out of 18) worked in the private sector or NGOs/UN. The family income of mothers

Table 2. Characteristics of study participants (*n*=18)

Characteristics	*n (%)*
Age (years)	
21–30	10 (55.6%)
31–40	8 (44.4%)
Level of Education	
Post-graduate degree	4 (22.2%)
Bachelor's degree	13 (72.2%)
Diploma	1 (5.6%)
Type of Employer	
Government	7 (38.9%)
Private	8 (44.4%)
UN/NGO	3 (16.7%)
Family Income (per month)	
<2,400,000 IDR (<165.76 USD)	1 (5.6%)
2,400,000–6,000,000 IDR (165.76 - 414.39 USD)	2 (11.1%)
6,000,000–10,000,000 IDR (414.39 - 690.65 USD)	5 (27.8%)
>10,000,000 IDR (>690.65 USD)	9 (50%)
Ethnicity	
Javanese	8 (44.4%)
Padangese	2 (11.1%)
Betawi	5 (27.8%)
Sundanese	1 (5.6%)
Bataknese	1 (5.6%)
Manado	1 (5.6%)
Parity	
Primiparous	9 (50.0%)
Multiparous	9 (50.0%)
Type of Family	
Nuclear family	6 (33.3%)
Extended family	12 (66.7%)

was mostly >6,000,000 IDR (414.39 USD) and most of the mothers were of Javanese ethnicity. The numbers of primiparous and multiparous was equal and all multiparous mothers had two children. Two-thirds of the mothers lived in extended families (Table 2).

Workplace environment

The lack of internal regulations that support breast-milk expression

Some mothers mentioned that their workplaces had no facilities for breast-milk expression that were provided by the management. However, those who worked in the civil service and the UN/NGOs had a better chance of being permitted to undertake breast-milk expression by the superior than those working in a private company.

The following are excerpts of some comments of the mothers on breastfeeding:

Expression of breast-milk at the workplace

Often, seeking permission to express breast milk made many participants uncomfortable:

> *'I felt uncomfortable to express breast milk at office hours, because if I had a meeting and it coincided with my pumping schedule, I could not ask permission from my supervisor. Therefore, I delayed my pumping schedule until after the meeting ends*' (A mother who partially breastfed and worked in the private sector).

However, some managers permitted mothers to express their breast milk during work hours:

> *'Until now there are no internal regulations to support exclusive breastfeeding programme in our office. However, if any of our staff want to express the breast milk, we are very supportive for that'* (A manager of the UN/NGO sector).
>
> *'There are no pressures from the superior, so I have to adjust my time and work efficiently'* (A mother who exclusively breastfed and worked in the government sector).

Maternity leave of less than 6 months

Every working mother would wish for a 6-month maternity leave so as to focus on breastfeeding their infant exclusively for whole 6 months. However, a mother who received maternity leave of >3 months thought that maternity leave was highly useful:

> *'Maternity leave is very important to me and my baby... I got the maternity leave for four months: 1 month before delivery and 3 months after delivery. I'm so glad because I have so much time with my baby'* (A mother who exclusively breastfed and worked in the UN/NGO sector).

Some mothers, who only had 3 months of maternity leave, wanted 6 months for exclusive breastfeeding:

> *'Actually I wanted to have maternity leave for 6 months so (that) I can give exclusive breastfeeding and (be) at home with the child, but it seems impossible'* (A mother working in the government sector).

Although mothers did not get 6 months of maternity leave, at least, the availability of a lactation room would allow working mothers to express their breast milk for their child. Given below is the response from a breastfeeding counsellor:

> *'Although the government cannot set the policy on maternity leave for 6 months, the availability of a lactation room in the office will allow working mothers to give the expressed breast milk to her child'* (A breastfeeding counsellor who gives counselling in the lactation room).

Support from co-workers

Most respondents received support from colleagues who had previously breastfed. Support from co-workers mattered for some mothers because, during working time, they always met with them while expressing breast milk:

> *'I have a co-worker that always cheer*

me up with expressing the breast milk. Sometimes I feel so bored with the same breast pumping activity but she said that even though my baby have nipple confusion, I can still have the bonding between me and my daughter... It encouraged me to keep giving breast milk through expressed breast milk' (A mother who worked in the private sector).

A co-worker shared her experience that makes her suggestion was accepted with her friends:

'I always try not to judge the mothers, because no mother wants to be judged. Therefore, during pumping together in the lactation room, I often tell stories about my breastfeeding experiences and send an article about breastfeeding and related matters' (A mother who worked in the private sector and always encouraged her friends in the office to continue breastfeeding).

The perceptions of co-workers about breastfeeding

The perception of co-workers that breast-milk is the best food for children is quite widespread. Some mothers mentioned that their co-workers often discussed breastfeeding practice:

'I think in this office breastfeeding practice is quite popular. Sometimes when we have a discussion, there are mothers who feel sad because they are not exclusively breastfeeding' (A mother who worked in the government sector).

However, a mother revealed a different perception of her co-workers about breastfeeding:

'My perception is that breastfeeding is not popular in my office. My co-workers do not seem to know the importance of breastfeeding. For instance, when my friend was not permitted to wash her breast pump equipment in the pantry because other co-workers felt disgusted. So, I didn't use the pantry anymore' (A mother who worked in the private sector).

Seeking information during pregnancy

Table 3 shows that working mothers who exclusively breastfed their child were more likely to seek information about infant-feeding during pregnancy rather than predominant and partial breastfeeding working mothers.

Expressing breast milk at workplace facilities

Experiences

In offices, the most frequent place used to express breast milk was the lactation room. However, mothers faced many challenges, such as the inappropriateness of lactation room, its distant location, and the lack of facilities that support mothers to express breast milk. The following are some comments that were made by breastfeeding mothers:

'My office already provides a lactation room, but the location was poorly suited. It is located in front of male ablution room, therefore I do not want to express breast milk there... Besides the air is so humid and musty...' (A mother who worked in the government sector and who exclusively breastfed).

A different reason shared by others about the lactation room:

'Actually there is lactation room on the 22nd floor but it's too far from my room. Just for time efficiency, I have to express my breast milk in the toilet...' (A mother who worked in the private sector and who exclusively breastfed).

Some mothers who did not have a lactation room in their office expressed breast milk in an available room, meeting room, and classroom:

'Although there is no lactation room in my office, I can still express my breast milk in the unused room. I should be grateful... as previously, I used the toilet for expressing my breast milk' (A mother who worked in the government sector who expressed her breast milk in the unused room).

In this study, we conducted some of the interviews in a lactation room. Figure 2 illustrates the various lactation rooms found in each workplace. Every workplace had different standards and facilities to support the breast-milk expression practice for working mothers. Some workplaces offered full facilities to support working mothers to express their breast milk but some provided fewer, as a result of which the mothers felt less comfortable.

Limited time to expressed breast milk

Some mothers reported the problem of managing their break time for lunch, pray and expression of breast milk. Those who worked in government and UN/NGO sectors had a greater flexibility of time compared with those who worked

Table 3. Methods of obtaining information about breastfeeding during pregnancy according to type of work place

Source of information	*Type of work place*		
	Government sector	*Private sector*	*UN/NGO*
During pregnancy	• Seeking information about breastfeeding via the internet and then sharing it with other co-workers • Getting information from reading articles, internet, or sharing information with people who have been breastfeeding before (EBF) • Reading books on childcare and from internet search (EBF)	• Joining breastfeeding class (EBF) • Getting information from high school friends or family experience (EBF) • Joining a seminar provided by the company about breastfeeding (EBF) • Sharing with co-workers (EBF)	• Seeking information about breastfeeding via the internet and sharing information from family experience (EBF) • Reading books, sharing information with co-workers and joining breastfeeding class • Attending training about how to breastfeed correctly (partial BF due to HIV+)
After childbirth	• After childbirth, much information can be obtained from the husband or the obstetrics & gynaecology specialist (predominant BF) • Getting information about breastfeeding via the internet and asking a counsellor at the lactation room (EBF) • Getting information about breast milk only from the TV shows (similar to talk shows) (an infant getting a breast milk donor because the mother had baby blues) • Getting information only from the husband (EBF)	• Getting information from the obstetrics & gynaecology specialist after childbirth (EBF) • Looking for information on the internet after having a breastfeeding problem (e-Ping) • Reading the magazine on childcare or parenting (partial BF)	

Note:
EBF = exclusive breastfeeding
BF = breastfeeding
HIV+ = HIV positive
e-Ping = exclusively pumping (means meeting all the infant's milk needs through expressing breastmilk only)

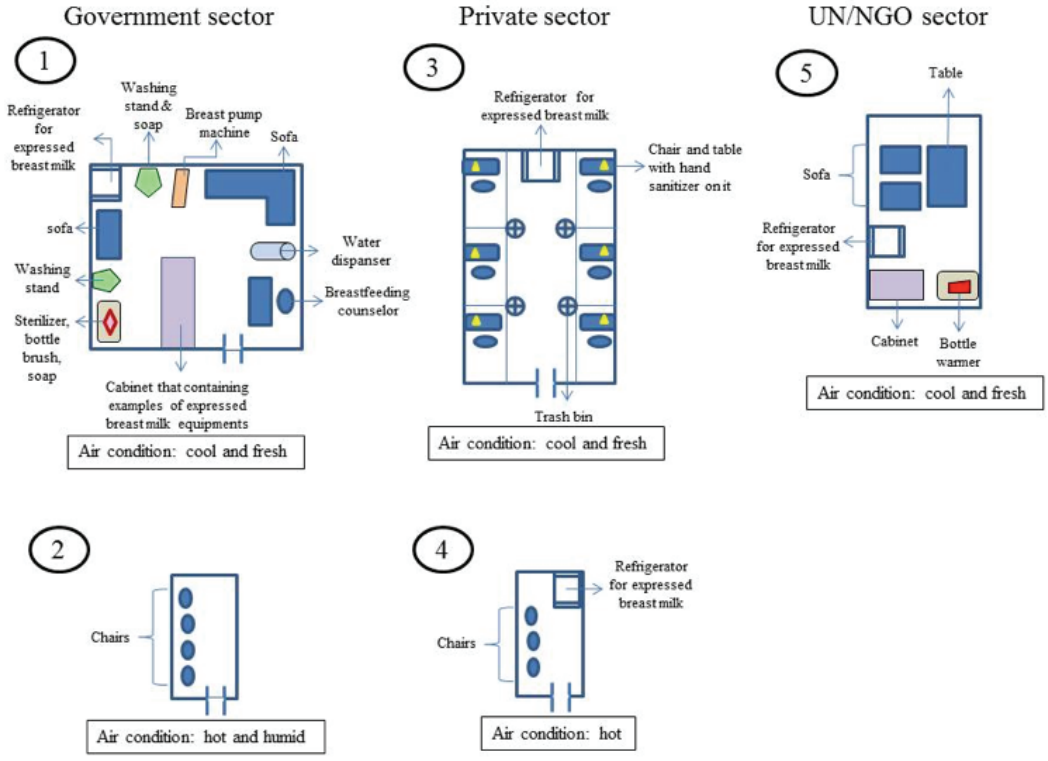

Figure 2. Arrangements and setting of some observed lactation rooms

in private sector as the latter group had rigid work hours and shorter break times. Some even reported that they had to add working hours to replace the break they used for breast-milk expression:

> *'Essentially, I had to work eight hours a day, every time I took the break it means I had to replace it whatever the time I used'* (A mother who exclusively breastfed and worked in the private sector).

Some mothers reported going to offices earlier than office hours for expressing their breast milk:

> *'Sometimes expressing breast milk was really time-consuming, so I go early in the morning so as to express my breast milk first. During lunch break, I expressed my breast milk using breast pump for the right side and my hand for the left side. I think that's really good strategy to save my time'* (A mother working in the private sector who exclusively breastfed).

Breastfeeding problems

Table 4 indicates the several problems faced by working mothers who returned to work. Primarily, working mothers experienced difficulty in expressing breast milk during working hours and managing breast milk stocks. Some other challenges were inadequate knowledge and breastfeeding experience and its related matters such as when babies had nipple confusion because of being fed by bottles, mothers' illness, and inappropriate lactation room in offices.

DISCUSSION

Breastfeeding practice of working mothers

In this study, working mothers revealed that the chief obstacles they faced during

Table 4. Problems faced by working mothers who returned to work

Problems faced by working mothers	*Elaboration*
Unprepared breast milk stocks during maternity leave	• Inadequate knowledge and experience about expressed breast milk • Delay to save breast milk
Difficult to express breast milk during working hours	• Decreased frequency due to work-load • Having difficulties to look for the best time • Having difficulties to ask permission
Nipple confusion (e-Ping[†])	• Prolonged bottle use for expressed breast milk
Mothers' illness influenced breast milk production	• Adaptation after maternity leave
Inappropriate lactation room	• The location is too far from her desk • Lack of facilities • The room temperature is too hot • The room is too small

[†]e-Ping = exclusively pumping (means meeting all the infant's milk needs through expressing breastmilk only)

their breastfeeding practice were the difficulty in finding places to express their breast milk during working hours and managing the breast milk stocks because of low milk supply. Some of them revealed that upon returning to work, their breastfeeding performance was reduced, accounting for sickness in some, because of the need to adapt their breastfeeding/ breast-milk expression to the home and office. A study on comprehending the maternal breastfeeding confidence revealed that returning to work could challenge mothers' ability to breastfeed successfully if they perceive that they will be able to express adequately to meet their infant's needs. This suggest that health care professionals should discuss with mothers about their plans for breastfeeding and to be prepared upon returning to work (Grassley & Nelms, 2008). Mothers started using expressed breast milk, not only after their return to work but also during the maternity leave to compensate for the times they were tired. This caused another problem of nipple confusion among babies after being introduced to bottles too early in life. The finding was confirmed by Biagioli (2003) who reported that introducing a bottle too early (at the age of <1 month) could cause nipple confusion because feeding on a bottle required less suction and less coordination of tongue movements and resulting in babies rejecting nipples when breastfed.

Workplace environment

Returning to work after maternity leave is a vital factor possibly affecting breastfeeding practice amongst working mothers. Most studies reported that breastfeeding working mothers expressed their breast milk regularly, stored it, and brought home after work. However, working mothers reported encountering several problems such as inappropriate lactation rooms, distance location of the lactation room, lack of facilities, limited time to express breast milk and the lack of formal support for breast-milk expression by the management. Every workplace had different facilities that served as lactation rooms and some were observed to be inappropriate.

These findings were not consistent with the Ministry of Health's circular (No. 872/Menkes/XI/2006) about

the criteria and facilities for lactation rooms. The Government Regulation on Breastfeeding No. 33 in 2012 about the Exclusive Breastfeeding Practice, Indonesia, stated that every workplace and public facility should support exclusive breastfeeding programmes by providing appropriate facilities and rooms for mothers to express their breast milk (Article 30—Workplace and Public Facilities). In addition, regulations about time and internal regulations are mentioned in Article 34 and 35—every management or executive board of a workplace should provide opportunities for working mothers to breastfeed or express their breast milk during working hours and introduce internal regulations supporting successful exclusive breastfeeding programmes (Ministry of Health, 2012).

Although many offices do not have internal regulations to support exclusive breastfeeding programmes, several supervisors permitted their staff if they wanted to express their breast milk during work hours. The support of co-workers influenced the breastfeeding practices amongst working mothers; some mothers revealed that support from co-workers was significant to increase their motivation. These findings are supported by many studies which report that working mothers who continued their breastfeeding after returning to work needed the support of their employers, co-workers and other people in the workplace to ensure the provision of lactation room and facilities. Protecting and disseminating information, on the rights of breastfeeding working mothers, may encourage them to continue their breastfeeding practice (Basrowi *et al.*, 2015; Hirani & Karmaliani, 2013; Kolinsky, 2010; Shealy *et al.*, 2005).

Based on interviews, most working mothers in the government sector had more time to express their breast milk than their counterparts who worked elsewhere. This finding corroborated a cross-sectional study in Malaysia, which reported that working mothers in government sectors were more likely to have flexible time to express their breast milk compared with those working in private sector because the private sector had stricter rules and shorter breaks (Amin *et al.*, 2011).

The duration of maternity leave was another vital factor for working mothers. In this study, working mothers revealed that they only had 3 months of maternity leave. Typically, they took 1 month before delivery and 3 months post-delivery. Most felt that a 6-month maternity leave could enable them to exclusively breastfeed their infants for 6 months. A qualitative study in Pakistan reported that working mothers were worried and stressed because they always thought about their infant during working hours (Zafar & Bustamante-Gavino, 2008). The government's perspective in this study was that it already released rules and regulations on breastfeeding in workplaces to assist working mothers in continuing the breastfeeding practice by expressing their breast milk. However, the facilities and conveniences provided by most workplaces were still lacking. A study in one Indonesian company by Lestari, Trisyani & Widiasih (2014) reported that the regulation, Law no. 13 of 2003, concerning the employment in Indonesia, offered the maternity leave for only 1.5 months; this period was not consistent with the recommendations by the International Labour Office (ILO), which recommended, at least, an 18-week maternity leave (ILO, 2010). Thus, the maternity leave implemented by the Indonesian government was still less than that recommended by the ILO. Another study concluded that strong management support at workplaces and relevant policies of employers played a vital role in providing supportive workplace environments, appropriate facilities, to make working mothers feel adequately supported and encouraged to continue breastfeeding upon returning to work (Weber *et al.*, 2011). Yet another study

reported that post-partum maternity leave might exert a positive impact on breastfeeding amongst full-time working mothers. In this study, short post-partum maternity leave amongst full-time working mothers correlated with a higher risk of early discontinuation of breastfeeding (Guendelman *et al.*, 2009). Flacking, Dykes & Ewald (2010) reported that paternity leave might help mothers to breastfeed up to 6 months.

The duration of maternity leave in Indonesia as mentioned in Government Regulation No. 24 1976 paragraph 19, states that women can remain absent 1 month before and 2 months post-delivery (Ministry of Health, 2008). However, a discrepancy exists between the government practices and its health programmes which calls for the implementation of exclusive breastfeeding for up to 6 months. To implement that programme, all working mothers should receive the 6 months of maternity leave to able them to practise exclusive breastfeeding.

Seeking information during pregnancy

This study suggests that one of the favourable points experienced by mothers who were exclusively breastfeeding as against those who were predominantly and partially breastfeeding was their desire to seek 'information during pregnancy about breastfeeding' (Table 3). The timing of exposure to information affected the ability of mothers to breastfeed successfully. Exclusively breastfeeding mothers tended to seek the information before having breastfeeding problems. Some mothers who received the information during pregnancy and right after delivery had some advantages to prepare for their breastfeeding practice. However, some mothers received the information only after developing breastfeeding problems. These findings were consistent with a study in Depok, Indonesia, which concluded that earlier the mothers received good knowledge about breastfeeding, the better the level of confidence they exhibited in their practise (Februhartanty *et al.*, 2012). Besides, the most accessed source of information amongst working mothers was the Internet because it was easily accessible and saved their time. A study in Malaysia reported that in most urban societies, mothers gathered the breastfeeding information from the Internet, demonstrating that the mass media could effectively disseminate the breastfeeding information as public education (Eeng *et al.*, 2008). Thus, early appropriate support and information about breastfeeding and related matters during the reproductive age are imperative for mothers to prepare their breastfeeding practices.

Breastfeeding problems

In this study, mothers shared their feelings about their breastfeeding problems. For instance, mothers worried about their breast milk stock right after returning to work, and that made them lose confidence with their ability to breastfeed well; this result was supported by a prior study (Grassley & Nelms, 2008). Thus, by decreasing emotional responses could increase the coping mechanism to tackle breastfeeding problems. A study in Depok, Indonesia reported that the support of fathers enhanced the decision to sustain breastfeeding (Februhartanty *et al.*, 2012). This finding was also supported by a study in Canada by Rempel and Rempel (2011), who stated that expressions of support by fathers played a vital role in the positive responses of mothers towards breastfeeding. Fathers who extended emotional support, such as appreciating the breastfeeding practice of mothers, could reduce the emotional stresses faced by mothers (Rempel & Rempel, 2011).

CONCLUSION

Most working mothers practised exclusive breastfeeding, but some mothers performed mixed-feeding. Working mothers who continued breastfeeding after returning to work need the support from their employers and co-workers in the workplace, to maintain their confidence to continue breastfeeding. Ensuring the provision of necessary facilities, protecting and disseminating the rights of breastfeeding for working mothers were also important for this to happen. Continuous efforts are warranted to advocate the importance of improving the maternity leave to increase the practice of exclusive breastfeeding amongst working mothers. One limitation in this study was the absence of mothers who worked in factories, who may have different experiences from office workers in relation to breast-milk expression performance in the workplace.

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Authors' contributions

YF, designed the research, conducted the data collection, data analysis and interpretation, and wrote the first draft of the manuscript; JF, designed the research, interpreted the data and gave substantial contribution to the final manuscript; DNH, designed the research, interpreted the data and gave substantial contribution to the final manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest.

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Nutrition labelling: an exploratory study on personal factors that influence the practice of reading nutrition labels among adolescents

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ABSTRACT

Introduction: The consumption of processed food is increasing in developing countries. Nutrition labels on food packaging are important for the education of consumers, particularly adolescents, to help them make healthier food choices. However, there is evidence to suggest that adolescents generally do not use nutrition labels. This study aims to explore the personal factors that influence the practice of Malaysian adolescents in reading nutrition labels. **Methods:** The participants were adolescents, aged 13-16 years, from five public schools in Negeri Sembilan. Five semi-structured focus group discussions (FGDs) were conducted. The participants discussed their personal views, knowledge and perceptions regarding the use of nutrition labels and food selection. Data gathered from the FGDs were coded through thematic analysis using the NVivo software. **Results:** While the participants were familiar with nutrition labels, their usage was relatively low during food selection due to the lack of interest in nutrition information, past experiences, hunger and cravings, time constraints and the taste of the food. The main reasons for using nutrition labels were health consciousness and their curiosity about specific nutrition information provided on the labels. The majority of participants believed that information provided on the labels was accurate because it was provided by reliable institutions. There was also misperception among some participants, mixing up nutrition labels with list of ingredients and the expiry dates. A few participants were unconvinced by the labels and stated that the labels provided misleading information. **Conclusion:** Personal factors such as knowledge, misperception, awareness and trust significantly impact how adolescents read nutrition labels.

Keywords: Nutrition labels, adolescents, food choice, focus group discussion

INTRODUCTION

Several studies have demonstrated that processed food and beverages contribute to the increased intake of fat, sugar, and salt (Baker & Friel, 2014). Ochola and Masibo (2014) showed that the widespread consumption of processed

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foods such as bread, biscuits, carbonated drinks, ice cream, canned sausage and cheese among adolescents contributes to the high prevalence of obesity. In order to prevent the excessive intake of processed foods and to make healthier food choices, i.e. to consume foods that are low in sugar, salt, and saturated fats, it is important that adolescents be motivated to read nutrition labels (Jun *et al.*, 2011).

As nutrition labels provide important information regarding the nutrient content of a food, they can guide consumers in the selection of food. In Malaysia, nutrition labels must include a nutrition information panel (NIP) with information on energy, protein, carbohydrate and fat content. Nutrition labels must be displayed on packaged foods and beverages (MOH Malaysia, 2010).

The National Health and Morbidity Survey (NHMS) 2014 (IPH, 2014) revealed that the percentage of Malaysians who do not read nutrition labels had increased to 55.0% from 19.3% in 2006 (IPH, 2006). Norazmir *et al.* (2012) reported that 53.6% of Malaysian youth did not use nutrition labels, while 69.5% did not understand it. Among Malaysian adolescents, 33.0% have been reported as always reading nutrition labels when purchasing food and only 24.8% of Malaysian adolescents were interested in nutrition information (IPH, 2017). Other studies have noted that a low percentage of adolescents use nutrition labels and most of them did not understand the information (Talagala & Arambepola, 2016; Wojcicki & Heyman, 2012). Therefore, nutrition education is important to increase awareness and use of nutrition labels. However, most nutrition education in Malaysia focuses on nutrition *per se* (Talib *et al.,* 2013), physical activity (Poh & Nor Izzati, 2016) and behavioural modification (Yahya *et al.*, 2017).

The present study aims to explore the personal factors that influence the use of nutrition labels amongst Malaysian adolescents.

MATERIALS AND METHODS

Study design and location

Data on the use of nutrition labels and the factors that influence this practice were gathered using focus group discussions (FGDs). The study was conducted in Negeri Sembilan, a state located in the central region of Peninsular Malaysia. Negeri Sembilan was selected because the prevalence of obesity among children and adolescents there (12.5%) was higher than that for the same group nationally (11.9%) (IPH, 2015).

Ethical Approval

The study procedures received approval from the National University of Malaysia (UKM) Ethics Board, the Malaysian Ministry of Education and the Negeri Sembilan State Department of Education.

Participants

The adolescents who participated in this study were recruited from five public secondary schools in both urban and rural areas. The schools were randomly selected from a list of public secondary schools located in four districts of Negeri Sembilan, namely, Seremban, Kuala Pilah, Port Dickson and Tampin. The students were eligible to participate in the study if they were adolescents aged 13-16 years, capable of reading and understanding the Malay language and had received the consent of their parents or guardians. Adolescents who were obese and diagnosed with common chronic diseases such as diabetes or asthma or who were on specific diet plans were excluded from the study. One hundred and fourteen participants were

screened prior to the study. Thirty-four participants met the inclusion criteria for the study.

Focus group discussion

Participants were asked to complete a demographic questionnaire prior to the FGD session. Five FGDs were conducted in five different public schools. Each session was held in a private room and the session lasted 55 minutes. The sessions were conducted in the Malay language. Two researchers facilitated the focus groups. One researcher acted as a moderator and the other took detailed notes. The moderator used validated, semi-structured interview questions that allowed the participants to generate new ideas and explore specific topics. The participants were informed that the discussion would be audio-recorded and that would not be shared with any third party.

The discussions began with an introduction by the moderator and a warm-up session. The moderator then briefly explained the objectives of the focus group and emphasised that the discussion would be confidential. The main discussion included questions exploring the personal, behavioural and environmental factors that influence the practice of reading nutrition labels among adolescent participants. Follow-up questions were asked to obtain additional details about the discussion topic and to allow the participants to clarify what they had said. The discussion ended with a summary of the entire discussion by the moderator and final comments from the participants. Table 1 shows the questions asked in this study.

Data collection and analysis

Data on the demographic characteristics of the participants were analysed descriptively. Audio-recorded discussions and field notes were transcribed verbatim onto a Microsoft Word document. Data cleaning was performed to ensure that the responses were correct and matched with the corresponding participant. Once the transcripts were finalised, the qualitative software QSR NVivo version 11 was used to analyse the data. Data were systematically and automatically coded by using main themes based on social cognitive theory: personal, behavioural and environmental factors (Bandura, 1986). After the coding process was completed, sub-themes were identified through the frequency of coding within similar factors from all focus groups. To ensure the reliability of the data, three researchers undertook the coding process. They reached an inter-rater correspondence of 90%. Finally, three experts evaluated the outcomes of the analysis to determine the value of Cohen's Kappa (K) based on the agreement of the experts (Landis & Koch, 1977). The calculated K value for this study was 0.84, which indicates significant agreement.

RESULTS

Participants

Demographic characteristics of the participants are shown in Table 2. Of the 34 eligible participants, only 33 participated in the discussions. One of the participants was absent from school during the FGD session. Most of the participants were female, aged 14 years old and Malay. More than half (55.0%) of the participants had bought pre-packaged food once or twice a week. The majority (90.9%) reported that they are aware of nutrition labels on food packages. However, only 24.2% reported they always read nutrition labels when purchasing such food.

The outcomes of personal factors were organised into themes based on the responses from participants. These were knowledge, misperception, awareness

Table 1. Interview guide of the focus group discussion

Topic	*Question*
Personal factor	1. Do you know what the nutrition label is? Probe: What do you understand about the nutrition label?
	2. What is your opinion on the importance of the nutrition label? Probe: Do you trust the information on the nutrition label?
Behavioural factor	3. Do you read/use the nutrition label when purchasing packaged food or beverages? Probe: Can you explain why you read/do not read the nutrition label when purchasing packaged food or beverages?
	4. Does the nutrition label influence you to buy packaged food or beverages?
	5. Can you name three types of information that you searched for when you read the nutrition label? Probe: Can you explain why you chose the information?
	6. These are two same products. Please choose one of the products based on their nutrition information. Then, please explain why you chose this product.
Environmental factor	7. How did you come to know about the nutrition label? Probe: Did you learn about it from your parents, teachers, friends, or media?
	8. Have you ever seen your parents, other family members, or friends read the nutrition label when purchasing packaged food or beverages? Probe: Did the nutrition label influence them to buy packaged food or beverages?
	9. Do you read the nutrition label when you buy packaged food or beverages after seeing their advertisements in media? Probe: Do you trust what is conveyed in the advertisements?
	10. These are two different nutrition information panels (NIP). Please choose one of the NIPs and describe what you like or dislike about its format and design.
	11. In your opinion, how can the NIP be improved to be more attractive? Probe: How about the colour/design/position of the NIP?
	12. How do you prefer to learn about the nutrition label, conventionally or using new media or technology? Probe: What else do you want to know about the nutrition label? Why do you want to know these things?
	13. In your opinion, what is the best way to educate adolescents to use the nutrition label when choosing their food? Probe: Why do you think an adolescent does not use/read the nutrition label when purchasing packaged food and beverages?

and the credibility of information on nutrition labels.

Knowledge of nutrition labels

In general, the participants described nutrition labels as information on the nutrient content of the food and its health implications. The majority of participants described nutrition labels as lists of nutrients and the amounts that were present in the food item. For example, one participant commented:

Table 2. The characteristics of participants

Characteristics of participants (n=33)	*n*	*%*
Gender		
Male	11	33.3
Female	22	66.7
Age (years)		
13	12	36.4
14	18	54.5
16	3	9.1
Ethnicity		
Malay	24	72.7
Chinese	7	21.2
Indian	2	6.1
BMI-for-age (z-score)†		
Underweight (z-score < -2SD)	2	6.1
Normal (z-score ≥ -2SD & ≤1SD)	31	93.9
The frequency of pre-packaged food purchase in the past week		
Never	8	24.2
1 – 2 times/week	18	54.5
3 – 4 times/ week	7	21.2
More than 4 times/ week	0	0.0
Do you know about nutrition labels?		
Yes	30	90.9
No	3	9.1
The frequency of nutrition labels reading during food purchasing		
Never	15	45.5
Sometimes	10	30.3
Always	8	24.2

†Classification based on WHO Growth Reference 5-19 years, BMI-for-age (5-19 years) (WHO, 2007)

"It tells how much sugar is in the food. It also shows energy and protein contents in that food" (FGD406, 13-year-old boy).

Another participant also responded:

"It shows how much fat is contained in the food. We can also know the sugar content of the food from the panel, that is, whether it is high or appropriate for our consumption" (FGD407, 14-year-old girl).

Further, participants described nutrition labels as tools to choose healthy foods. Most were concerned about the health benefits of the food that they purchased. Some of the responses were:

"*Nutrition label tells if the food is good for our health. If we over consume a particular nutrient, we can get sick. If we eat more fat, we can become obese or get other diseases*" (FGD305, 16-year-old girl).

"*I want to be healthy. The label tells me how much sugar they put in a food. If we take much sugar, we can get diabetes. To stay healthy, I will read the sugar content on the label to choose more nutritious food*" (FGD505, 14-year-old girl).

Misperception of nutrition labels

Some participants reported that the information on nutrition labels was confusing. Despite being well-informed about nutrition labels, they were not

able to differentiate nutrition labels with other information on food labels such as the expiry date and list of ingredients. For example:

"*Nutrition label is the expiry date on food packaged. I always read the expiry date to know the lifespan of a food product. It tells me if the food is already rotten. Sometimes I read the quantity of the food on the package*" (FGD101, 13-year-old boy).

"*Nutrition label tells us whether the food contains natural or artificial colouring. So we can assess the food from the health and safety aspects of ingredients before purchasing a food product*" (FGD203, 16-year-old girl).

Barriers to the use of nutrition labels

Although most of the participants were familiar with nutrition labels, the majority of participants were not interested enough to read them. The findings revealed five barriers to the use of nutrition labels: the lack of interest, past experiences, hunger and food cravings, time constraints, and taste of food.

Lack of interest

Many participants felt that nutrition labels were not important. For example:

"Sometimes I do not feel like reading it. I am too lazy to read all of the information. It is not even important to me" (FGD202, 14-year-old boy).

"For me, it is not important. I do not know; I feel like I do not need to read the information when I buy pre-packaged food" (FGD503, 14-year-old girl).

Past experiences

As some participants purchase the same foods regularly, they reasoned, there was no need for them to read the nutrition labels again.

"I do not read the nutrient contents because I have eaten that food before. I do not think I have to read the information again. I already know the content" (FGD105, 14-year-old girl).

"I always purchase that food. I already know the information because I have read the information before. So I do not have to read it again" (FGD407, 14-year-old girl).

Hunger and food cravings

The participants also stated that they preferred to purchase food that was ready to be consumed when they were hungry. They also purchased food they craved for even if they were not hungry. Therefore, reading nutrition labels was not important. Some participants expressed:

"I buy food that I want to eat. Whenever I see food in the supermarket that I like to eat it, I will just buy it without even reading the information" (FGD403, 13-year-old girl).

"I do not care about reading the information because I am too hungry. I just want to purchase and eat the food" (FGD504, 14-year-old girl).

Time constraints

Some participants also mentioned they had no time to read nutrition labels except for price and expiry date. For example:

"Sometimes when we are rushing, we do not have enough time to read all of the information. We want to make it quick" (FGD303, 14-year-old boy).

"I have no time to read the panel because we need to buy many things when I go grocery shopping together with my parents. We will only purchase food that we want" (FGD506, 14-year-old girl).

Taste of food

Participants also indicated they chose food that looked delicious and appealing:

"I bought food without reading the nutrition information because the

food looks so tempting" (FGD205, 13-year-old girl).

"I already know that the food tastes so good. I want to eat it even though I know that the food contains a lot of sugar. I do not think I need to read the nutrition information" (FGD201, 13-year-old boy).

On the other hand, the potential health benefits of the food motivated some of the participants who read nutrition labels. These participants thought that nutrition labels would interest them if they were overweight or concerned about non-communicable diseases:

"I want to reduce my fat intake because I want to lose weight. So every time I purchase food, I will look for information on fat content" (FGD401, 13-year-old girl).

"Normally I will read the glucose content of food to monitor my daily sugar intake because I am afraid of having diabetes" (FGD304, 16-year-old girl).

In addition, participants reported that the information influenced their choice of food to purchase. They stated that they read nutrition labels when they wanted to avoid certain nutrients with health risks:

"It will influence me to buy food only if the nutrient content is good for my health. For example, I will purchase food that is low in fat..." (FGD102, 13-year-old boy).

"I will not buy food that is high in sugar. Nowadays there are diseases that afflict persons of any age. Therefore, I will not purchase food that is bad for my health" (FGD305, 16-year-old girl).

Trusting nutrition labels

Some participants reported that they were not convinced by the information found on nutrition labels. However, the majority of the responses were positive. For example:

"I believe that the information [on nutrition labels] is true because the food comes from a reputable manufacturer endorsed by the government" (FGD106, 14-year-old boy).

"I will trust the information if the food is good for the health. For example, I will trust the nutrition label on less fat or less sugar food" (FGD306, 16-year-old girl).

While most of the participants thought that the information in nutrition labels was truthful, several other participants did not seem to think so.

"I do not believe these kinds of information on certain products. It happened to me once before. I purchased a supposedly low-sugar yoghurt, but it ended up being too sweet. So I do not trust the information so much" (FGD304, 16-year-old girl).

"I do not trust the information because the manufacturer can manipulate the details. They always claim that food is nutritious to attract buyers. However, it is actually high in fat and sugar, which is unhealthy" (FGD402, 13-year-old girl).

DISCUSSION

This study was conducted to explore the personal factors that influence the practice of reading nutrition labels amongst adolescents. The participants reported low usage of nutrition labels when purchasing food, even though a majority reported they recognised nutrition labels. Four sub-themes were identified reflecting personal level factors: knowledge, misperception, awareness and trust of nutrition labels information.

The increasing prevalence of overweight and obese individuals in Malaysia (Poh *et al.*, 2013) has directed the attention of policymakers to the

provision of nutrition information as an important tool to promote healthier eating habits. The regulations for mandatory nutrition labelling and nutrition claims in Malaysia have been implemented since 2003. Besides, the Ministry of Health Malaysia has been engaged in various activities to enhance the knowledge of consumers and awareness of nutrition labelling. For example, one of the aims of the "Healthy Eating Through Healthy Shopping" programme was educating the participants to read nutrition labels when making smart food choices in general (NCCFN, 2016). Nevertheless, there is no education programme focused on nutrition labelling among adolescents conducted by either the government or private bodies.

The use of nutrition labels enables consumers to make healthier food choices by comparing the nutritional values of similar food products to decide which one has the higher or lower amount of nutrients. However, studies have shown that most consumers do not refer to nutrition labels when purchasing food. Campos, Doxey & Hammond (2011) observed that the use of nutrition labels is lower among children, adolescents and older adults who are obese. The study highlights challenges regarding consumer understanding and appropriate use of labelling information. Studies have also found that adolescents had low usage of nutrition labels and most of them could not interpret information provided in nutrition information panel (Talagala & Arambepola, 2016; Saha *et al.*, 2013).

In the present study, most of the participants were familiar with nutrition labels, even though the majority reported they would not read them when purchasing foods. These findings are similar to a previous study which demonstrated low nutrition labels usage among adolescents (Wojcicki & Heyman, 2012). Nonetheless, the participants could understand nutrition labels and describe them as providing information on nutrient contents and their importance to health. Similar results have been reported by an earlier study on adults (Wahlich, Gardner & McGowan, 2013).

Additionally, some of the participants were confused between nutrition labels and other information on food labels such as expiry date and ingredients. Previous studies have shown that adolescents pay more attention to the expiry date, manufacturing date and also the list of ingredients (Talagala & Arambepola, 2016; Jacobs, deBeer & Larney, 2011) than they do to the nutrition panel.

Some participants reported that their main reason for using nutrition labels was because they were health conscious. Specifically, they were concerned about over-consuming some nutrients, such as fat and sugars, as these would make them fat or cause diet-related diseases. These findings were consistent with those from a study of female college students in South Korea, where the participants were interested in reading information on the calorie, fat and sugar content because they wanted to control their weight and reduce their intake of energy or fat (Lim, Kim & Kim, 2015). Similarly, another study found that individuals use nutrition labels and expressed their readiness to change their diet because of health-related concerns (Soederberg & Cassady, 2015).

This study has also revealed five barriers to the use of nutrition labels among participants, namely, the lack of interest, past experiences, hunger and food cravings, time constraints, and taste of the food. Results from the present study are consistent with other studies which have shown that the most common reasons given for not reading nutrition labels are the lack of interest (Ranilović & Baric, 2013) and time to read when making

food purchases (Prieto-Castillo, Royo-Bordonada & Moya-Geromini, 2015). A study conducted in a supermarket found a low usage of nutrition labels by participants who considered the taste as the main reason for purchasing a particular food (Petrovici *et al.*, 2012). A study based on interviews of female consumers in the United Kingdom found that reading nutrition information was viewed as time-consuming and tiresome. The respondents reported that they bought food that was convenient and quick to consume. Jacobs *et al.* (2011) also observed that the reasons for not reading nutrition labels were because of taste and price considerations (and more important than other reasons), lack of knowledge in nutrition and time constraints. According to Koen *et al.* (2018), another important reason was because they bought the same brand of a product all the time.

Most of participants in the present study were convinced that the information on the nutrition labels was truthful though some expressed scepticism about it. Our results are consistent with results of similar studies on younger respondents (Campos *et al.*, 2011). Often, the participants were worried that food manufacturers could easily manipulate nutrition information to entice people to buy their products. A review by Tonkin *et al.* (2015) found similar concerns about their accuracy.

Psychological, economic and social factors played an essential role in influencing the use of nutrition labels. For example, adolescents from a low-income family preferred to buy cheaper food even if they were thought to be unhealthy. Those from middle or high-incomes preferred to buy more expensive but healthier foods. Social influences from parents and friends may also have an impact on the knowledge, attitudes and preferences of adolescents toward food (Bargiota *et al.*, 2013), which may limit their use of nutrition labels.

To the best of our knowledge, this is the first qualitative study done in Malaysia to explore the personal factors that influence the understanding and practices of reading nutrition labels among adolescents. However, there are some limitations in the present study. First, the sample size was small and findings may not be generalised for all Malaysian adolescents. However, the focus group discussions were sufficient to obtain detailed information about the participants' personal views on this issue. Furthermore, the perspectives of the adolescents on their food choices may be influenced by their exposure to educational programmes at school, as well as gender, race, socioeconomic status, and other factors that have not been addressed in this study. Future research should explore the opinions of adolescents based on gender, race or socioeconomic status.

CONCLUSION

Personal factors such as knowledge, misperception, awareness and trust on nutrition labels information have significant impact on the practice of reading nutrition labels among adolescents. Food manufacturers may need to communicate better and design more effective nutrition labels. The findings of this study can provide important information to improve knowledge, attitude and practices of reading nutrition labels among adolescents.

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Authors' contributions

NJ, led the data collection, conducted the study, data analysis and interpretation, prepared the draft of the manuscript and reviewed the

manuscript; NMN, advised on study methodology, data analysis and interpretation and reviewed the manuscript; RAT, principal investigator, conceptualized and designed the study, provided advice and interpretation of the data and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Nutrient composition of milkfish (C*hanos chanos*, Forskal) from Pangkep, South Sulawesi, Indonesia

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ABSTRACT

Introduction: Milkfish is a potential source of animal nutrition, especially for supplying human protein needs. In the present paper, we provide complete data on nutrient content of milkfish that can be used as a reference for diet formulation and for the further processing of milkfish. **Methods:** Proximate analysis, amino acid and fatty acid composition, and vitamin and mineral content of milkfish were determined. **Results:** The results showed that milkfish contained high concentration of protein (24.18%) and high proportion of monounsaturated fatty acids as oleic acid (32.11%). The amino acid found in the highest concentration was glutamic acid (1.28%). The macro-minerals in the milkfish were calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K). Among the micro-minerals present were iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn), and the main vitamins present include A, B1 and B12. **Conclusion:** Based on their protein content, milkfish may be classified as a source of high protein. Glutamic acid which is the highest amino acid in milkfish as well as fatty acid content of oleic acid makes milkfish a healthful fish.

Keywords: Amino acids, fatty acids, milkfish, minerals, proximate, vitamins

INTRODUCTION

Milkfish is one of the most cultivated fish species in Indonesia, because these fish have a high tolerance to the various environmental conditions of tropical waters and are resistant to many pests and diseases. One of the districts that has developed milkfish cultivation in Indonesia is the Pangkep Regency where it is one of the main commodities produced.

Milkfish is the most consumed fish by the people of South Sulawesi and even Indonesia because of their success in the brackish aquaculture sector. Thus it is important to have information about the nutritional content of milkfish for consumers and the fisheries processing industry for storage and processing needs.

The nutritional content of milkfish is influenced by internal and external factors. Influential internal factors include gender, age and reproductive phase. Influential external factors include cultivation location or habitat,

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feed formulation and conditions of the quality of the waters of the fish farm (Hafiludin, 2015).

This was a preliminary study that was conducted in the Pangkep Regency to determine the nutritient composition of milkfish from pond culture. This study is the initial stage of a series of research in making premix powder from milkfish surimi.

MATERIALS AND METHODS

Materials

A total of 20 fresh milkfish were obtained from ponds in Mandalle District in the Pangkep Regency of South Sulawesi, Indonesia, in September 2017. The milkfish samples that were chosen were of uniform size. The fish samples were put in an insulated box containing ice, with a fish to ice ratio of 1:2 (w/w) and transported to the Chemical Analysis Laboratory, State Polytechnic of Ujung Pandang, Indonesia. Other materials used in this study were chemicals for proximate analysis, and the determination of minerals, vitamins, amino acids, and fatty acids profiles. The standards of fatty acid methyl ester (FAME) were obtained from Supelco Inc., Bellefonte, PA (Supelco 37 Component FAME Mix) and all other chemicals or reagents were from Merck, Germany.

Sample preparation

Five samples were taken randomly from the 20 fish obtained for analysis. Length (cm) and weight (g) measurements of the milkfish samples were taken using digital micrometres and digital scales, respectively. The fish were descaled and dissected with a cleaned stainless steel knife. After morphometric measurements, the central vertebra of each fish was completely removed. The head and viscera were discarded. The edible part, i.e. the flesh and skin, which represent the parts consumed by the local population, was filleted (deboned), cut into small pieces and homogenised. The homogenised sample were stored at -40°C for 12 h and used for food composition analyses, except for those specifically mentioned below. The multiple analysis for proximate composition and single analysis for other analysis were applied.

Proximate composition analysis

For lipids analysis, the fresh edible parts of the milkfish were immediately used. For proteins, ash and mineral analyses, the samples (edible parts or clean central vertebrae) were dried in an oven at 45°C for 48 h and were homogenised thoroughly in a food blender with stainless steels cutters. The proximate composition analysis was carried out by following the methods of the Association of the Official Analysis Chemists. The moisture content was determined by using a hot air oven, drying the sample at 105°C±2°C until a constant weight was obtained (AOAC, 1990). Total lipid was determined by the Soxhlet method. The crude protein content was determined by converting the nitrogen content obtained by Kjeldahl's method (N×6.25) (AOAC, 1990). Ash was obtained after the incineration of moisture-free dry samples in a tube furnace at 600°C for 6 h (AOAC, 2006). Total carbohydrate was determined by subtracting the sum of fat content, protein content, ash content and moisture from 100.

Mineral analysis was undertaken using the S2 Ranger X-ray Spectrometer, according to the user manual XRF (2012) by Bruker AXS GmbH, Ostiche Rheinbruckenstr, 49.76187 Karlsruhe, Germany. Fatty acid compositions were determined by gas chromatograph mass spectrometer (GC-MS) QP 2010 Shimadzu (Japan). Lipids were esterified by the method adapted from Metcalfe (1961), which consisted of lipid saponification with 0.5 M potassium

hydroxide (KOH) in methanolic solution and catalysed by boron trifluoride-methanol reagent. The sample was solubilised by dichloromethane, from which 1 µL was injected for GC analyses. To separate and quantify the esterified FA mixture, the GC-MS QP 2010 by Shimadzu equipped with split/split less injector, capillary column RTX®-1 (30 m×0.25 mmID×0.25 µm) was used. Helium was used as the carrier gas at a flow rate of 1.25 mL/min. The injector and detector temperatures were set to 260°C. The chromatographic conditions for separation were: column initial temperature of 50°C, raising to 200°C at a rate of 6°C/min, holding during 4 min. The second step consisted of increasing the heating rate at 2°C/min to 240°C, and held for 10 min. FAME peaks were identified by comparing their retention times with equivalent chain length standards of FAME.

The amino acid composition was determined by following the method of Ishida, Fujita & Asai (1981). Muscle protein was hydrolysed with 6N hydrochloric acid (HCl) at 110°C under anaerobic condition for 24 h. The hydrolysed samples were neutralizsd with 6N sodium hydroxide (NaOH) and were derivatised using a kit (AccQ-Fluor Reagent, WAT052880, Waters, USA). The derivatised samples were injected into high performance liquid chromatography (HPLC) (1525, Waters) equipped with a C18-RP column and a fluorescence detector (2475, Waters). The amino acids were identified and quantified by comparing with the retention times and peak areas of standards (WAT088122, Waters). For the tryptophan analysis, the minced meat was digested with 5% (w/v) NaOH for 24 h and neutralized to pH 7.0 with 6N HCl. The tryptophan content was measured spectrophotometrically at 530 nm (Sastry & Tammuru, 1985).

Data analysis

The analytical data that was obtained from this study was compared with previously published results of the nutritional composition of milkfish from fish farms in Bangkalan Madura, East Java, Indonesia and Narasapur West Godavari, Andhra Pradesh, India.

RESULTS

The average weight and length of the fish used in this study were 191.70±12.13 g and 28.25±2.41 cm, which are approximately the sizes of the milkfish consumed in many households. The results of proximate analysis, that of the content of minerals and vitamins, and the amino acid and fatty acid profile of milkfish are presented in Table 1, 2, 3, and 4.

DISCUSSION

Proximate composition

Our results showed that water is the main constituent of milkfish. The

Table 1. Proximate composition of milkfish (%)

Component	*Pangkep, Indonesia*†	*Bangkalan, Indonesia*‡	*Narasapur, India*§
Moisture	70.79±0.23	70.78	72.18±0.39
Crude Protein	24.18±0.36	24.18	20.37±0.50
Crude Fat	0.87±0.05	0.85	3.84±0.39
Total Ash	1.40±0.02	1.41	4.02±0.08
Carbohydrate	2.77±0.21	2.78	NA

†Primary data from this study
‡Hafiludin (2015); no SD values reported by the author
§Murthy *et al.* (2016)

Table 2. Content of main minerals and vitamins of milkfish

Component	*Pangkep, Indonesia*[†]	*Bangkalan, Indonesia*[‡]	*Narasapur, India*[§]
Minerals (mg/100 g)			
Calcium	54.92	56.22	355.50
Copper	0.04	0.04	0.30
Iron	0.03	0.03	8.00
Potassium	320.01	318.73	845.50
Magnesium	39.97	40.10	NA
Manganese	0.06	0.06	NA
Sodium	61.89	83.67	NA
Zinc	0.08	0.08	10.56
Vitamins			
Vitamin A (mg/100 g)	0.02	0.01	NA
Vitamin B1 (mg/100 g)	0.06	0.05	NA
Vitamin B12 (mg/100 g)	3.81	3.97	NA

[†]Primary data from this study
[‡]Hafiludin (2015)
[§]Murthy *et al.* (2016)

Table 3. Amino acid profile of milkfish (%)

Amino Acid	*Pangkep, Indonesia*[†]	*Bangkalan, Indonesia*[‡]	*Narasapur, India*[§]
Alanine	0.73	0.78	5.80
Arginine	0.26	0.29	2.10
Aspartic acid	0.80	0.79	12.00
Glutamic acid	1.28	1.27	16.20
Glycine	0.28	0.27	2.60
Histidine	0.49	0.49	6.10
Isoleucine	0.34	0.35	4.90
Leucine	0.67	0.67	8.00
Lysine	0.57	0.52	7.30
Methionine	0.25	0.22	3.00
Phenylalanine	0.34	0.34	6.70
Proline	0.41	0.41	0.70
Serine	0.29	0.29	4.70
Cysteine	0.14	0.14	0.40
Tyrosine	0.26	0.26	3.20
Threonine	0.45	0.45	4.40
Valine	0.46	0.47	5.90

[†]Primary data from this study
[‡]Hafiludin (2015)
[§]Murthy *et al.* (2016)

Table 4. Fatty acid profile of milkfish (%)

Fatty acid	*Lipid Number*	*Group*	*Pangkep, Indonesia*[†]	*Bangkalan, Indonesia*[‡]	*Narasapur, India*[§]
Myristic	C14:0	SFA	4.13	4.04	1.09
Palmitic	C16:0	SFA	41.00	41.48	29.82
Stearic	C18:0	SFA	4.20	4.01	7.28
Oleic	C18:1	MUFA	32.11	31.40	26.10
Linoleic	C18:2	PUFA	6.72	6.04	10.90
Linolenic	C18:3	PUFA	3.81	3.46	0.89

[†]Primary data
[‡]Hafiludin (2015)
[§]Murthy *et al.* (2016)
SFA: saturated fatty acid; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid

moisture content of milkfish was 70.79±0.23% and high levels occurred in the edible parts. The moisture content in fish has been reported to be 70% and 80% of the total weight (Ackman, 1989). The moisture content of fresh fish determines its durability from decay caused by microbial growth and enzyme activity (autolysis) at room temperature. Higher moisture content accelerates fish rot. The high water content of fresh milkfish meat causes the fish to require proper handling after harvest to maintain its quality or for further processing into food products.

The protein content of the edible parts of milkfish was 24.17±0.36%. This indicated that the milkfish contained high levels of protein, and can thus be used as a source of animal protein. The high protein content of >15% of milkfish placed it in the high-protein fish category (FAO, 2016). The fat content was 0.87±0.05%. This, according to the Ackman classification (1989), placed it in the low-fat category of <2%. Fish can be classified based on the composition of fat and protein. If it contains fat content <5% and protein content >20%, then it is considered as fish with low fat content and high protein (Stansby, 1976). The low fat and high protein content of fresh milkfish provide an opportunity to process its meat into protein-rich premix flour.

Carbohydrate and total ash content were low compared to other nutrients. The chemical composition of each fish varies depending on the species of fish, between individual fish within the species, and between parts of the body of an individual fish. These differences can be caused by several factors, namely age, metabolic rate, movement of fish, feed, reproduction period, habitat and eating habits. The chemical composition varies greatly from one species and one individual to another depending on diet, sex, age, environment and season (Ondo-Azi *et al.*, 2013).

Mineral and vitamin content

The milkfish is rich in mineral content in the form of potassium, calcium, magnesium and sodium. Calcium and phosphorus are essential nutrients for growth and are the main elements of the structural components of human bone tissue (Murthy *et al.*, 2016). Low concentrations of sodium and high potassium were observed. It has been suggested that a sodium to potassium ratio in food of less than 1 acts to prevent cardiovascular disease (Perez, Ellen & Chang, 2014).

Microelements are essential for human nutrition (Francisca *et al.*, 2013). Among the most abundant microelements found in the edible parts were iron and zinc. Milkfish originating from Indonesian waters have a low iron and zinc content, unlike that which is cultivated in India. This is thought to be influenced by the nutrient content present at the location of the fish culture. Some microelements can be harmful when present in high concentration. However, the concentrations of copper, zinc, manganese and iron in the samples were lower than the toxic levels described by FAO/WHO (FAO, 2001).

Amino acid profile

The protein quality of any food is judged by the ratio of essential and non-essential amino acids that are present in it. High-quality protein contains dietary essential amino acids in quantities that correspond to human requirements (WHO, 2007). The amino acid profile of milkfish consists of approximately 17 types of amino acids (Table 3). Milkfish also contains the highest essential amino acids namely leucine. The difference of amino acid composition in milkfish meat is caused by several factors. These are internal factors including age, size, condition of fish, and the external factor that is the habitat. The red meat and white meat, liver, heart and other organs in milkfish have different amino acid compositions. The highest amino acid content for red meat and white meat in milkfish is histidine and taurine, while the highest amino acid for other organs (liver, intestine, and heart) is the amino acid taurine (Chyuan-Yuan *et al.*, 1996). Table 3 shows that the content of glutamic acid in milkfish meat is fairly high, giving the brackish water fish a more savoury taste. Seafood tastes are mostly influenced by the content of free amino acids (FAA). The FAA that is dominant in the white muscle of milkfish are histidine, taurine, and glycine (Shiau *et al.*, 2001).

It has been proposed that FAA regulates the main metabolic pathways to improve the health, survival, growth, development, lactation and reproduction of organisms. FAA also plays an important role in the prevention of metabolic diseases such as obesity, diabetes, and cardiovascular disorders, intrauterine growth restriction, infertility, intestinal and neural dysfunction and infectious diseases. Clandinin *et al.*, (1997) reported that arginine, cystine, leucine, methionine, tryptophan, tyrosine, aspartate, glutamic acid, glycine, proline, and taurine have been classified as important FAA in human nutrition.

Fatty acid profile

Fish lipids are known to be beneficial to human health because they are rich in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The fat content and fatty acid composition of fish varies according to species, season and environmental conditions (Moradi *et al.,* 2011). Six main types of fatty acids were identified in milkfish (Table 4). The saturated fatty acid that is present in highest concentration is palmitic acid, while the highest unsaturated fatty acid is oleic acid. The fatty acid content of palmitic and oleic acids in cultured milkfish from Indonesia is higher than that of cultured milkfish from India.

Fish have the ability to synthesise saturated fatty acids and monounsaturated fatty acids. It can also selectively absorb and metabolise fatty acids in their food intake including long chain polyunsaturated fatty acids (Bell *et al.*, 1997) to obtain optimum fatty acid compositions (Ackman, 1989). This optimum composition appears to be a characteristic specific to each species and even each strain (Pickova, Kiessling & Dutta, 1999).

CONCLUSION

Based on the results of proximate analysis, the profile of amino acids and fatty acids, and the content of minerals and vitamins, it can be concluded that milkfish is a highly nutritious source of animal food. Based on its protein content, milkfish has been classified as a source of high protein. Glutamic acid, which is the amino acid that is present in the highest concentration, makes milkfish very popular. In addition, the oleic acid content makes milkfish very good for health.

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Authors' contributions

MS, the principal investigator, conceptualised and designed the study, undertook the data analysis and interpretation of results, prepared the draft of the manuscript and reviewed it; TAB, provided advice on data analysis and interpretation and reviewed the manuscript; MMT and MB provided advice on the data analysis and interpretation and reviewed the manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest in relation to this article

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Total lipid and omega-3 content in Pangasius catfish (*Pangasius pangasius*) and milkfish (*Chanos chanos*) from Indonesia

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ABSTRACT

Introduction: Supplementation of the diet with fish oil omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) has been associated with multiple health benefits. This study aimed to determine total lipid and omega-3 content in two fishes from Indonesia, which were *Pangasius pangasius* (*P. pangasius)* and *Chanos chanos (C. chanos).* **Methods:** Total lipid was extracted from *P. pangasius* and *C. chanos* and the lipid content was then analysed using gas chromatography–mass spectrometry (GC-MS). **Results:** Lipid content of *C. chanos* (4.63±3.84%) was higher than *P. pangasius* (3.94±1.43%) but less than that found in *Salmo salar* (*S. salar)* which was found to contain 6.98±2.56% lipid. Furthermore, polyunsaturated fatty acid omega-3 (EPA and DHA) analysis showed that *C. chanos* oil contained 0.36% EPA and 1.17% DHA. These levels are lower than that found in *S. salar*, often referred to as the "gold standard" for omega-3 fatty acids. **Conclusion:** *C. chanos* contains considerable amounts of EPA and DHA. As it is widely available in Indonesia, it may be used as source of omega-3 fatty acids instead of salmon.

Keywords: *Chanos chanos*, *Pangasius pangasius*, omega-3 fatty acids

INTRODUCTION

Omega-3 fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have been associated with various health benefits. These dietary polyunsaturated fatty acids (PUFAs) play a role in the immunological (Ergas *et al.*, 2002), neuronal (Katakura *et al.*, 2013) and muscular system (Smith, 2016). They also support adult and foetal development (Starling *et al.*, 2015). The supplementation of omega-3 fatty acids through fish oil has been proven to reduce blood pressure in patients with systolic hypertensions significantly (Minihane *et al.*, 2016). Furthermore, population that resides in fishing village or those who consume large amount of fish are found to have lower chance of suffering from cardiovascular diseases (Bjerregaard & Dyerberg, 1988).

The dietary intake demands of omega-3 fatty acids EPA and DHA are met mainly through the consumption of fish, fish oil and krill oil since only a limited percentage of EPA and DHA (<15%) is formed in the body from the shorter 18-carbon-fatty acids, alpha-linoleic acid (ALA). Unlike EPA and DHA, ALA is derived from plant oil such as

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canola oil, flaxseed oil as well as chia seed and soya bean (Harris, 2010). The composition of DHA and EPA present in fish depends on the types of food it consumes (Sprague, Dick & Tocher, 2016). USDA reported that *Salmo salar* (*S. salar*), especially the Atlantic salmon, contain high levels of EPA and DHA. Unfortunately, salmon is known to be expensive due to their susceptibility to sea lice and changes in ocean condition. The act of over harvesting and changes in land use has reduced the number of salmon overtime (Hilborn, 2013). Efforts have been developed to attend to and resolve such problem (Gormaz *et al.*, 2014).

Although Indonesia accounts for 4.6% of global food fish aquaculture production, it depends on imports for salmon (FAO, 2014). Consequently, efforts have been made to analyse local fishes to find a substitute for salmon as a source omega-3 fatty acids. Indonesia has been the second producer of *Chanos chanos* (*C. chanos*) after Philippines and the second producer of *Pangasius* sp. after Vietnam. Due to toxicity concern as a result of heavily polluted Mekong River in Vietnam (Murk, Rietjens & Bush, 2016), Ministry of Marine Affairs and Fisheries Indonesia (2016) reported the increase in production of *Pangasius* sp. during the period 2011-2015. Furthermore, a report by Food and Agriculture Organization (FAO) Regional Office for Asia and The Pacific (Needham & Funge-Smith, 2015) showed that the amount of fish consumption in Indonesia was 187,200 tons for *C. chanos* and 130,000 tons for *P. pangasius*. In view of the high production and consumption of *C. chanos* and *Pangasius pangasius (P. pangasius)* in Indonesia, this study assessed the lipid and omega-3 content of *C. chanos*, *P. pangasius*, and *S. salar*.

MATERIALS AND METHODS

Sample preparation

Raw fish samples, including four *P. pangasius* and three *C. chanos*, were obtained from traditional markets in Tangerang, Indonesia. Meanwhile, three *S. salar* were obtained from supermarket in Tangerang, Indonesia. The samples were then halved equally, but only one piece was used. Since *S. salar* is bigger than *P. pangasius* and *C. chanos*, only the middle part (around one third) of one piece was used (Figure 1). The cut samples were incised and the ventral and dorsal muscles were taken. Later, a sharp knife was used to separate the skin from the meat of the cuttings. The meat was then partitioned into smaller cubes (Figure 2).

Lipid extraction

The lipid content of fish samples was extracted and purified according to Bligh & Dyer (1959). Each 100 g sample of the fresh or frozen fish tissue was homogenised for 1 min with a mixture of 100 ml chloroform and 200 ml methanol, followed by the addition of 100 ml chloroform. After blending for 1 min, 180 ml distilled water was

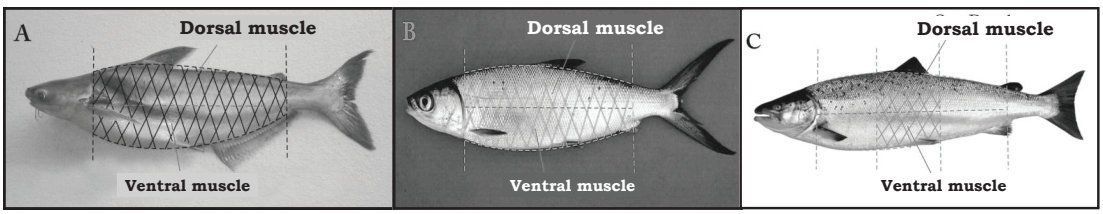

Figure 1. Incision of (A) *P. pangasius*, (B) *C. chanos*, and (C) *S. salar*. ××× refers to cutting area.

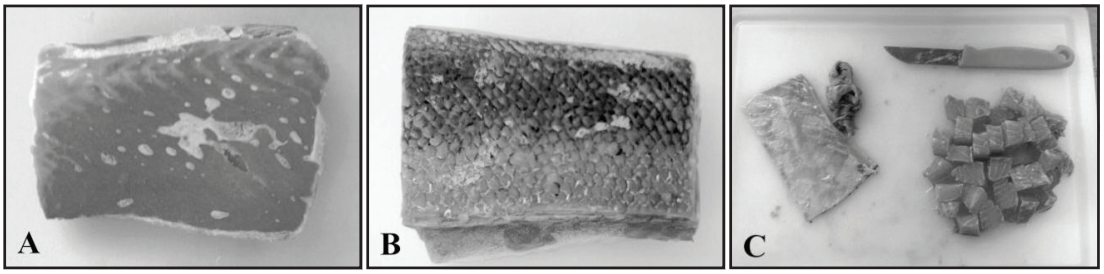

Figure 2. Separation of fish meat and skin sample. (A) Layer of meat on large pieces of *S. salar*; (B) Layer of skin on large pieces of *S. salar*; (C) Skin and small pieces of *S. salar*.

added and blended for another 1 min. The homogenate was then filtered and centrifuged at 1,000 rpm for 10 min. The chloroform layer formed at the bottom of the tube contained the purified lipid was then aspirated and filtered. Upon filtration, the solvent was evaporated using a rotary evaporator at 50 °C with agitation at 120 rpm. To ensure all the solvent was removed, the concentrated lipid was dried at 100 °C for 1 h and then cooled to room temperature. The lipid that was obtained was weighed and placed in a vial.

Gas chromatography–mass spectrometry (GC-MS) preparation

Fatty acid methyl esters (FAME) of total lipid were prepared for GC-MS analysis (Harynuk, Wynne & Marriott, 2006). The ampoule containing the mixture of 15 mg lipid and 1 ml of 14% BF3-MeOH was flame-sealed. It was then placed in boiling water for 7 min. After cooling to room temperature, the ampoule was broken and the lipid was poured into a new ampoule. One ml of hexane was added to the lipid and the ampoule was then filled entirely with distilled water and flame sealed. The mixture was homogenised with vigorous shaking and then incubated till phase layers were formed. After allowing for complete separation, ampoule was broken and the organic layer on top was moved into a new vial. For GC-MS analysis, standard methyl ester EPA and DHA were used.

Gas chromatography–mass spectrometry (GC-MS) procedure

Prior to sample injection, hexane was injected three times to rinse GC-MS machine. Lipid samples (1 µl) and standard methyl ester EPA-DHA (1 µl) were separately injected and the chromatograms that were obtained were analysed. The EPA and DHA concentration in sample were calculated based on relative abundance by comparing the peak of EPA and DHA on sample's chromatogram with standard's chromatogram, which showed the peak of known concentration of EPA and DHA.

RESULTS

The meat was analysed for its total lipid as it was the most commonly consumed part of the fish. Total lipid content in raw fish samples as compared to other fishes is shown in Table 1. Salmon had the highest lipid content (6.98±2.56%) followed by *C. chanos* (4.63±3.84%) and *P. pangasius* (3.94±1.43%). Since *C. chanos* had a higher lipid content, its omega-3 fatty acid component was then analysed using GC-MS. Figure 3 is a typical GC-MS chromatogram of fatty acids in lipid samples of *C. chanos.* Table 1 shows the polyunsaturated fatty acid omega-3, EPA and DHA content in *C. chanos* and *S. salar* analysed in this study, alongside content reported by other sources.

Table 1. Total lipid and omega-3 fatty acid content in various fishes

Fish species	*English name*	*Country*	*Total lipid (%)*	*Omega-3 (g/ 100 g)*		*Reference*
				EPA	*DHA*	
Salmo salar†	Atlantic Salmon	Indonesia	6.98±2.56	1.60	3.89	this study
Salmo salar, wild	Atlantic Salmon	United States	6.34	0.29	1.12	Exler, 2007
Salmo salar, farmed	Atlantic Salmon	United States	10.80	0.62	1.29	Exler, 2007
Salmo salar, wild	Atlantic Salmon	n/a	2.54	0.32	1.12	USDA, 2018 (NDB_No:15076)
Salmo salar, farmed	Atlantic Salmon	n/a	13.42	0.86	1.10	USDA, 2005 (NDB_No:15236)
Salmo salar, farmed	Atlantic Salmon	Scotland	12.40±3.50	0.60±0.30	0.80±0.30	Henriques *et al.*, 2014
Salmo salar, farmed	Atlantic Salmon	Norway	10.00±2.30	0.40±0.10	0.60±0.20	Henriques *et al.*, 2014
Salmo salar, farmed	Atlantic Salmon	Faroe Island	11.70±0.90	0.80±0.10	1.20±0.10	Henriques *et al.*, 2014
Chanos chanos†	Milkfish	Indonesia	4.63±3.84	0.36	1.17	this study
Chanos chanos	Milkfish	n/a	6.73	n/a	n/a	USDA, 2018 (NDB_No:15053)
Pangasius pangasius†	Pangasius Catfish	Indonesia	3.94±1.43	n/a	n/a	this study
Pangasius pangasius	Pangasius Catfish	Indonesia	3.83±0.77	0.21-2.48	0.95-9.96	Panagan, Yohandini & Gultom, 2011
Pangasius hypothalamus	Striped catfish	Malaysia	6.23	1.41±0.03	0.14±0.01	Muhamad & Mohamad, 2012
Ictalurus punctatus, wild	Channel Catfish	n/a	2.82	0.13	0.23	USDA, 2018 (NDB_No:15010)
Nile tilapia	Tilapia	n/a	1.70	0.01	0.09	USDA, 2002 (NDB_No:15261)

†fish samples in this study

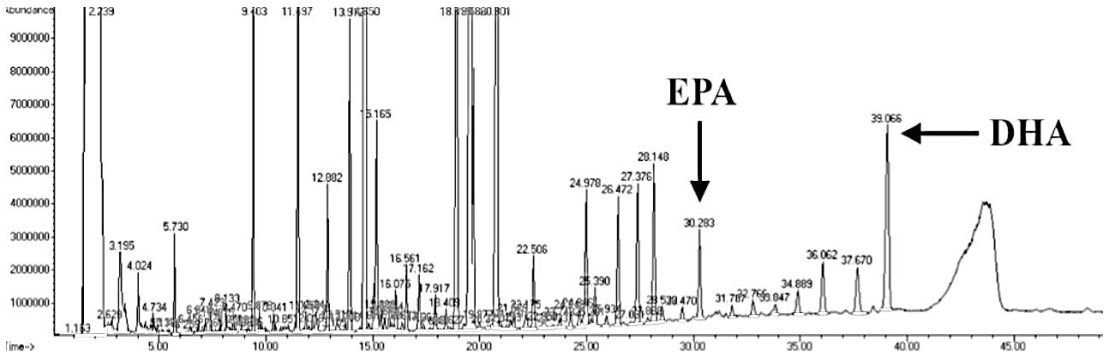

Figure 3. GC-MS chromatogram of fatty acids in lipid samples from *C. chanos*. Peaks of EPA and DHA from lipid sample of *C. chanos* are displayed at RT 30.283 and 39.066 min, respectively

DISCUSSION

The lipids of the fish samples were extracted and purified in a single-step procedure (Bligh & Dyer 1959). The complex mixture of lipid was fractionated according to polarity or solubility in different solvents. Chloroform, which is hydrophobic solvent, was used to extract neutral lipids with low polarity. The more polar solvent, methanol, was used to extract the amphiphilic membrane lipids. Optimum lipid extraction was achieved when fish tissue was homogenised with a mixture of chloroform and methanol. The resulting homogenate was then added to water and this resulted in monophasic solution with methanol, but produced a biphasic layer with chloroform. As a result, the chloroform layer contained lipids and the methanol-water layer contained the non-lipids. When chloroform layer was isolated, a purified lipid extract was obtained.

Salmon, especially the *S. salar* (the Atlantic salmon), was reported to have high lipid content, while other local fresh water fishes, such as *P. pangasius* and *C. chanos*, were reported to have lower lipid content (Table 1). Nevertheless, high amount of total lipid does not mean a high content of omega-3 fatty acids since the fish oil contains both unsaturated fatty acids (UFA) and saturated fatty acids (SFA) (Panagan, Yohandini & Gultom, 2011). Foods with high SFA and low UFA content are not recommended for consumption. Omega-3 fatty acids are one of the UFA commonly found in fish oil.

USDA Food Composition Databases provided data on the nutritional composition, including total lipids and PUFAs, of *C. chanos*. However, data on EPA and DHA content was not mentioned, suggesting the lack of information on EPA and DHA in this fish. On the other hand, the Atlantic Salmon was reported to contain 0.32-0.86% EPA and 1.10-1.11% DHA (Table 1). The EPA and DHA content in the Atlantic Salmon that was used in this study was found to be higher than that reported by the USDA. These differences of the omega-3 fatty acids content are due to the different samples used. A previous study, for example, reported differences in EPA and DHA content between wild and farmed Salmon (Sprague, Dick & Tocher, 2016). Like humans, salmon are inefficient at converting the shorter-chain fatty acids, α-linolenic acid (ALA; 18:3n-3), into EPA and DHA. As such, they need to obtain the omega-3 through their diet. Wild salmon usually consume foods with high levels of marine ingredients, including other pelagic fish. Farmed salmon are usually fed with terrestrial food such as those from plant sources which are mainly of oilseed origin (Bell *et al.*, 2004). The fatty acid profiles of vegetable oils differ from those of fish oil, the former being richer in omega-6 and devoid of omega-3 fatty acids, resulting in changes to the fatty acid composition of farmed fish (Torstensen, 2005).

The Atlantic salmon, *S. salar,* often referred to as the "gold standard" for omega-3 fatty acids were found to have higher EPA and DHA ie 1.60% and 3.89% respectively than *C. chanos* oil. Nevertheless, the sample of *C. chanos* analysed was found to contain a considerable amount of these important omega-3 fatty acids, ie 0.36% EPA and 1.17% DHA.

CONCLUSION

The study was conducted due to the vast availability and production of both *C. chanos* and *P. pangasius* in Indonesia in contrast to the scarce availability of salmon. To date, there is no information on omega-3 fatty acid content of *C. chanos* and *P. pangasius,* both of which are widely available in Indonesia. The analysis showed that *C. chanos* has

considerable content of EPA and DHA which can be used as an alternative source of the beneficial fatty acids.

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Authors' contributions

MS, advised on the data analysis and interpretation, prepared the draft of the manuscript and reviewed the manuscript; PFW, conducted the study, performed data collection, analysis and interpretation; JL, assisted in drafting of the manuscript and reviewed it; TTJ, conceptualised and designed the study, advised on the data analysis and interpretation, assisted in the drafting and reviewing the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Energy density of ethnic cuisines in Singaporean hawker centres: a comparative study of Chinese, Malay and Indian foods

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ABSTRACT

Introduction: A major focus in the prevention and management of obesity has been in the self-monitoring of foods consumed to reduce total energy intake. The present study used a novel instrument called the Calorie Answer™ to measure the energy content of various local foods in Singapore. The study aimed to build a database on energy density of commonly consumed Chinese, Malay and Indian foods to facilitate appropriate food choices by the consumer. **Methods:** The first part consisted of measuring the energy density of 15 popular local foods purchased from 8 different hawker centres. In the second part, 46 additional local foods were analysed, again using the Calorie Answer™ instrument. **Results:** Despite the different locations from which the foods were purchased, the energy content of the same foods was remarkably similar with a coefficient of variation (CV) of ≤15% for all foods. There was a higher average energy density of Indian foods compared to Chinese and Malay foods (Welch test, p=0.027). **Conclusion:** Our results suggest that the energy density of commonly consumed foods from different locations was remarkably similar. The average energy density of Indian foods was significantly higher than that of Chinese and Malay. Knowledge of the energy density of foods is essential information that is needed in the battle against being overweight and obesity. The application of the Calorie Answer™ may be used as a means to collate data on the energy density of foods consumed in other countries in the ASEAN region.

Keywords: Energy density, calories, food intake, variability, Singapore

INTRODUCTION

With rapid urbanisation, economic growth and advancement in technology, there has been a dramatic increase in consumption of animal fats, refined grains, sugar sweetened foods and a concomitant decline in physical activity (Malik, Willett & Hu, 2013). This is particularly evident in developed countries such as Singapore where the prevalence of obesity has been consistently rising (Yoon *et al.*, 2006). The aetiology of obesity is due to being in a state of positive energy balance. Energy

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balance may be defined as the difference between energy intake and energy expenditure. Obesity is known to be one of the major preventable risk factors that drive the epidemic of diabetes and cardiovascular diseases (CVDs) (Garrow, 1992; Kim, Després & Koh, 2016).

A major focus in the prevention and management of obesity has been in the self-monitoring of foods consumed, in order to reduce total energy intake (Burke, Wang & Sevick, 2011; Foster, Makris & Bailer, 2005; Wadden & Butryn, 2003). A significant nutritional challenge has been to use the best method to measure and quantitate what we eat in free-living populations. Among the several methods used to estimate energy intake include duplicate analysis, weighed food intake, food diary, diet record and food frequency questionnaires (Kroke *et al.*, 1999). Apart from the duplicate analysis method, all other methods necessitate the use of food composition tables (FCT) to transform the estimated weight of foods consumed into energy values.

In many regions of the world, the estimation of energy intake is based on the measurement of the amount of food that is eaten, in combination with the use of FCT. The earliest example of such table is the FCT developed by McCance and Widdowson in 1939 (Institute of Food Research & Public Health England, 2014), that has been extensively used in UK, Europe and worldwide. In Singapore, the FCT developed in 2003 by Health Promotion Board remains the most popular table in use (Health Promotion Board, 2011). At the individual level, the application of FCT is limited by the following factors: (a) the lack of data on energy/nutrient values of several commonly consumed foods; (b) a paucity of country-specific foods and recipes reported in the FCT; (c) that FCT does not reflect contemporary food products and food processing practices; (d) the perception that FCT may lead to over/under estimation of certain nutrients (Slimani *et al.*, 2007; Speek, Speek-Saichua & Schreurs, 1991; Truswell *et al.*, 1991).

Singapore has a multi-racial cosmopolitan society consisting of three major ethnic groups, namely, the Chinese, Malays and Indians who co-exist in harmony. In Singapore, as in many regions in Southeast Asia, street foods and foods prepared by small enterprises (also known as hawker centres) are major sites for the community consumption of breakfast, lunch and dinner. According to the National Nutrition Survey Singapore (2010), the proportion of Singaporeans visiting hawker centres remains high, at approximately 4-7 visits per week. This has increased from 47.8% in 2004 to 60.1% in 2010 (Health Promotion Board, 2010; Shandwick, 2014). The increasing pattern of eating at hawker centres has generated considerable interest amongst Singaporeans to know the energy density (kcal or kJ/100g) of locally available foods. This awareness may enable consumers to reduce the risk of overconsumption of energy-dense foods.

There is limited data on the caloric content of locally available foods. Most data were gathered several years ago using a combination of bomb calorimetry and Atwater Conversion Factors (Health Promotion Board, 2017). More recently, the energy content of 105 local and composite foods was reported (Lau *et al.*, 2016). The study used a novel, rapid, reproducible and cost-efficient instrument called the Calorie Answer™ to measure the energy content of various foods. This method has been validated in a range of foods (Lau *et al.*, 2016).

In the first part of our study, the objective was to determine the consistency (or otherwise) of the calorie content of 15 commonly consumed hawker foods sourced from eight

regionally diverse locations within Singapore. In the second part, we further analysed 46 additional local foods in order to build up a database that could be used with confidence by the food consumers to facilitate appropriate food choices. The choice of foods analysed was based on the commonly consumed foods in each of the Chinese, Malay or Indian communities.

MATERIALS AND METHODS

Samples and sample preparation

In the first part of the study, 15 popular and commonly consumed local foods were purchased from eight different hawker centres and food courts in Singapore. The choice of foods selected was based on 1027 interviews/questionnaires by local Singaporeans in a GUSTO cohort study (Chen *et al.*, 2014) and an online food guide for Singapore (Wiens, 2019). The foods were selected from four regions of Singapore, North of the island – Ang Mo Kio & Seng Kang, East of the island – Parkway Parade & Simei, West of the island – Clementi & Jurong and the Central – City Hall & Tiong Bahru (Figure 1). For the second part of the study, a total of 46 foods (16 Chinese, 13 Malay and 17 Indian foods) were purchased from random hawker centres and food courts in Singapore. The descriptions of these foods obtained for this study are presented in Table 1. All foods were purchased within a week and analysed within two days of purchase.

The food samples were homogenised with a homogeniser (Blixer® 6 V.V., Robot-coupe, France) to obtain a smooth and consistent texture. All samples were allowed to equilibrate to room temperature (20–25°C) and analysed using the procedure and techniques described previously (Lau *et al.*, 2016).

Near-infrared (NIR) spectroscopy and analysis (Calorie Answer™)

The near-infrared (NIR) spectra of the homogenised samples were obtained using the Calorie Answer™ instrument (CA-HM, JWP, Japan) over a wavelength

Figure 1. Map of Singapore showing locations of foods purchased for analysis

Table 1. Description of local foods

Local Foods	*Description*
Char kway teow	Rice noodles, stir fried in sweet sauce with cockles and Chinese sausage
Fried carrot cake	Fried Chinese radish cake made with rice flour and eggs
Chicken rice	Roasted chicken with skin, served with flavoured rice and chilli sauce
Fried oyster omelette	Stir fried eggs with oyster and tapioca flour
Kaya butter toast	Toasted bread with *kaya* (coconut, egg jam) and filling
Popiah	Radish, eggs, Chinese dried sausage and sweet black sauce wrapped in a flour-based skin
Chicken biryani	Rice cooked with ghee and spices, served with spicy chicken
Ban mian	Flat handmade noodles served in anchovy soup with egg, anchovies, minced pork meat and green vegetables
Laksa	Thick rice vermicelli served with thick coconut milk gravy with *tau-pok* (fried soya bean curd) and fish-cake
Mee rebus	Thick yellow egg noodles served in thick spicy gravy together with hard-boiled egg
Ba chor mee (Minced pork noodle)	Egg noodles with black mushroom and minced pork served with chili sauce
Roti prata (Plain)	Thick, flat, round dough made with wheat flour, sugar, salt and water, fried with ghee
Wanton mee	Boiled minced pork dumpling served with egg noodles, sliced *char siew* (roast pork), *chye sim* (mustard leaves) and gravy
Rojak	Chinese salad mixed with cucumber, pineapples, apples, *tau-pok* (fried soya bean curd) drizzled with a sweet and sour sauce containing prawn paste, sugar, lime and peanuts
Economic bee-hoon	Fried rice noodles with fried egg, luncheon meat and cabbage
Prawn noodle soup	Noodles with prawns and beansprouts in soup
Chee cheong fun (with sauce)	Rice noodle with sweet dark colour sauce
Lor Mee	Yellow noodles with beansprouts, egg and pork in thick dark gravy
Char siew wanton noodle	Boiled wheat noodles with sliced barbecued pork and minced pork dumpling
Steamed chicken noodle	Boiled wheat noodles with steamed shredded chicken breast
Hokkien mee (black sauce)	Braised yellow noodles in dark, fragrant sauce with pork, squid, fish cake and cabbage
Roasted duck rice	Roasted duck meat served with white rice
Sliced fish hor fun	Flat rice noodles with thinly sliced fish and vegetables served in thick sauce
Roasted chicken rice	Roasted chicken served with chicken flavoured rice
Roasted pork rice	Roasted pork served with white rice
Soya sauce chicken noodles	Thin wheat noodles with soy sauce with chicken and preserved vegetables

Local Foods	*Description*
Claypot rice	Rice with black sauce, chicken and mixed vegetables steamed in a Claypot
Fan choy	Rice steamed together with barbecued pork, hard-boiled egg and stewed mushroom
Rice dumpling with meat filling (Nyona style)	Traditional Chinese rice dish made from glutinous rice stuff with marinated pork, candied winter melon and steamed mushrooms
Char siew pau	Chinese barbequed pork bun
Kentang ball soup with rice cube	Lightly flavoured soup with onions, cucumbers and fried potato balls stuffed with minced beef
Lontong goreng	Rice cakes cut into cubes and stir fried with egg and meat
Mee soto	Thick egg noodle soup with Indonesian spicy chicken broth
Lontong	Rice cake in the form of a cylinder wrapped in banana leaves, cut into bite-sized pieces served in coconut milk soup with shredded tempeh, tofu, long beans and hard-boiled egg
Nasi goreng	Indonesian stir-fried rice with meat and vegetables
Mee Bakso	Meatball soup served with yellow egg noodles and rice vermicelli
Mee Bundung	Noodles, egg, shrimp, chicken, fish cakes and vegetables served in a soup made with chili, onion, spices, shrimp paste and dried shrimp
Mee Siam	Rice vermicelli, hard-boiled egg, with a sweet and tart gravy
Gado gado	Indonesian salad with blanched vegetables, hard-boiled eggs, boiled potatoes, fried bean curd and tempeh, and rice cake (wrapped in banana leaf) served with peanut sauce dressing
Mee Goreng	Spicy fried yellow egg noodle coated in a thickened sweet and spicy sauce, tossed with fried bean curd cubes, tiger prawns, tomato wedges, leafy vegetable, bean sprout and green onions
Grilled fish with rice	Charcoal grilled sambal belacan fish with sliced shallots wrapped in banana leaves served with white rice
Nasi lemak with chicken wing and egg	Rice dish cooked in coconut milk and pandan leaf served with chicken wing, egg and sambal chili
Ayam Penyet with rice (grilled)	Grilled chicken thigh with sambal, cucumber slices, fried bean curd and tempeh served with white rice
Putu mayam	Steamed rice noodle
Idli	Steamed savoury rice cakes
Vegetable briyani	Basmati rice flavoured with spices and served with vegetables
Thosai masala	South Indian snack made from fermented pulses
Makhani dal	Whole black lentils and red kidney beans cooked in butter and cream
Mutton briyani	Basmati rice flavoured with spices and served with mutton
Chicken masala	Baked chicken marinated in coconut cream, spices and yoghurt
Fish tikka	Fish marinated in spice mix and grilled in oven or tandoor
Mutton vindaloo	Lamb curry cooked in wine, vinegar and garlic

Local Foods	*Description*
Mee goreng	Spicy stir fried egg noodle
Roti john	French loaf fried with minced mutton, sliced onions and egg
Thosai	Thin pancake made from fermented pulses and rice flour
Onion prata	Thick, flat, round dough made with wheat flour, sugar, salt and water, fried with ghee and onion
Egg prata	Thick, flat, round dough made with wheat flour, sugar, salt and water, fried with ghee and egg
Chapati	Whole wheat flour mixed with water and oil

range from 1100 – 2200 nm with a resolution of 7.5 nm and a data interval of 2.0 nm. The main components of the instrument were as follows: a halogen lamp as radiation source; an acousto-optic tunable filter as wavelength selector, and light receiving sensors as light detectors. The reflectance mode was used for the solid samples and reference reflectance data was obtained with a calcium carbonate filled cell. Triplicates of each sample were scanned in cylindrical sample cells (internal diameter = 50 mm, depth = 10 mm for solid sample holders). The inbuilt computer software (CA-HM Measurement Application Software, JWP, Japan) was set so that each triplicate portion was scanned ten times, which were then averaged to give a mean spectrum for improved accuracy. The data were transformed into log 1/R and energy content for each sample was then calculated in accordance with regression expressions pre-programmed in the software. The analysis time for each measurement (including time for calibration) was about 5 minutes. The procedure of Lau *et al.* (2016) used has a very small margin of error (R^2=0.98, p<0.001).

Statistical analyses

The foods were divided into three main types of ethnic cuisines namely, Chinese, Malay and Indian. These foods were then ranked from the lowest to the highest energy content (per 100g). To obtain an equally represented number in each cuisine, 12 foods from each cuisine were randomly sampled using random numbers generated from Excel (Microsoft Office 2016). A one-way analysis of variance (ANOVA) was used to determine if the means of these three groups were statistically different from one another. The Welch test was used in the case of significant Levene's test. The post hoc test (Games-Howell) was obtained for the significant main effect in ANOVA. The alpha (α) level for all statistical analyses in this study was set at 0.05. All statistical analyses were performed using Statistical Package for the Social Science (SPSS version 24).

RESULTS

The data on the 15 foods selected from four regions, eight locations of Singapore are presented in Table 2. Despite being purchased from different locations, the energy content of the same foods was remarkably similar. The coefficient of variation (CV) for energy density was less than 10% for the following foods: *char kway teow*, fried carrot cake, chicken rice, kaya butter toast, *popiah*, *ban mian*, *mee rebus*, *ba chor mee* and economic *bee-hoon*. Foods with CV for energy content that are >10% but ≤15% included fried oyster omelette, chicken biryani, *laksa*, *roti prata*, *wanton mee* and *rojak*.

A more extensive list of measured energy density (per 100g) of the 46

Table 2. Summary of average measured energy (kcal/100g), portion size and total energy in each portion of 15 commonly consumed hawker foods sourced from eight regionally diverse locations within Singapore

Name of food	*Location*								*Mean± standard deviation*	*Coefficient of variation (CV)*
	Ang Mo Kio	*Seng Kang*	*City Hall*	*Tiong Bahru*	*Parkway*	*Simei*	*Clementi*	*Jurong Point*		
Char kway teow										
Average energy content (kcal/100 g)	155	175	168	162	167	167	166	174	167±6.36	3.82
Portion size (g)	540	516	401	434	472	479	339	458	455±63.97	14.06
Total energy in a portion (g)	837	903	674	704	789	800	563	797	758±106.72	14.07
Fried carrot cake										
Average energy content (kcal/100 g)	153	160	153	184	181	147	150	142	159±15.56	9.80
Portion size (g)	284	446	331	358	310	326	260	299	327±56.83	17.38
Total energy in a portion (g)	435	714	507	659	562	480	390	425	521±115.77	22.20
Chicken rice										
Average energy content (kcal/100 g)	443	430	558	437	502	584	541	425	164±13.04	7.96
Portion size (g)	316	253	365	262	306	322	307	265	300±37.72	12.59
Total energy in a portion (g)	443	430	558	437	502	584	541	425	490±64.46	13.16
Fried oyster omelette										
Average energy content (kcal/100 g)	286	206	246	227	236	172	†	238	230±35.22	15.30
Portion size (g)	335	290	359	281	271	287	†	353	311±36.98	11.90
Total energy in a portion (g)	958	596	884	638	640	493	†	840	721±172.15	23.87
Kaya butter toast										
Average energy content (kcal/100 g)	92	108	412	330	368	366	349	363	368±28.92	7.86
Portion size (g)	92	108	97	92	135	105	63	113	101±20.72	20.55
Total energy in a portion (g)	376	375	401	305	497	385	219	412	371±81.12	21.85

Name of food	Location								Mean± standard deviation	Coefficient of variation (CV)
	Ang Mo Kio	Seng Kang	City Hall	Tiong Bahru	Parkway	Simei	Clementi	Jurong Point		
Popiah										
Average energy content (kcal/100 g)	132	125	139	144	151	130	145	135	138±8.72	6.33
Portion size (g)	200	150	162	150	144	189	156	165	165±19.74	12.00
Total energy in a portion (g)	264	188	226	216	218	245	227	223	226±22.17	9.83
Chicken biryani										
Average energy content (kcal/100 g)	206	154	202	166	202	162	163	150	176±23.53	13.40
Portion size (g)	528	636	473	493	573	736	537	405	548±102.25	18.67
Total energy in a portion (g)	1087	980	956	818	1157	1192	876	608	959±192.72	20.09
Ban mian										
Average energy content (kcal/100 g)	107	108	103	82	98	94	94	96	98±8.43	8.62
Portion size (g)	979	1000	899	706	781	864	791	805	853±101.91	11.94
Total energy in a portion (g)	1048	1080	925	579	766	812	743	773	841±167.53	19.92
Laksa										
Average energy content (kcal/100 g)	131	113	140	161	135	134	142	119	134±14.66	10.91
Portion size (g)	637	516	405	616	571	475	596	597	551±79.67	14.45
Total energy in a portion (g)	835	583	567	991	770	636	846	711	742±146.56	19.74
Mee rebus										
Average energy content (kcal/100 g)	142	123	121	119	107	137	111	124	123±11.82	9.61
Portion size (g)	669	699	534	576	537	530	641	607	599±65.49	10.93
Total energy in a portion (g)	950	859	646	686	574	726	711	752	738±118.83	16.10

Name of food	Location								Mean± standard deviation	Coefficient of variation (CV)
	Ang Mo Kio	Seng Kang	City Hall	Tiong Bahru	Parkway	Simei	Clementi	Jurong Point		
Ba chor mee										
Average energy content (kcal/100 g)	157	163	169	171	145	168	154	155	160±9.02	5.63
Portion size (g)	462	378	288	405	359	389	324	353	370±52.60	14.23
Total energy in a portion (g)	726	616	487	693	521	653	499	548	593±91.82	15.49
Roti prata										
Average energy content (kcal/100 g)	374	347	349	299	282	338	344	391	341±35.76	10.50
Portion size (g)	243	221	132	138	349	215	142	242	210±73.30	34.85
Total energy in a portion (g)	909	766	462	411	985	728	488	947	712±231.46	32.50
Wanton mee										
Average energy content (kcal/100 g)	126	134	160	169	175	157	115	175	151±23.31	15.40
Portion size (g)	358	438	424	303	270	304	379	288	345±63.95	18.51
Total energy in a portion (g)	450	587	679	512	472	478	436	504	515±80.81	15.70
Rojak										
Average energy content (kcal/100 g)	190	166	200	194	149	191	147	149	173±22.86	13.20
Portion size (g)	240	273	277	329	275	341	280	277	286±32.63	11.39
Total energy in a portion (g)	456	453	554	639	410	651	411	412	498±101.87	20.45
Economic *bee-hoon*										
Average energy content (kcal/100 g)	154	153	170	142	136	166	155	150	153±11.22	7.32
Portion size (g)	370	447	349	516	415	524	486	434	442±64.11	14.49
Total energy in a portion (g)	570	683	593	733	564	869	753	650	677±105.49	15.58

†Data removed due to too much oil in the fried oyster omelette (Clementi)

Table 3. Energy density (per 100 g), portion size and total energy in a portion of 46 additional Chinese, Malay and Indian foods

Ethnic group	*Name of Food*	*Energy Content (kcal/ 100g)*	*Portion size (g)*	*Total Energy in a portion (kcal/ 100g)*
Chinese	Prawn noodle soup	107	643	690
(*n*=16)	*Chee cheong fun* (with sauce)	137	15	21
	Lor mee	109	688	750
	Char siew wanton noodle	151	345	521
	Fried vegetarian *bee-hoon*	124	312	387
	Steamed chicken noodle	143	352	503
	Hokkien mee (black sauce)	152	399	606
	Roasted duck rice	153	297	454
	Sliced fish *hor fun*	155	707	1096
	Roasted chicken rice	164	330	541
	Roasted pork rice	170	311	529
	Soya sauce chicken noodles	174	258	449
	Claypot rice	180	350	631
	Fan choy	181	177	320
	Rice dumpling with meat filling (Nyona style))	203	170	345
	Char siew pau	278	63	175
Malay	*Kentang* ball soup with rice cube	117	281	362
(*n*=13)	*Lontong goreng*	124	424	496
	Mee soto	129	147	182
	Lontong	142	269	382
	Nasi goreng	144	377	543
	Mee bakso	146	435	635
	Mee bundung	149	466	694
	Mee siam	151	329	497
	Gado gado	161	421	678
	Mee goreng	166	285	473
	Grilled fish with rice	183	310	567
	Nasi lemak with chicken wing and egg	201	300	603
	Ayam penyet with rice (grilled)	203	499	1013
Indian	*Putu mayam*	132	104	137
(*n*=17)	*Idli*	134	150	201
	Vegetable briyani	142	640	909
	Thosai masala	167	225	376
	Makhani dal	171	436	746
	Mutton briyani (boneless)	174	459	799
	Chicken *masala*	177	445	788
	Fish *tikka*	190	203	386
	Mutton *vindaloo*	199	284	565
	Mee goreng	203	170	345
	Roti John	230	418	961
	Thosai	267	45	120
	Onion *prata*	270	127	343
	Egg *prata*	292	130	380
	Chapati	308	92	283
	Naan	324	113	366
	Vadai	346	78	268

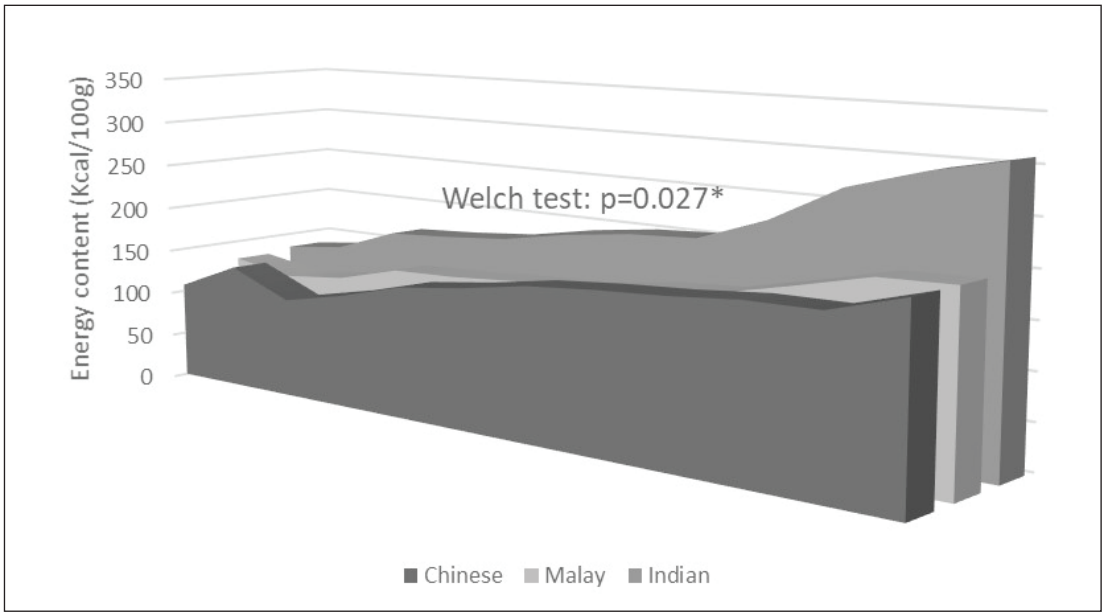

Figure 2. Energy content of Indian (n=12), Chinese (n=12) and Malay foods (n=12)

Chinese, Malay and Indian foods are shown in Table 3. The list of foods has been ranked from the lowest to the highest energy density. To illustrate the variability in energy density across the various ethnic food groups (Chinese, Malays, Indians), 12 foods from each group were randomly selected and plotted (Figure 2). Since 13 was the maximum number of foods in the Malay cuisine, in order to maintain consistency of number of foods selected from each ethnic group, a random selection of 12 foods per ethnic group were chosen. The figure shows a distinctively higher average energy density of Indian foods compared to Chinese and Malay foods (Welch test, p=0.027). Post hoc test (Games-Howell) showed that Indian foods had significantly higher energy density compared to Chinese (p=0.028) and Malay (p=0.033). Bootstrapped confidence intervals of the difference in energy density between Indians versus Chinese or Malay were 18.26-91.14 and 16.04-88.45, respectively.

DISCUSSION

The primary objective of our study was to undertake a preliminary investigation of the variability of the energy density of commonly consumed hawker foods purchased from different locations in Singapore. The secondary objective was then to quantitate the total energy density of other commonly consumed local foods in Singapore of Chinese, Malay and Indian ethnic origin.

Our results in Table 2 indicated that for all 15 foods, the energy density (kcal or kJ/100g) was remarkably consistent for the same food regardless of the eight locations in Singapore they were purchased. This was contrary to popular belief and the frequent lament of nutritionists that the energy density of foods was so diverse within a country or a region that it was inappropriate to estimate the energy intake using FCT. Our results challenge the commonly held view that there is considerable variability in energy density of hawker

foods purchased from different locations of Singapore. Since the variability in energy density is low between locations, we can assume that similar foods purchased anywhere else in Singapore have similar energy densities. A possible explanation for this may be the fact that vendors use standard ingredients, cooking methods and purchase common ingredients from a centralised supplier.

Two prominent factors that influence weight gain are the consumption of energy-dense foods and limited energy expenditure due to the lack of physical activity (Foo *et al.*, 2013). In Singapore, because of urbanization, the establishment of an obesogenic environment promotes nutritional transitions and a rapid decrease in physical activity (Malik *et al.*, 2013). Several studies have also shown a correlation between obesity and the built environment (Cummins & Macintyre, 2006; Sallis & Glanz, 2006). Various ethnic cuisines are available in local hawker centres and coffee shops, both of which are easily accessible and widely located all over Singapore (Khoo, 2017). To enable consumers to make informed choices on the foods that they consume, there is a need to provide the energy density of locally consumed foods (Table 3). Our study provides the first systematic investigation on the energy density of over 46 foods that will enable consumers to make healthier choices.

From this analysis, we found that the mean energy density (per 100 g) of Indian foods was significantly higher compared to Chinese and Malay foods (p=0.027). One possible explanation for the increased in energy density of Indian foods is the inclusion of foods high in oils and fats for example *briyani*, chicken *masala*, mutton *vindaloo*, *thosai*, *prata* and *vadai*. The observation that Indian foods have a higher energy density corroborates with the observation that South Asians, living especially in urban settings, have an increasing prevalence of obesity (Azmi *et al.*, 2009; Misra & Shrivastava, 2013). Despite the higher energy density of Indian foods compared to Chinese and Malay foods, there were no significant differences in total energy content of these three ethnic food groups. In contrast, in Table 2, the CV of total energy was relatively large ranging from 10.93% to 34.85%. Much of this variability in energy may be attributable to the varying portion sizes recorded in Table 2. This further reinforces the need for consumers to know both the energy density and the portion size in order to make informed choices about their energy intake.

In Singapore, there is a difference in the prevalence of obesity between the ethnic groups. Malays (20.7%) and Indians (14.0%) have the greatest prevalence of obesity compared to Chinese (5.9%) (Health Promotion Board, 2016). One possible contributor to this is the higher energy density of Malay and Indian foods. Since obesity is the outcome of being in positive energy balance, we also estimated the prevalence of physical activity in these three ethnic groups. The prevalence of leisure time physical activity was reported to be 19.2% in Chinese, 15.3% in Malays and 21.7% in Indians (unpublished). The low prevalence of physical activity and consumption of high energy-dense foods may be the contributory factors in the development of obesity in Malays. However, the higher prevalence of leisure time physical activity in Chinese and Indians compared to Malays, may suggest that in Indians, the consumption of high energy-dense foods contribute more in the etiology of obesity than the impact of inadequate leisure time physical activity. This speculation needs to be further tested and validated.

A possible strategy to reduce the prevalence of obesity and to minimise weight gain is the awareness of the

energy density of various foods that people consume. We have demonstrated that the innovative instrument Calorie Answer™ is an easy to use, reproducible method to obtain rapidly the energy density of various foods (Lau *et al.*, 2016). Due to its ease of use, the Calorie Answer™ is capable of generating a large body of data on the energy density of various composite foods. It is hoped that this paper will stimulate researchers in this region to generate much needed information on the energy density of foods. Part of our objective was to validate the use of Calorie Answer™ instrument with local foods. An important limitation of this study was the modest sample that was analysed. We also wish to caution that the observations recorded in Singapore may not be reproducible in neighbouring countries such as Malaysia, Indonesia and other countries with similar ethnic demographics.

CONCLUSION

In the absence of directly measured energy content of foods, the use of FCT may be a useful first approximation. We have provided evidence to suggest that, contrary to popular belief, the energy density of commonly consumed foods in Singapore is remarkably similar, irrespective of the region of purchase. The mean energy density (per 100 g) of Indian foods was significantly higher compared to Chinese and Malay foods (p=0.027). Similar work in other regions of the world will enable us to understand the variability in energy content of foods and provide public health recommendations on how best consumers can make informed choices on what they plan to eat.

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Authors' contributions

CJH, principal investigator, conceptualized and designed the study and reviewed the manuscript; RYCQ, carried out the study, data analysis and drafting of the manuscript; GHJ, carried out the study.

Conflict of interest

All authors declare no conflict of interest.

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