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Impact of food nutrition intervention on food handlers' knowledge and competitive food serving: a randomized controlled trial

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Abstract

The aim of this study was to evaluate the impact of Food Nutrition Intervention (FNI) for improving food handlers' knowledge and serving of competitive food in the primary school canteens. We randomized 16 out of 98 primary schools into intervention and control groups using a multistage sampling method. The training programme for the intervention group and questionnaires for evaluating knowledge were developed. On-site observations were done to document all competitive foods served in school canteens. Out of the 79 food handlers who participated in this study, 33 (41.8%) were in the intervention group and 46 (58.2%) were in the control group. The majority of food handlers were female, Malay, had education at middle levels, and at middle-aged. The commonest food category served was carbohydrate (75%), high-fat foods (34.4%) and food not recommended for sale (34.4%). Knowledge about healthy food choice in the intervention group at 6 weeks and 12 weeks post intervention were significantly higher than at baseline. The intervention group also demonstrated significantly better knowledge composite score at 6 weeks and 12 weeks following intervention. These improvements were also observed between intervention and control regardless of time. By six weeks, the number of vegetable menu served significantly increased in the intervention ($p=0.040$) and by 12 weeks, the number of milk and milk products served also significantly increased ($p=0.015$) as compared to the control group. Thus, the provision of FNI was associated with significantly improved healthy food knowledge amongst food handlers, the serving of vegetables and milk or milk products in school canteens.

Introduction

School should serve nutritious food choices for children. Failure to serve a healthy diet to schoolchildren may result in unhealthy growth and development of children, and affect their learning in school (Best *et al.*, 2010; Khor *et a*l., 2011). Schools can influence children's diets through two main avenues. The first is the competitive foods, which are foods that are sold in addition to the school meal programmes. The second is the government sponsored school meal programmes (the National School Lunch Programme [NSLP] and the School Breakfast Programme [SBP]) (Snelling *et al*., 2007; Fox, 2010). In Malaysia, schools act as an important provider of breakfast and lunch for the children (Moy *et al.*, 2006) through either SBP or the sale of competitive foods. The association between school food environment and student eating behaviour had been confirmed by previous reviews (Neumark-Sztainer *et al.*, 2005; O'toole *et al.*, 2007; Jaime and Lock, 2009). Factors such as easy accessibility of low nutrient and high fat and sugar foods in school canteens (French *et al.*, 2003; Neumark-Sztainer *et al*., 2005; O'toole *et al.*, 2007) has marked influence on their choice of food. Currently, high fat, high calorie and low nutrient foods remain abundantly available in many schools canteens like energy-dense foods and beverages such as fat spreads, packaged snacks, biscuits and fruit/cordial drinks (Bell and Swinburn, 2004; Bevans *et al*., 2011). Past study in the United States reported that schoolchildren aged

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11 to 13 years consumed energy and other nutrients at significantly lower than recommended from school food service (Templeton *et al*., 2005).

The existence of unhealthy food in school environment contributes to some extent to the emerging problem of overweight and malnutrition amongst children. The reported prevalence of overweight was generally below 15% in Africa, Asia, and the Eastern Mediterranean (Best *et al.*, 2010), 16.4% in Hong Kong (Wong *et al.*, 2005), 12% in urban area of Manila (Florentino *et al*., 2002), and the highest prevalence was 20% to 35% in Latin American countries (Best *et al*., 2010). Typical of a country in nutrition transition, Malaysia faces the dual burden of the emerging overweight and malnutrition problems in children especially in poor urban areas (Khor, 2005; Lee and Manan, 2014). A local studies conducted by Ismail *et al.* in 2002 and 2008 reported an increased in the prevalence of overweight and obesity among children aged 6 to 12 years in Peninsular Malaysia from 11.0% to 12.8% and 9.7% to 13.7% respectively (MOH, 2010). The 2009 Annual Report by the Ministry of Health Malaysia (MOH) (Annual Report, 2009) demonstrated the percentage of overweight and obesity was 6.7% and 6.0% for standard one and 9.8% and 8.4% for standard six students in Malaysia respectively. Surprisingly, the highest prevalence of overweight and obesity reported so far amongst schoolchildren in Malaysia (aged 7-10 years) was 17.9% for overweight and 16.4% for obese (Khor *et al*., 2011). The most current published study on nutritional status in Kelantan' primary schoolchildren aged 10 to 12-year-old reported that 11.0% and 7.1% of them were found to be overweight and obese, respectively (Lee and Manan, 2014). The problem of vitamin D insufficiency in schoolchildren was documented in Malaysia by Khor *et al.* (2011), in which 35.3% and 37.1% of them are D deficient (≤37.5 nmol/L) and vitamin D insufficient (> 37.5-≤50 nmol/L) respectively.

Many initiatives have been taken throughout the world to ensure food served in school canteens comply with nutrition standards such as the Dietary Guidelines for Americans, 2010 (McGuire, 2011), healthy canteen strategy (Yoong *et al*., 2015) and school nutrition policies established in many industrialized countries (Dubuisson *et al*., 2015). The strategies being implemented in Malaysia targeting schoolchildren include School Health Programme (Khor, 2005) and the development of the Management Guide for Healthy School Canteen by the Malaysian Ministry of Education (MOE) (MOE, 2011). The first edition of this guideline was in the year 2011. To ensure the message is transferred to the food handlers in the school canteen, routine site visits by health care staffs (nutrition background) was planned and carried out. However, none of the local studies assessed the impact of these initiatives on the knowledge and practice of food handlers and on the pattern of competitive food availability in the school canteen in Malaysia setting. Furthermore, it appears to be less effective when correlated with the poor nutritional status of schoolchildren. Soon *et al.* (2011) highlighted the failure of cascading knowledge and skills to food handlers due to lack of effective follow-up monitoring and mentoring. Thus, the best training should be able to identify and address the barriers preventing food handlers from preparing and serving the healthy competitive food.

Providing knowledge alone does not always resulted in desired behaviour (Seaman and Eves, 2006; Roberts *et al.,* 2008). Rennie (1995) also pointed out that the health education theory following the knowledge, attitude and practice (KAP) model predicts a limited effectiveness of formal food education. There are several behavioural theories available. The most popular theoretical framework used for the prediction of health-related behaviours seems to be the Theory of Planned Behaviour (TPB) (Astr and Rise, 2001). The purpose of this study was to determine the effect of 65 minutes of Food Nutrition Intervention (FNI), using the TPB framework, on the knowledge of food handlers on healthy food and the serving of competitive foods in school canteens.

Materials and Methods

Research population and data collection

A community intervention study was conducted in primary school canteens located in Kota Bharu, Kelantan, Malaysia from January 1, 2013, until November 31, 2014. A simple random sampling was used to select 16 schools out of 98 listed standard primary schools. The selected schools were numbered and schools with the odd number was randomly assigned to the intervention group, whereas the even number was assigned in control group, resulted in eight schools as intervention and another eight as control. For each selected school canteen, all food handlers who fulfil the inclusion and exclusion criteria were recruited as respondents. The inclusion criteria were those with age between 18 to 55, had attended Food Handlers' Training Programme that approved by MOH, Malaysia and prepare or handles food. Whereas, the exclusion criteria were illiterate food handlers, those with intention to change work within a year, and had history of mental illness.

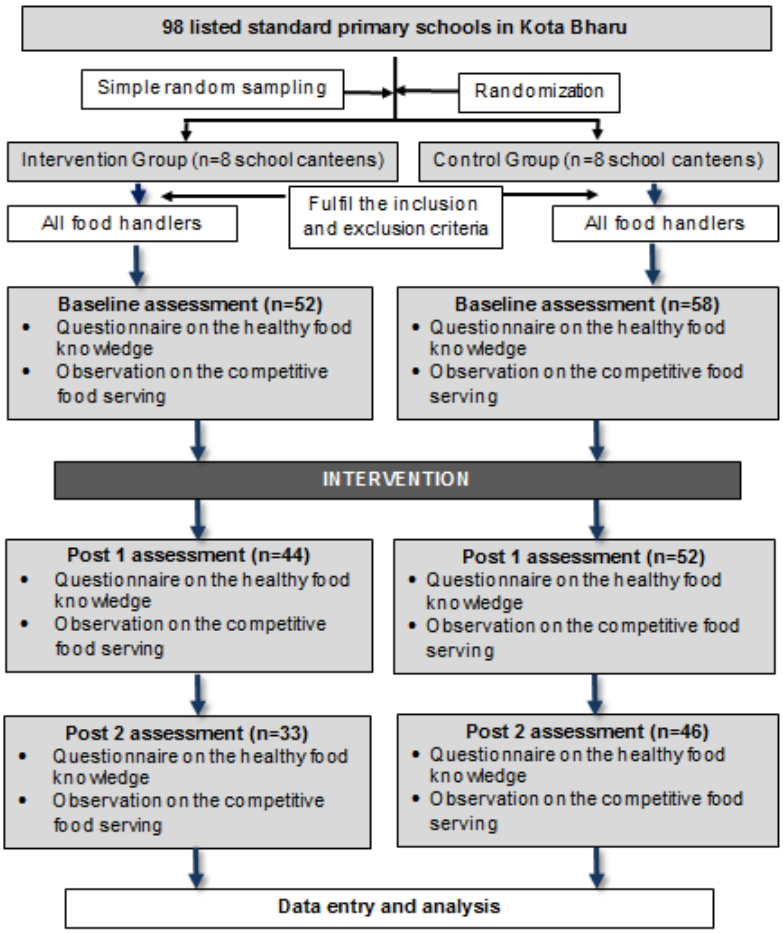

Figure 1. Study flowchart

The sample-size calculation required 53 food handlers in each group. Site visits to each school canteen were carried out one month prior to the intervention programme (baseline data) and during 6-week (Post1) and 12-week (Post2) after the participants completed an intervention programme. Data were collected through guided self-administered questionnaires and on-site observations by documenting all available competitive foods in the school canteen on a checklist. The detail study flowchart is explained in the Figure 1. Ethical approval to conduct the study was obtained from the Human Research Ethics Committee, Universiti Sains Malaysia (Reference No: USMKK/PPP/JEPeM [259.3. (16)]). Ethical approval was also obtained from the Malaysian Education Ministry [Reference No: KP(BPPDP)603/5/JLD.02(43)] since the study was conducted in the government schools.

Intervention plan and materials

The content development of the FNI was based on baseline data gathered during a pilot study, the Malaysian Dietary Guidelines 2010 (MOH, 2010) and the Management Guide for Healthy School Canteen (MOE, 2011). This study utilizes TPB to design an intervention to improve competitive food serving, targeting the enabling factors for behavioural change namely, the behavioural attitude, normative beliefs, and perceived behavioural control, as suggested by past researchers (Ajzen, 1991; Rennie, 1995; Ehiri *et al*., 1997; Green and Selman, 2005). To evaluate the appropriateness and operational feasibility of the intervention, ten experts in the field, including two food handlers and two food managers, reviewed the initial draft. The hard copy of the module was distributed and the experts were asked to fill out the assessment form. Then, a workshop was held two weeks later to comment, discuss, refine and rephrase on the intervention content, appropriateness of the language, words and phrases, as well as the design of the module.

The FNI targeted behavioural attitudes of food handlers by instilling a positive belief toward the consequences of serving healthy diet for students and increase their concern about disadvantages related to unhealthy diet intake. To improve the normative belief, the intervention covered the inspiration of MOH and MOE as stated in the Malaysian Food Pyramid and guidelines. Finally, in targeting perceived behavioural control, the training focused on reducing

the barriers, improving beliefs and self-capability to perform the intended behaviours. The intervention was delivered through 40 minutes interactive presentations and visual materials, 15 minutes quiz & discussion, followed by 10 minutes serving of healthy tea prepared with a recommended amount of sugar. Lastly, a booklet regarding a balanced diet for students was distributed to all participants. The above interventions were carried out during the weekend for the purpose of full attendance of the participants since their canteen not operated at the weekend.

Site visits to each school canteen in the intervention group was carried out three weeks after the completion of the intervention. The main purpose of the site visits was to continuously motivate the participants to execute the intended behaviours, to reinforce the given knowledge and skills, and to help solve any difficulties or barriers, if presence.

Questionnaire, study checklist and statistical analysis

Healthy food knowledge was assessed through a validated questionnaire (Nik Rosmawati *et al*., 2015). The questionnaire consisted of 23 closed-ended questions as follows: 6 questions for the knowledge on food nutrition, 6 questions regarding the knowledge on healthy food serving, and 11 questions regarding the knowledge on healthy food choice. For the score, one point was given for correct answers and zero points were given for incorrect or unsure answers. The checklist for the observed competitive food contains a blank template that needs to be filled in with a list of foods and drinks served by the school canteen for the consumption of primary schoolchildren. Later, the listed foods were categorized into carbohydrate, protein, high-fat food, food with added sugar, vegetable, fruits, milk and milk products, fast foods, forbidden food, and food not recommended for sale. The last two food categories follow the Management Guide for Healthy School Canteen (MOE, 2011). Statistical analyses were performed using SPSS version 21.0. For the knowledge score, a Repeated-measure ANOVA analysis was done for the repeated measures of the same variable within the same group, to compare that variable between groups and to determine the between-group differences based on time. Meanwhile, a Friedman chi-square test and Mann-Whitney test was used to compare the competitive food served between more than two groups of dependent and two independent groups.

Results

Demographic characteristics of respondents

The majority of the canteens were from the National Primary Schools, with only one being a Chinese National-Type School. All school canteens operated since early morning (5:00 am) and closed after 2:00 pm or may extend up to 5:00 pm. The peak serving time was between 10:00 to 11:30 am. For the baseline data, 110 food handlers were successfully recruited, consisting of 52 (47.3%) in the intervention group and 58 (52.7%) in the control group. Post1 data collection revealed that 12.7% had dropped out, and Post2 found that another 15.5% had dropped out. Out of 79 food handlers participating in this study up to Post2 data collection, there were 33 (41.8%) in the intervention group and 46 (58.2%) in the control group. The majority were middle-aged female Malaysians with educations at the middle level (up to secondary school). The groups were homogenous since there were no significant sociodemographic differences, including work experience and duration.

Healthy food knowledge

The knowledge composite score for healthy food resulted from a combination of all 23 closed-ended questions constructed from three knowledge subdomains. At the baseline, the overall mean percentage score did not differ much in all subdomains, 66.0%, 61.3% and 59.6% for knowledge on food nutrition, healthy food serving and healthy food choice respectively. The overall mean percentage score for the knowledge composite was 61.7%. Based on group and time of the measurements, all subdomains demonstrate the mean percentage score more than 50% in both groups throughout all measurements. Following an intervention, the subdomain measuring the knowledge on food nutrition, healthy food choice and knowledge composite resulted in a significant score increment as compared to the control group. Nevertheless, minor score change was observed in the dimension of healthy food serving following the intervention.

a. Within-group differences based on time (time effect)

The univariate test of within-subject effects revealed that out of three knowledge subdomains, knowledge related to healthy food choice was significantly improved (p=0.006). Similarly, the knowledge composite showed significantly improved (p=0.001) based on time. Pairwise comparison with confidence interval (CI) adjustment (Bonferroni) for knowledge on healthy food choice demonstrated that the mean score at Post1 (8.30, sd: 1.94) was significantly higher than that at the baseline (6.58, sd:1.60) in the intervention group. The means score

Table 1. Pairwise comparison of mean score of healthy food knowledge within each group based on time

Subdomain	Comparison	Intervention group (n=33)		Control group (n=46)	
		MD (95% CI)	*p*-value[a]	MD (95% CI)	*p*-value[a]
Knowledge on healthy food choice					
	Baseline - Post1	-1.73 (-2.74, -0.72)	**<0.001**	0.06 (-0.73, 0.86)	>0.95
	Baseline - Post2	-1.70 (-2.58, -0.81)	**<0.001**	-0.07 (-0.87, 0.74)	>0.95
	Post1 - Post2	0.03 (-0.87, 0.93)	>0.95	-0.13 (-0.93, 0.66)	>0.95
Composite knowledge					
	Baseline - Post1	-2.18 (-3.81, -0.55)	**0.006**	-0.44 (-1.35, 0.48)	0.723
	Baseline - Post2	-2.15 (-3.53, -0.77)	**0.001**	-0.33 (-1.34, 0.69)	>0.95
	Post1 - Post2	0.03 (-1.33, 1.39)	>0.96	0.11 (-0.95, 1.17)	>0.95

Notes:
[a]The repeated measure of ANOVA within-group analysis was applied, followed by pairwise comparison
MD=mean difference

Table 2. Mean score differences in healthy food knowledge between intervention and control groups, regardless of time (n=79)

Subdomain	Mean difference (95% CI)	Repeated measure ANOVA[a]	
		F-statistics (df)	*p*-value
Knowledge on food nutrition	-0.10 (-0.67, 0.47)	0.127 (1,77)	0.723
Knowledge on healthy food serving	-0.24 (-0.55, 0.06)	2.589 (1,77)	0.112
Knowledge on healthy food choice	-1.17 (-1.83, -0.52)	12.819 (1,77)	**0.001**
Composite knowledge	-1.52 (-2.67, -0.37)	6.940 (1,77)	**0.010**

Notes:
[a]The repeated-measure ANOVA between-group analysis was applied
Level of significance <0.05

at Post2 (8.27, sd:2.13) also revealed a significantly higher than at the baseline. Meanwhile, there was no significant difference in this knowledge area in all comparisons in the control group. Moreover, pairwise comparison of knowledge composite score found a significant difference in the intervention group between baseline vs. Post1 and baseline vs. Post2. It means score at Post1 (16.58, sd: 3.30) and Post2 (16.55, sd: 3.39) in the intervention group were significantly higher than at baseline (14.39, sd: 3.03). In the control group, there were no significant differences of knowledge composite score in all comparisons (Table 1).

b. Between-group differences regardless of time (intervention effect)

For comparison of intervention effect by using tests of between-subjects effects, there were significant differences in knowledge scores with relation to healthy food choice and composite knowledge score between the intervention and control groups, regardless of time. The intervention group showed significantly higher scores than the control group for Knowledge on healthy food choice (mean difference = -1.17) and composite knowledge (mean difference = -1.52). However, for other subdomains of knowledge, the scores demonstrated no significant differences between the two groups, as shown in Table 2.

c. Between-group differences based on time (time-intervention effect)

For a comparison between the intervention and control groups with regard to time, significant

Table 3. Comparison of mean knowledge score of healthy food choice and the composite knowledge between intervention and control groups based on time (n=79)

Subdomain	Time	Group	Mean	95% CI[a]
Knowledge on healthy food	Baseline	Intervention	6.58	5.95, 7.02
choice		Control	6.54	6.01, 7.08
	Post1	Intervention	**8.30**	7.66, 8.95
		Control	**6.48**	5.93, 7.02
	Post2	Intervention	**8.27**	7.57, 8.97
		Control	**6.61**	6.01, 7.20
Composite knowledge	Baseline	Intervention	14.39	13.37, 15.42
		Control	14.07	13.20, 14.93
	Post1	Intervention	**16.58**	15.53, 17.62
		Control	**14.50**	13.62, 15.39
	Post2	Intervention	**16.55**	15.43, 17.66
		Control	**14.39**	13.45, 15.33

Notes:
[a]The repeated-measures ANOVA between-group analysis with regard to time was applied

differences were found in knowledge related to healthy food choice (p=0.001) and composite knowledge (p=0.014). However, the other two subdomains of knowledge showed no significant time-intervention interaction, as the p-value was larger than 0.05. Further analysis for adjusted means with its adjusted CI was performed. The mean score of one group at a particular time was considered significantly different from the mean score of another group when its mean did not overlap with the CI of that group. The results indicated that the mean knowledge score of healthy food choice at Post1 was significantly higher in the intervention group compared to the control group. The mean score at Post2 was also significantly higher in the intervention group compared to the control group. For the composite knowledge, there was a significantly higher mean score at Post1 in the intervention group compared to the control group. Moreover, the mean score at Post2 was also significantly higher in the intervention group compared to the control group (Table 3).

The serving of competitive food in school canteen

Since the sample size was small (n=8) in both groups, the results are presented in the median and interquartile range. At the baseline, both groups were homogenous in term of food categories served in the school canteens. Overall, carbohydrate dominated (75.0%) the food served followed by high-fat foods (34.4%) and food not recommended for sale (34.4%). Foods high in protein and fast food also represent almost one-third out of total foods served. Milk and milk products confined to very small proportion (6.3%) of competitive foods served, whereas, fruits and vegetables were nil in overall. The commonest foods categorized as not recommended for sale in school canteens include ice cream, creamy foods, sugar-coated foods and chocolate-coated foods.

a. Within-group differences based on time (time effect)

For within-group effects, the Friedman test indicated that the FNI resulted in significant improvements in one or more of the three observed vegetables served in the school canteen (p=0.021). However, post hoc analysis revealed no significant differences between the baseline vs. Post1 (p=0.042), baseline vs. Post2 (p=0.059) and Post1 vs. Post2 (p=0.056). The significance levels of Post hoc tests was set at <0.0167 after Bonferroni correction. Furthermore, there were no significant within-group differences for a number of vegetables served in all three measurements in the control group (p=0.717). The results from the Friedman test for protein, high-fat food, food with added sugar, fruits, forbidden food, not recommended food, fast food and milk products indicated that the measurements at baseline, Post1 and Post2 were not significantly different in both groups.

b. Between-group differences regardless of time (intervention effect)

To determine the between-group effects of the intervention, a Mann-Whitney test showed statistically significant improvements of the observed vegetables served in the school canteen in the intervention

Table 4. The difference in the number of competitive foods served in the school canteen between the intervention and control groups

Food category	Median (IqR)		Z stat[a]	*p*-value[b]
	Intervention (n=8)	Control (n=8)		
Carbohydrate				
Baseline	11.5 (5.0)	13.5 (5.0)	-1.007	0.314
Post1	10.0 (6.0)	9.0 (7.0)	-0.316	0.752
Post2	10.0 (4.0)	13.5 (11.0)	-1.372	0.170
Protein				
Baseline	5.0 (1.0)	5.0 (5.0)	-0.325	0.745
Post1	5.0 (4.0)	4.0 (5.0)	-0.107	0.915
Post2	7.0 (4.0)	5.5 (4.0)	-1.167	0.243
High fat				
Baseline	5.0 (3.0)	6.5 (5.0)	-0.694	0.488
Post1	6.5 (7.0)	7.5 (8.0)	-0.212	0.832
Post2	8.0 (4.0)	8.0 (5.0)	-0.107	0.915
Added sugar				
Baseline	1.5 (3.0)	2.5 (5.0)	-1.229	0.219
Post1	2.0 (3.0)	1.0 (2.0)	-1.086	0.278
Post2	1.5 (4.0)	2.5 (6.0)	-0.325	0.746
Vegetable				
Baseline	0	0 (1.0)	-1.464	0.143
Post1	1.5 (3.0)	0 (0)	-2.056	**0.040**
Post2	0.5 (1.0)	0 (0)	-1.411	0.158
Fruits				
Baseline	0.5 (1.0)	0 (2.0)	0.000	>0.95
Post1	0 (1.0)	0 (0)	-1.179	0.239
Post2	1.0 (1.0)	0 (1.0)	-1.120	0.263
Forbidden food				
Baseline	0 (1.0)	0.5 (2.0)	-1.031	0.303
Post1	0 (1.0)	0 (0)	-0.620	0.535
Post2	0.5 (2.0)	0 (0)	-1.412	0.158
Not recommended food				
Baseline	4.5 (8.0)	6.0 (8.0)	-0.423	0.673
Post1	4.5 (6.0)	5.5 (5.0)	-0.053	>0.95
Post2	7.0 (8.0)	6.0 (14.0)	-0.527	0.598
Fast foods				
Baseline	4.0 (8.0)	6.0 (9.0)	-0.212	0.832
Post1	3.5 (5.0)	5.0 (6.0)	-0.212	0.832
Post2	7.0 (7.0)	6.0 (13.0)	-0.526	0.574
Milk and milk products				
Baseline	1.0 (1.0)	0.5 (1.0)	-0.707	0.480
Post1	1.0 (2.0)	0.5 (1.0)	-1.389	0.165
Post2	1.0 (0)	0 (1.0)	-2.440	**0.015**

Notes: aMann-Whitney test, bSignificance level was set at <0.05

group as compared to the control group at Post1 (p=0.040). At Post1, the number of vegetable menu served for the intervention group (1.5, IqR 3.0) was significantly higher than for the control group (0, IqR 0). However, there was no significant difference in the number of vegetable menu served at Post2 between the intervention and control group. Furthermore, the significant improvement was demonstrated for a number of milk and milk products served in the school canteen at the Post2 (p=0.015). The number of this menu for the intervention group (1.0, IqR 0) was significantly higher than that for the control group (0, IqR 1.0). However, there was no significant effect of the intervention at Post1 (p=0.165). Other food categories revealed no significant differences between the intervention and control groups at Post1 and Post2 as presented in Table 4.

Discussion

The school environment is deemed as an important aspect of the healthy lifestyle campaign (Jaime and Lock, 2009; Fox, 2010) in line with the global initiative to propose schools as a major setting for tackling childhood obesity (Jaime and Lock, 2009). The consumption of more than 37% of the total energy intake at school among schoolchildren (Bell and Swinburn, 2004) supports the contribution of school to their nutrition and health. Unhealthy dietary patterns are of concern because of their potential risks for developing obesity, heart disease, osteoporosis, dental caries, various types of cancer, other metabolic diseases later in life (Neumark-Sztainer *et al*., 2005; Hamidi *et al*., 2006; MOH, 2010) and colorectal cancer (Azizi *et al.*, 2015).

Modification in school food environments was pointed out to facilitate the choices of nutritious foods, limit unhealthy foods and better match students' preference and thus improve healthy diet intake amongst schoolchildren (Gosliner *et al.*, 2011; Yoong *et al*., 2015). Thus, the knowledge level of food handlers in relation to the serving of healthy or nutritious competitive food in school canteen is essential in order to improve the availability of healthy competitive food. Therefore, we hypothesised, after the FNI, food handlers will

improve their knowledge and later will adopt a more positive attitude towards the intention to prepare and serve healthier food choices for the consumption of primary schoolchildren.

Effectiveness of intervention programme on healthy food knowledge

The intervention did significantly improve knowledge related to healthy food choices and composite knowledge score. However, the intervention has failed to improve the knowledge of food nutrition and healthy food serving. Trained food handlers demonstrated the knowledge score of healthy food choices and knowledge composite significantly increased up to 15.6% and 9.5% respectively during the 6-week follow-up assessment. These improvements were sustained over a period of 12 weeks after the intervention. Compared to the control group, the knowledge score of healthy food choices and knowledge composite also demonstrated positive improvement in the intervention group with overall score difference 1.17 and 1.52 accordingly. These results indicate that the intervention group has presented significant knowledge improvements compared to the control group Furthermore, the positive impact of the intervention can also be seen in the time-intervention interaction during the 6-week and 12-week follow-up assessments. The improvement of the composite knowledge together with the improvement in the knowledge on healthy food choices may be regarded as an encouraging achievement for the current intervention. Hence, FNI targeting specific behaviours, has successfully improved food handlers' knowledge regarding healthy food. Moreover, the inclusion of all food handlers and food managers from similar food premises would further influence the positive norms towards positive behavioural changes, as elaborated by Ajzen (1991). Shapiro *et al*. (2011) and Mullan *et al.* (2015) also supported the important of this moral norm as a predictor of intention to engage in behavioural change.

The limited score improvements in relation to food nutrition and healthy food serving could be due to the majority of them having secondary education background; thus, it may be difficult for them to memorize technical terms and information. For example, considerable new terms and information were elicited in the subdomain knowledge on food nutrition that includes carbohydrate contents, fibre, omega 3 fatty acids and saturated fat. Whereas, the subdomain knowledge on healthy food serving had required information pertaining to the number of servings per meal, as stated in the Malaysian Food Pyramid. According to Webb and Morancie (2015), knowledge can easily improve in areas commonly related to daily and repeated exposure and practices, but it is difficult to improve knowledge that involves things that are more technical. The educational background of respondents has been identified by previous studies to be associated with knowledge gained from interventions. As explained by Roberts *et al.* (2008), respondents with better education level determine more new information they can retain from the intervention. El Derea *et al.* (2008) have also pointed out that food managers who graduated from university may retain greater knowledge from the training programme. To further improve the impact of intervention, future provisions of additional information using posters (Park *et al*., 2010) together with the implementation of clear school food policy (Bevans *et al.*, 2011) are suggested.

Effectiveness of the intervention programme on the competitive food served in school canteens

At the baseline, both groups of school canteen had served mostly food rich in carbohydrate and the availability of vegetables, fruits and milk or milk products were tremendously limited. The current intervention has significantly improved the availability of vegetable menu during Post1, although this improvement was not sustained during Post2. The results have shown that no vegetable menu was served for schoolchildren in the control group compared to 1.5 menus available in the canteens of the intervention group Moreover, the intervention was successful in increasing the availability of milk and milk products in the intervention group by serving one milk and milk products menu compared to none in the control group during the 12-week post-intervention.

Competitive foods rich in carbohydrate and high in fat have shown the widespread availability of energy-dense foods in school canteens. These findings raise a crucial concern because increased availability and easy access to these types of food would encourage excessive intake (Cleland *et al*., 2004; Fox, 2010) and thus, increase the risk of overweight and obesity among schoolchildren. Bell and Swinburn (2004) have reported that high-fat food is the top food group that contributes to the highest energy intake at school. However, the current intervention has failed to reduce the availability of these energy-dense foods in school canteens.

Minimal choices of fruits or vegetables served in school canteens may lead to less consumption. The lack of fruits and vegetable consumption will lead to deprivation of vitamins, minerals, fibre and

important phytochemicals (MOH, 2010). Milk is rich in calcium, readily absorbed by the body, contains protein, vitamin A, riboflavin, vitamin B12, zinc and other essential nutrients to the diet. Thus, it is highly recommended for everyday consumption (MOH, 2010). Again, the purchasing pattern of these types of foods depends on their accessibility and availability (Cleland *et al*., 2004; Jaime and Lock, 2009). This study has found that the availability of vegetables and milk or milk products in primary school canteens had significantly improved after the intervention. However, modifications to future interventions are still needed to improve the availability of fruits, such as by offering students a daily choice of 2 or more types of fruit or 100% fruit juice, as recommended by O'toole *et al*. (2007).

This study has determined that almost one-third of fast food and food not recommended for sale were available in the participating school canteens. The most common type of food included in this food category are deep-fried processed foods, and they often contain high-fat and calorie (Halpern and Shukla, 2005) and was reported as a primary source of salt over consumption (Hoogenkamp, 2012). The wide accessibility of fast food has been shown to be associated with an increase in the average body mass index among children (Fox, 2010). Unfortunately, the current intervention had failed to reduce the serving of these foods for the schoolchildren's consumption.

A number of factors may have led to the failure of the current intervention to reduce the availability of unhealthy food in school canteens. We think that school canteens are operated more as profit-making businesses, far exceeding the purpose of ensuring the healthy dietary intake of schoolchildren. Previous studies supported the argument of profit making as the main focus of the operation of school canteens (Cleland *et al*., 2004; Ardzejewska *et al*., 2013). School canteen managers prefer to sell tastier, although unhealthier moneymaking food, rather than sell nutritious food with little profit. Similar remarks about profit making as the primary focus in school canteen were made by Bell and Swinburn (2004). The most profitable types of foods they have pointed out included packaged snacks, chocolate, confectionery and fast foods. Thus, it is very important not to identify profit as the main goal by compromising the health of schoolchildren. Setter *et al*. (2003) and Fox *et al.* (2005) have reported that canteens that sell healthy food may still be profitable. Thus, future intervention is needed to further influence the behavioural attitude of canteen managers on the belief about profitable, yet healthy nutritious food.

The second reason for the limited impact of the intervention is the lack of support from the surrounding community, such as teachers, parents, and students. The intervention was supposed to incorporate these individuals through education, to help the students make the right, healthy food choices. This is in agreement with researchers in Korea who have pointed out that, healthy food intervention should educate and encourage schoolchildren to choose healthy foods and learn good dietary choices in order to ensure healthy dietary behaviours (Yoon *et al*., 2012). The role of parents is also crucial to further encourage their children and be the secondary force that provides healthy food choices in school canteens. However, a report has indicated that there are parents who do not see the need for canteens to sell healthy food choices (Bell and Swinburn, 2004). This opinion was in agreement with Setter *et al.* (2003) and (Hoffman *et al.*, 2015), who reported that effective, healthy canteen programmes and standards must be supported by the involvements of administrators, students, and parent-teacher organisations as the main key stakeholders. Another reason for our lack of success might be due to the lack of healthy food preparation skills to influence their behavioural changes. Based on the recommendations from earlier research, in order to improve healthy food choices, dishes must be prepared and presented in a more attractive and tastier manner (Cleland *et al*., 2004).

The final reason could be due to the lack of available food policies or guidelines to further enforce the need to prepare healthy food for the consumption of primary students. A number of studies have recommended the implementation of food policy enforcement and guidelines (Neumark-Sztainer *et al*., 2005; Jaime and Lock, 2009; Fox, 2010) or Canteen Menu Planning Guide (Ardzejewska *et al*., 2013) to highlight the positive impacts of healthy food intervention. The success of school food policies in reducing access to foods high in fat and sugar, and with less frequent purchases of these items in school (Neumark-Sztainer *et al.*, 2005) and reduced adolescent body mass index (Taber *et al*., 2012) have been reported. Hoffman *et al.* (2015) have shown that legislative requirements may have effectively reduced the availability of unhealthy foods in the schools of Massachusetts. They had successfully started the enactment of the school nutrition bill in 2010 and developed nutrition standards for all competitive foods served in school canteens in 2012. They then continued to examine the compliance rate one year after the school nutrition standards were implemented, and found a 47% increase in competitive food compliance. Setter et al. (2000) have commented that any education related to healthy

food must be sequential rather than one-offs, and that this attempt must be conducted through an integrated health education policy across the whole school.

In the Malaysian setting, the Management Guide for Healthy School Canteen has stressed on the approach to serve healthy foods in school canteens (MOE, 2011). However, their messages still failed to influence and improve the current high sale percentages of high-fat food, food categorised as not recommended for sale, and fast food. Thus, there is a need to have the School Nutrition Policies, which are simplified, easily understood and followed by food managers, and easy to be monitored.

The overall dropout rate in this study was 28.2%, representing 14 and 17 food handlers during Post1 and Post2, respectively. This value outnumbered the 20% anticipated dropout rate during the sample size calculation thus, regarded as study limitation. Reasons for dropping out included switching to jobs with better salaries, the delivery of new babies for female food handlers, and the employers were not satisfied with the work performance of their employees. In order to reduce the dropout rate, we have only enrolled food handlers with the intention to work at the same school canteens within a one-year period. Moreover, we had already anticipated the dropout rate to be much higher compared to previous studies, such as 10% for 10 weeks following handwashing intervention programmes among schoolchildren (Bowen *et al*., 2007). A small number of samples (n=8 schools for each group) will affect the study power, thus, subjected to further study limitation. Due to time constraint, manpower and budget issue, we could not expand the sample size. In order to maximize the power, this study reduced the respondents reliability by randomly assign the schools (sampling unit) and both groups found to be homogenous.

Conclusion

In conclusion, this study has confirmed the positive impact of TPB-based FNI on the healthy food knowledge among food handlers and the serving healthy competitive foods in school canteens. Thus, it offers the potential to reduce the problem of overweight and malnutrition amongst primary schoolchildren. However, there are rooms for future improvements in the training content, specifically in relation to food nutrition and healthy food serving. In order to further increase the serving of nutritious food and reduce the unhealthy food, future intervention needs to modify the targeted behaviour and the intervention approaches.

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References

Ajzen, I. 1991. The theory of planned behavior. Organizational Behavior and Human Decision Processes 50(2): 179-211.

Ardzejewska, K., Tadros, R. and Baxter, D. 2013. A descriptive study on the barriers and facilitators to implementation of the NSW (Australia) healthy school canteen strategy. Health Education Journal 72(2): 136-145.

Azizi, H., Asadollahi, K., Esmaeili, E. D. and Mirzapoor, M. 2015. Iranian dietary patterns and risk of colorectal cancer. Health Promotion Perspectives 5(1): 72-80.

Bell, A. and Swinburn, B. 2004. What are the key food groups to target for preventing obesity and improving nutrition in schools? European Journal of Clinical Nutrition 58(2): 258-263.

Best, C., Neufingerl, N., Van Geel, L., van den Briel, T. and Osendarp, S. 2010. The nutritional status of school-aged children: why should we care? Food and Nutrition Bulletin 31(3): 400-417.

Bevans, K. B., Sanchez, B., Teneralli, R. and Forrest, C. B. 2011. Children's eating behavior: the importance of nutrition standards for foods in schools. Journal of School Health 81(7): 424-429.

Bowen, A., Ma, H., Ou, J., Billhimer, W., Long, T., Mintz, E., Hoekstra, R. M. and Luby, S. 2007. A cluster-randomized controlled trial evaluating the effect of a handwashing-promotion program in Chinese primary schools. The American Journal of Tropical Medicine and Hygiene 76(6): 1166-1173.

Cleland, V., Worsley, A. and Crawford, D. 2004. What are grade 5 and 6 children buying from school canteens and what do parents and teachers think about it? Nutrition and Dietetics 61(3): 145-150.

Dubuisson, C., Lioret, S., Dufour, A., Calamassi-Tran, G., Volatier, J.L., Lafay, L. and Turck, D. 2015. The relationship between school lunch attendance and the food intakes of French schoolchildren aged 3–17 years. Public Health Nutrition 18(09): 1647-1657.

Ehiri, J., Morris, G. and McEwen, J. 1997. Evaluation of a food hygiene training course in Scotland. Food Control 8(3): 137-147.

El Derea, H., Salem, E., Fawzi, M. and Abdel Azeem, M. 2008. Safety of patient meals in 2 hospitals in Alexandria, Egypt before and after training of food handlers. Eastern Mediterranean Health Journal 14(4): 941-952.

Florentino, R. F., Villavieja, G. M. and Laña, R. D. 2002. Regional study of nutritional status of urban primary schoolchildren. 1. Manila, Philippines. Food and Nutrition Bulletin 23(1): 24-30.

Fox, M. K. 2010. Improving food environments in schools: Tracking progress. Journal of the American Dietetic Association 110(7): 1010-1013.

Fox, S., Meinen, A., Pesik, M., Landis, M. and Remington, P. L. 2005. Competitive food initiatives in schools and overweight in children: a review of the evidence. Wisconsin Medical Journal 104(5): 38-43.

French, S. A., Story, M., Fulkerson, J. A. and Gerlach, A. F. 2003. Food environment in secondary schools: a la carte, vending machines, and food policies and practices. American Journal of Public Health 93(7): 1161-1168.

Gosliner, W., Madsen, K. A., Woodward-Lopez, G. and Crawford,

P. B. 2011. Would students prefer to eat healthier foods at school? Journal of School Health 81(3): 146-151.

Green, L. R. and Selman, C. 2005. Factors impacting food workers' and managers' safe food preparation practices: a qualitative study. Food Protection Trends 25(12): 981-990.

Halpern, G. and Shukla, T. 2005. Processed meats comprising emulsified liquid shortening compositions comprising dietary fiber gel, water and lipid. U.S. patent 0084590. Google Patents. United States. Retrieved on November 17, 2015 from Website: https://www.google.com/patents/US20050084590

Hamidi, A., Fakhrzadeh, H., Moayyeri, A., Poirebrahim, R., Heshmat, R., Noori, M., Rezaeikhah, Y. and Larijani, B. 2006. Obesity and associated cardiovascular risk factors in Iranian children: A cross-sectional study. Pediatrics International 48(6): 566-571.

Hoffman, J. A., Rosenfeld, L., Schmidt, N., Cohen, J. F. W., Gorski, M., Chaffee, R., Smith, L. and Rimm, E. B. 2015. Implementation of competitive food and beverage standards in a sample of massachusetts schools: The NOURISH study (Nutrition Opportunities to Understand Reforms Involving Student Health). Journal of the Academy of Nutrition and Dietetics 115(8): 1299-1307

Hoogenkamp, H.W. 2012. Sodium: too much or too little? Fleischwirtschaft international: Journal for Meat Production and Meat Processing (4): 32-36.

Jaime, P. C. and Lock, K. 2009. Do school based food and nutrition policies improve diet and reduce obesity? Preventive Medicine 48(1): 45-53.

Khor, G. L. 2005. Micronutrient status and intervention programs in Malaysia. Food and Nutrition Bulletin 26(Suppl. 2): 281-285.

Khor, G. L., Chee, W. S., Shariff, Z. M., Poh, B. K., Arumugam, M., Rahman, J. A. and Theobald, H. E. 2011. High prevalence of vitamin D insufficiency and its association with BMI-for-age among primary school children in Kuala Lumpur, Malaysia. BMC Public Health 11(1): 95-102.

Lee, Y. and Manan, W. W. A. 2014. Nutritional status, academic performance and parental feeding practices of primary school children in a rural district in Kelantan, Malaysia. Progress in Health Sciences 4(1): 144-152.

McGuire, S. 2011. US Department of Agriculture and US Department of Health and Human Services, Dietary Guidelines for Americans, 2010. Washington, DC: US Government Printing Office, January 2011. Advances in Nutrition: An International Review Journal 2(3): 293-294.

Ministry of Education (MOE). 2011. Management Guide for Healthy School Canteen. Putrajaya: Ministry of Education, Malaysia.

Ministry of Health (MOH). 2009. Annual report. Ministry of Health Malaysia. Kuala Lumpur.

Ministry of Health (MOH). 2010. Malaysian Dietary Guidelines. Kuala Lumpur: Ministry of Health, Malaysia.

Moy, F. M., Ying, G. C. and Kassim, S. Z. M. 2006. Eating patterns of school children and adolescents in Kuala Lumpur. Malaysian Journal of Nutrition 12(1): 1-10.

Mullan, B., Allom, V., Sainsbury, K. and Monds, L. A. 2015. Examining the predictive utility of an extended theory of planned behaviour model in the context of specific individual safe food-handling. Appetite 90, 91-98.

Neumark-Sztainer, D., French, S. A., Hannan, P. J., Story, M. and Fulkerson, J. A. 2005. School lunch and snacking patterns among high school students: associations with school food environment and policies. International Journal of Behavioral Nutrition and Physical Activity 2(1): 14-20.

Nik Rosmawati, N.H., Wan Manan, W.M., Noor Izani, N.J. and Nik Nurain, N.H. 2015. Validity and reliability of food safety knowledge and practices questionnaire among food handlers. Health and the Environment Journal 6(1): 11-30.

O'toole, T. P., Anderson, S., Miller, C. and Guthrie, J. 2007. Nutrition services and foods and beverages available at school: results from the School Health Policies and Programs Study 2006. Journal of School Health 77(8): 500-521.

Park, S.H., Kwak, T.K. and Chang, H.J. 2010. Evaluation of the food safety training for food handlers in restaurant operations. Nutrition Research and Practice 4(1): 58-68.

Rennie, D. M. 1995. Health education models and food hygiene education. The Journal of the Royal Society for the Promotion of Health 115(2): 75-79.

Roberts, K. R., Barrett, B. B., Howells, A. D., Shanklin, C. W., Pilling, V. K. and Brannon, L. A. 2008. Food safety training and foodservice employees' knowledge and behavior. Food Protection Trends 28(4): 252-260.

Seaman, P. and Eves, A. 2006. The management of food safety--the role of food hygiene training in the UK service sector. International Journal of Hospitality Management 25(2): 278-296.

Setter, T., Kouris-Blazos, A. and Wahiqvist, M. 2003. School-based healthy eating initiatives: recommendations for success. Victoria: Monash University.

Shapiro, M. A., Porticella, N., Jiang, L. C. and Gravani, R. B. 2011. Predicting intentions to adopt safe home food handling practices. Applying the theory of planned behavior. Appetite 56(1): 96-103.

Snelling, A. M., Korba, C. and Burkey, A. 2007. The national school lunch and competitive food offerings and purchasing behaviors of high school students. Journal of School Health 77(10): 701-705.

Taber, D. R., Chriqui, J. F., Perna, F. M., Powell, L. M. and Chaloupka, F. J. 2012. Weight status among adolescents in states that govern competitive food nutrition content. Pediatrics 130(3): 437-444.

Tee, E., Khor, S. C., Ooi, H. E., Young, S. I., Zakiyah, O. and Zulkafli, H. 2002. Regional study of nutritional status of urban primary schoolchildren. 3. Kuala Lumpur, Malaysia. Food and Nutrition Bulletin 23(1): 41-47.

Templeton, S. B., Marlette, M. A. and Panemangalore, M. 2005. Competitive foods increase the intake of energy and decrease the intake of certain nutrients by adolescents consuming school lunch. Journal of the American Dietetic Association 105(2): 215-220.

Webb, M. and Morancie, A. 2015. Food safety knowledge of foodservice workers at a university campus by education level, experience, and food safety training. Food Control 50: 259-264.

Wong, J. P. S., Ho, S., Lai, M., Leung, G., Stewart, S. and Lam, T. 2005. Overweight, obesity, weight-related concerns and behaviours in Hong Kong Chinese children and adolescents. Acta Paediatrica 94(5): 595-601.

Yoon, J. P., Kwon, S. P. and Shim, J. E. P. 2012. Present status and issues of school nutrition programs in Korea. Asia Pacific Journal of Clinical Nutrition 21(1): 128-133.

Yoong, S. L., Nathan, N. K., Wyse, R. J., Preece, S. J., Williams, C. M., Sutherland, R. L., Wiggers, J. H., Delaney, T. M. and Wolfenden, L. 2015. Assessment of the school nutrition environment: a study in Australian primary school canteens. American Journal of Preventive Medicine 14(2): 215-222.