

Juara Sihat™: Study Design of a School-based Childhood Obesity Nutrition Education Programme in Kuala Lumpur, Malaysia

(Juara Sihat™: Reka Bentuk Kajian Program Pendidikan Pemakanan Obesiti Kanak-kanak Berasaskan Sekolah di Kuala Lumpur, Malaysia)

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ABSTRACT

The global prevalence of overweight and obesity among children has increased rapidly in the recent decades, including in Malaysia. Thus, development of effective interventions to prevent childhood obesity in Malaysia is urgently needed. This paper describes the study design of a 12-week multi-component, school-based nutrition education programme aimed at managing childhood obesity. The objective of Juara Sihat™ is to determine the effectiveness of a nutrition education programme in improving anthropometric status, knowledge, attitude and practice (KAP) of nutrition, eating habits and physical activity level among overweight and obese children. This quasi-experimental study involves two primary schools in Kuala Lumpur with similar demographic characteristics. Eligibility criteria of research participants are overweight and obese children aged 9 to 11 years. The main components of the Juara Sihat™ intervention are nutrition education classes on healthy eating and active lifestyle; physical activity sessions; and active involvements of parents and teachers. The control school does not receive any interventions. The primary outcome is BMI-for-age z-score, while other outcomes include waist circumference, body fat percentage, KAP of nutrition score, dietary intake, physical activity level, sedentary behaviour and biochemical profile. Outcome measures will be assessed at three intervals: baseline, post-intervention 1 (3-month follow-up), and post-intervention 2 (6-month follow-up). The Juara Sihat™ programme represents a promising approach to examining the effectiveness of a school-based childhood obesity intervention with strong empowerment of Parents' and Teachers' Association (PTA). We anticipate that this study may provide insights towards the development of more effective strategies in formulating childhood obesity interventions.

Keywords: Children; obesity; intervention; nutrition education; physical activity

ABSTRAK

Prevalens global berlebihan berat badan dan obesiti dalam kalangan kanak-kanak telah meningkat secara mendadak dalam beberapa dekad kebelakangan ini, termasuk di Malaysia. Maka, pembentukan intervensi yang efektif untuk mencegah obesiti kanak-kanak di Malaysia amat diperlukan. Artikel ini menerangkan reka bentuk kajian program pendidikan pemakanan berasaskan sekolah, multi-komponen selama 12 minggu yang bertujuan untuk menangani masalah obesiti kanak-kanak. Objektif Juara Sihat™ adalah untuk menilai keberkesanan program pendidikan pemakanan dalam memperbaiki status antropometri, tahap pengetahuan, sikap dan amalan (KAP) pemakanan, corak pengambilan makanan dan tahap aktiviti fizikal dalam kalangan kanak-kanak yang berlebihan berat badan dan obes. Kajian percubaan kuasi ini melibatkan dua buah sekolah rendah di Kuala Lumpur dengan ciri-ciri demografi yang sama. Kriteria penerimaan peserta kajian adalah kanak-kanak berlebihan berat badan dan obes berumur 9 hingga 11 tahun. Komponen utama intervensi Juara Sihat™ adalah kelas pendidikan pemakanan mengenai pemakanan sihat dan gaya hidup aktif; sesi aktiviti fizikal; dan penglibatan aktif ibu bapa dan guru. Sekolah kawalan tidak menerima sebarang intervensi. Hasil utama adalah skor-z IJT-untuk-umur, sementara hasil lain termasuk ukur lilit pinggang, peratus lemak badan, skor KAP pemakanan, pengambilan makanan, tahap aktiviti fizikal, tingkah laku sedentari dan profil biokimia. Ukuran hasil akan dinilai pada tiga selang: garis dasar, pos-intervensi 1 (susulan 3 bulan), dan pos-intervensi 2 (susulan 6 bulan). Program Juara Sihat™ merupakan pendekatan yang mengupayakan kajian keberkesanan intervensi obesiti kanak-kanak yang berasaskan sekolah dengan pemerkasaan Persatuan Ibu Bapa dan Guru (PIBG). Kami menjangkakan bahawa kajian ini dapat memberikan input bagi pembangunan strategi yang lebih efektif dalam membentuk intervensi obesiti kanak-kanak.

Kata kunci: Kanak-kanak; obesiti; intervensi; pendidikan pemakanan; aktiviti fizikal

INTRODUCTION

Obesity in children is a serious public health problem and the prevalence is increasing dramatically (Ng et al. 2014).

It is an emerging issue in developing countries with the rate of overweight and obesity on the rise, comparable to the pattern seen in developed countries (Ng et al. 2014). It remains at historically high levels, despite latest indications

demonstrating that this upward trend has reached a plateau (Wabitsch et al. 2014). In Malaysia, prevalence of overweight and obesity among urban children aged 7 to 12 years was reported at 14.4% and 20.1%, respectively (Poh et al. 2013).

Childhood obesity has been associated with short- and long-term effects on physical and psychosocial health in both child and adult life (Bray & Bouchard 2014). Several studies found that overweight and obese children are more likely to remain obese into adulthood and more likely to develop non-communicable diseases later in life (Li et al. 2011; Petkeviciene et al. 2015). According to Wee et al. (2011), overweight and obese Malaysian children aged 9 to 12 years were at 16.3 times higher risk of developing metabolic syndrome compared to their normal weight counterparts.

Obesity is a complex issue and it is the result of interactions between multiple factors. Etiology of childhood obesity can be divided into two main categories: modifiable factors (socioeconomic status, diet, physical activity, sleep and parental determinants) and unmodifiable factors (genetics, ethnicity, intrauterine factors) (Ang et al. 2013). The increase in the percentage of overweight and obesity among primary schoolchildren in Malaysia was mainly caused by the type of foods consumed, which mostly were high in fat, sugar and calories (Umairah et al. 2012). Moreover, a majority of Malaysian children did not meet the recommended daily pedometer step counts and exceeded the recommended maximum screen time of 2 hours per day (Lee et al. 2015).

Considering the increasing prevalence of overweight and obesity among children, effective interventions to prevent this epidemic in Malaysia are urgently needed and should target modifiable health-related behaviours. The essential behavioural components of a childhood obesity intervention are likely to include dietary intake, physical activity and active parental involvement (Kirk et al. 2005). A number of childhood obesity nutrition education programmes have been initiated in several countries (Sbruzzi et al. 2013; Wang et al. 2013; Kothandan 2014), including in Singapore (Gupta et al. 2010) and Malaysia (Wafa et al. 2011; Koo et al. 2016). However, significant studies in Malaysia are largely lacking and sustainability of those childhood obesity interventions is questionable. Thus, this paper provides an overview of the rationale and study protocol of a school-based nutrition education programme aimed at managing childhood obesity.

The aim of the *Juara Sihat*TM programme is to assess the effectiveness of a nutrition education programme in improving anthropometric status, knowledge, attitude and practice (KAP) of nutrition, eating habits and physical activity among overweight and obese primary schoolchildren aged 9 to 11 years. It is hypothesised that, in comparison to the control group, the children in the intervention school will: (1) have improved anthropometric measurements; (2) demonstrate improved knowledge, attitude and practice of nutrition; (3) have improved overall dietary intake; and (4) demonstrate greater increase in physical activity level and less time spent on sedentary behaviours.

METHODS

STUDY DESIGN

*Juara Sihat*TM, which can be translated as ‘healthy champion,’ focuses on promotion of healthy eating habits, active lifestyles and reduced physical inactivity among overweight and obese primary schoolchildren aged 9 to 11 years old. It is a multi-component, school-based nutrition education programme aimed to modify key health behaviours (nutrition, physical activity and behavioural change). This study is a quasi-experimental trial with pre- and post-test, involving intervention and control group participants. Intervention group receives a 12-week nutrition education programme, while the control group does not receive any nutrition education. It is to be noted, however, that both the *Juara Sihat*TM intervention and control groups are exposed to some nutrition education elements in their primary school Physical Education and Health curriculum. The *Juara Sihat*TM intervention consists of four key components: (i) five 1-hour nutrition education classes; (ii) four 1-hour physical activity education sessions; (iii) family involvement; and (iv) strong empowerment of Parents’ and Teachers’ Association (PTA). This study adopted Socio-ecological Model (SEM) as a framework to consider interactions between intrapersonal (children), interpersonal (parents), institutional (school) and community factors (teachers). Data will be collected from both groups of participants at baseline (before intervention), post-intervention 1 (3 months after completion of intervention) and post-intervention 2 (6 months after completion of intervention). This study is divided into four main phases, namely: (i) pre-intervention, (ii) implementation of intervention programme, (iii) post-intervention 1, and (iv) post-intervention 2. The study protocol was approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia (Project code: NN-105-2014).

STUDY SETTING

This study is conducted in two primary schools in Kuala Lumpur after obtaining permission from the Ministry of Education of Malaysia and the Kuala Lumpur Federal Territory Education Department. A list of 200 government primary schools in Kuala Lumpur is obtained from the Kuala Lumpur Federal Territory Education Department. Based on the list, two schools are randomly selected, such that both schools have similar demographic characteristics and sufficiently far apart from each other (approximately 25 km distance) in order to avoid interaction between the intervention and control schools’ participants.

The intervention and control schools’ principals are approached by letter, phone call and a visit to obtain permission to conduct the project in their schools. Several meetings are conducted with the intervention school principal, teachers and PTA members to explain the objectives, importance of the study and procedures

involved throughout the study duration, in order to get the full commitment and engagement from the school authority, as intervention group participants are required to undergo 12 weeks of nutrition education programme. Written informed consent is obtained from parents or guardians of all participants, while verbal assent is also obtained from each child prior to participation in the study.

SAMPLE SIZE CALCULATION

The sample size for this study is estimated using Snedecor and Cochran (1989) formula: $n = 1 + 2C(s/d)^2$; whereby, s = standard deviation, d = detectable difference and C = constant. The present study is powered using BMI data from Malaysian Childhood Obesity Treatment Trial (MASCOT) (Wafa et al. 2011). Based on MASCOT, the mean difference of change in BMI z-score between groups was -0.09, with a standard deviation of change in BMI z-score of 0.72. Researchers expect a difference in standard deviation of 0.50. Hence, a sample size of around 45 people per arm would give 90% power at the 0.05 significance level. The sample size estimation is further adjusted to account for sample attrition over the course of 9 months of the study duration and we have planned to over sample by 55 10% to account for dropouts. Therefore, the total number of children needed is 55 (55 in each arm).

INCLUSION CRITERIA

Inclusion criteria for this study are: (i) Malaysian primary schoolchildren aged 9-11 years; (ii) children who are overweight or obese (BMI-for-age $> + 1SD$, relative to the WHO Growth Reference).

EXCLUSION CRITERIA

Children with chronic illness and metabolic symptoms that are likely to affect body are excluded. Besides that, children who are physically handicapped, under medication for a long period and those who are practicing or participating in a weight loss programme are not allowed to participate in the study, as these are likely to influence their height, weight, physical activity level or eating habits.

STUDY PROCEDURES

Phase I: Pre-intervention Phase I consists of development and pilot testing of the module and intervention components. During the formative phase, a series of meetings are conducted to explore the appropriateness of programme delivery, content of *Juara Sihat*TM module, information density in each lesson delivered and possible outcome measures. Two education modules are developed for facilitators and children after several meetings with experts, teachers and PTA members. A detailed plan on the implementation of the intervention programme is developed. At this stage, a time schedule for the deliverance of the intervention programme is

formulated, taking into consideration the intervention school calendar, annual school programmes and extra-curricular activities. Detailed protocols and related materials (example: posters, banners, flyers, teaching aids, handouts, healthy recipe book and education materials) are also developed for use throughout the study duration. Relevant school teachers and PTA members are invited to attend a two day interactive Training of the Trainers session. The main aim of this training is to provide an overview of our intervention programme, content and delivery of intervention lessons, whereby they are provided with all relevant materials (such as presentation slides and lessons plans) and practical sessions.

The screening process is performed in all classes involving children aged 9 to 11 years old in both intervention and control schools, whereby their body weight and height are measured. Body mass index (BMI) of the children is computed according to the WHO BMI-for-age growth reference chart, in order to identify overweight and obese children (WHO 2007). An information leaflet and parental consent form are distributed through the schools to parents/legal guardians of eligible children (overweight/obese) in participating schools.

Besides that, the pre-intervention phase involves baseline data collection in both intervention and control schools, which include assessment of socio-demography, anthropometric status, dietary intake, level of knowledge, attitude and practice (KAP) of nutrition and physical activity level.

Phase II: Implementation of intervention programme

The intervention programme is delivered by nutrition experts and it is comprised of nine sessions. Three main focus of the 12-week intervention programme are: (1) healthy eating; (2) increased physical activity and reduced sedentary activities; and (3) behavioural modification. The intervention is carried out during the first-term of the academic year, approximately 12 weeks with baseline measurements collected prior to intervention. Parents of children from the intervention group are invited to attend a half-day seminar before intervention programme starts to encourage them to create a supportive environment at home for their children.

The *Juara Sihat*TM nutrition education module has six main topics, namely Am I Healthy?; Cheerful and Healthy Chef!; Choose Wisely for Healthy Body!; Look at Me!; We are Active and 3 km Fun Run Challenge!; and Fruits and Vegetables are My Best Friends!. A detailed description of the intervention module is provided in Table 1. All these topics are formulated to educate the overweight and obese children in the intervention school about healthy eating, active living and behavioural change. The school serves as a platform for disseminating information targeting at children, parents and teachers. The intervention programme is conducted in the school, with support from school teachers and PTA members. A series of interactive educational sessions and activities are implemented during the intervention lessons to keep the students engaged.

TABLE 1. Topics in the *Juara Sihat*TM Nutrition Education Module

Topic	Contents	Week	Setting	Target group
Topic 1: Am I Healthy?	1) To assess body image based on Stunkard's Figure Rating Scale for Children. 2) To calculate BMI and compare with BMI-for-age Growth Chart. 3) Using pedometer.	3	Indoor	• Children • Teachers
Topic 2: Cheerful and Healthy Chef!	1) To understand the Malaysian Food Pyramid. 2) Understand the importance of breakfast. 3) To learn to prepare simple and nutritious breakfast and lunchbox meal.	5	Indoor	• Children • Teachers
Topic 3: Choose Wisely for Healthy Body!	1) To learn to differentiate between energy-dense and nutrient-dense foods. 2) Identify foods that are categorized as high energy, fat, sugar and salt. 3) Identify foods that are categorized as low energy, fat, sugar, salt and high fiber. 4) To plan a healthy menu based on recommended energy intake.	7	Indoor	• Children • Teachers
Topic 4: Look at Me!	1) To identify ideal body image based on own body weight status. 2) Controlling negative thoughts on body shape and size. 3) Role of self-efficacy in practicing healthy eating and optimal physical activity.	9	Indoor	• Children • Teachers
Topic 5: We are Active and 3 km Fun Run Challenge!	1) To participate in physical activity and exercise in outdoor setting. 2) Importance of doing physical activity together with family and friends. 3) Motivate children to spend more time being physically active and less time watching television/playing computer games.	2, 4, 6, 8	Outdoor	• Children • Teachers
Topic 6: Fruits and Vegetables are My Best Friends!	To increase awareness on the importance of fruits and vegetables consumption.	10	Indoor	• Children • Teachers

Overall, all the six topics are covered over a 12-week period in nine different sessions, with each session lasting up to an hour and are delivered in either indoor (classroom) setting or outdoor (school field) setting.

Besides the modules, some fun activities are also conducted over the course of the intervention programme in conjunction with school annual events or other weekend days agreed upon by the school. Five fun activities are organized with commitment from school authorities, namely Healthy Lifestyle Seminar, Cheerful and Healthy Chef Cooking Demonstration, Mini Cheerful Chef Cooking Competition, Aerobics Competition and 3 km Fun Run Challenge. The content of each activity is outlined in Table 2. These events involve intervention participants, participants' parents/guardian, school principal, teachers, PTA members and the school canteen operator. Control group participants will not receive any active intervention.

Phase III and IV: Post-intervention 1 and Post-intervention 2 The third phase of this study is post-intervention 1, which will be conducted three months after the completion of the intervention programme. Meanwhile, post-intervention 2 will be conducted six months after the

completion of intervention programme. The main aim of this phase is to examine the effectiveness and sustainability of the intervention programme that has been carried out. Re-measurement of baseline parameters, such as anthropometric status, dietary intake, level of knowledge, attitude and practice (KAP) of nutrition and physical activity level will be undertaken for both the intervention and control groups. At the end of phase IV, all the data collected at baseline, three-month and six-month follow-ups will be analysed to evaluate the effectiveness of the *Juara Sihat*TM programme.

OUTCOME MEASUREMENTS

The children will be assessed on three occasions: at baseline, three-month and six-month follow-ups. The primary outcome is BMI-for-age z-score, while other outcomes include waist circumference, body fat percentage, KAP of nutrition, dietary intake, physical activity level, sedentary behaviour and biochemical profile. Any loss of information including incomplete data, will be obtained through interviews or phone calls for further details from the participants.

TABLE 2. Overview of fun activities in the *Juara Sihat*TM Nutrition Education Programme

Activity	Contents	Week	Setting	Target group
Healthy Lifestyle Seminar	<ol style="list-style-type: none"> 1) Highlight the importance of participating in <i>Juara Sihat</i>TM Programme and share overview of activities to be carried out over a period of 12 weeks of intervention. 2) How parents can handle the challenges related to behavioural changes and create a family-oriented action plan. 3) Forum with nutrition experts to discuss ways to adopt healthy lifestyle at school and home environment. 	1	Indoor	<ul style="list-style-type: none"> • Children • Parents • Teachers • PTA members • Canteen operator
Aerobics Competition	Encourage team spirit among group members to choreograph rhythms for their aerobics in a most attractive and creative way.	11	Outdoor	<ul style="list-style-type: none"> • Children • PTA members • Teachers
Mini Cheerful Chef Cooking Competition	Each group consists of two members (parent/guardian along with their children). Participants are required to prepare, cook and serve a healthy and nutritious breakfast.	11	Outdoor	<ul style="list-style-type: none"> • Children • Parents • PTA members • Teachers
Healthy Chef Cooking Demonstration	Cooking demonstration by celebrity chef to educate parents about practices that promote healthy eating among children and encourage them to prepare healthy meals at home.	12	Outdoor	<ul style="list-style-type: none"> • Children • Parents • PTA members • Teachers
3 km Fun Run Challenge!	Each group consists of two members (parent/guardian along with their children). The participants are required to complete the full route in the challenge, whereby the pairs must arrive at the finishing line together.	12	Outdoor	<ul style="list-style-type: none"> • Children • Parents • PTA members • Teachers

SOCIODEMOGRAPHIC BACKGROUND

A Malay language parent-administered questionnaire is used in this study. Sociodemographic information including date of birth, age, sex, ethnicity, health status, parental education level, parents' occupation and household income are reported. Weight and height of the parents are self-reported by the parents themselves. The parent-administered questionnaires are also checked during data collection to ensure that there are no missing data and all items are correctly answered.

ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements are conducted according to the procedure proposed by the International Society for the Advancement of Kinanthropometry (ISAK) (Stewart et al. 2011). All measurements are carried out in the morning with the children barefooted and in light clothing. Any objects that could possibly interfere with the readings are removed from their pockets prior to measurements. Body weight is measured using a calibrated TANITA digital scale Model SC-330 (Tanita Co., Tokyo, Japan) and recorded to the nearest 0.1 kg. Height is measured using a SECA Bodymeter 217 (SECA GmbH & Co., Hamburg, Germany) to the nearest 0.1 cm. BMI is calculated by dividing the measured weight (kg) by the square of height (m). BMI-for-age z-score is determined using WHO AnthroPlus software (WHO 2009). The WHO BMI-for-age growth reference for children aged 5-19 years old is used as the standard reference for determining the anthropometric status of the

children (WHO 2007). Body fat percentage is measured by bioelectrical impedance (TANITA digital scale Model SC-330; Tanita Co., Japan) using the incorporated formula in the instrument. Waist circumference is measured to the nearest 0.1 cm using a Lufkin tape Model W606PM (Apex Tool Group, USA) at the midpoint between the lowest rib and iliac crest when the child is at minimal respiration, following a standardized protocol by WHO (2005).

BLOOD PRESSURE MEASUREMENT

Blood pressure is measured in a sitting position using a digital Omron sphygmomanometer and size-appropriate cuff (Falkner & Daniels 2004).

BIOCHEMICAL MEASUREMENTS

A venous blood sample (maximum 12 ml) is collected after an appropriate fasting period (8-12 hours) using the standard venepuncture technique by a trained phlebotomist. Venous blood is drawn for the analysis of full lipid profile, fasting blood glucose (FBG) and C-reactive protein level (CRP). Fasting blood glucose, total cholesterol (TC) and triglycerides (TG) are determined using enzymatic reaction, HDL cholesterol is determined using enzymatic elimination method and LDL cholesterol is calculated using the Friedewald formula. FBG, HDL-C, TC and TG are measured on Cobas 8000 Modular Analyser (Roche Diagnostics), while CRP is measured using ADVIA 2400 (Siemens). Blood samples are taken only from the intervention group participants.

DIETARY INTAKE ASSESSMENT

The dietary intake of the participants is assessed using a self-administered three-day dietary record, which comprised of two weekdays and one weekend day over the period of a week. Detailed descriptions of all foods and beverages including time of consumption, cooking methods and brand names of processed food are recorded. The dietary record is obtained with the aid of household measurements to estimate the portion sizes and quantities of food consumed. Total energy and nutrient intakes will be analysed using Nutritionist Pro™ software (Axxya Systems, United States), based principally on the Malaysian Food Composition Table (Tee et al. 1997) and food product labels. All dietary records are checked by trained researchers for completeness and accuracy. Further clarifications are obtained by interviewing the participants, in cases where the records are incomplete or filled incorrectly.

LEVEL OF KNOWLEDGE, ATTITUDE AND PRACTICE (KAP) OF NUTRITION

The knowledge, attitude and practice (KAP) of nutrition among the children are assessed using a validated, self-administered questionnaire. The questionnaire is constructed in the Malay language, and consists of three sections: (1) knowledge domain; (2) attitude domain; and (3) practice domain. Changes in the KAP scores are used to assess the effectiveness of this intervention programme. The nutrition knowledge domain is intended to discover children's knowledge on general nutrition, food groups and their functions based on Malaysian Food Pyramid. Whereas, the attitude domain is assessed by asking them to indicate their level of agreement to the statements using a five-point rating scale (strongly disagree = 1, disagree = 2, uncertain = 3, agree = 4 and strongly agree = 5). The nutrition practice domain corresponds to the frequency of food intakes, such as fruits, vegetables, breakfast, fast food, etc.

PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

Physical activity is measured using an objective method (pedometer) and a subjective method (Physical Activity Questionnaire for Children, PAQ-C).

Pedometer, Digi-walker CW-700 (Yamax Corp., Japan) is used to measure the step counts of the children in this study. Children are required to wear the pedometer on a waist belt, at all times, except while sleeping, bathing and swimming, for seven consecutive days. A minimum number of valid days of at least three weekdays and one weekend day is used for the calculation of average pedometer step counts (Laurson et al. 2008). They are required to record the time the pedometer was worn and removed each day in a logbook. A weighted average daily step count is calculated from pedometer readings on weekdays and weekend days. The pedometer step counts are considered valid if the

weighted average step counts exceed 1000 steps per day (Duncan et al. 2006); and the pedometer is worn for at least 10 hours a day (Laurson et al. 2008).

For subjective method, Physical Activity Questionnaire for Children (PAQ-C) is employed and children are required to complete this questionnaire based on their daily physical activity performed over the previous seven days. This questionnaire has been adapted from Physical Activity Questionnaire for Older Children, PAQ-C by Crocker et al. (1997), which had been translated into Malay language and validated by Lim (2010). The PAQ-C score is based on the average score of these questions. Children are classified into three categories of physical activity level (low, moderate, high) based on this score (Dan et al. 2007).

Sedentary behaviour is assessed with a questionnaire adapted from the survey of Child and Adolescent Physical Activity and Nutrition Survey, CAPANS (Hands et al. 2004). Children are required to complete the questions related to their daily sedentary activities over the past seven days. Screen time is calculated based on weighted average time spent watching television, playing video games and using computer on weekdays and weekend days as reported by the participant. According to Malaysian Dietary Guidelines (2013), the recommended level of screen time is not more than two hours a day. This value is adopted for use.

STATISTICAL ANALYSIS

Statistical analysis will be conducted using SPSS version 22.0 (IBM Corporation, Chicago, IL). The baseline data (including socio-demography, anthropometric measurements, dietary intake, KAP of nutrition, physical activity level) of intervention and control groups will be analysed using descriptive analysis. The differences between intervention and control groups at baseline will be determined using independent *t*-test or Mann-Whitney U test. General linear models will be applied to evaluate the effectiveness of the 12-week nutrition education programme between intervention and control groups. Analysis of covariance for repeated measures (ANCOVA) will be employed to determine the changes in outcome variables between study groups with regard to time intervals. Baseline variables which are significantly different between groups will be controlled in the model. Three models will be examined, including (1) within group difference (time effect); (2) between groups difference (treatment effect); and (3) within-between groups difference (time-treatment interaction).

DISCUSSION

To the best of our knowledge, the *Juara Sihat*™ programme is one of the first school-based, multi-component nutrition education programme combined with a strong empowerment of PTA conducted in Malaysia. Childhood obesity epidemic is a major public health concern

worldwide; therefore, effective preventive measures should be taken as early as childhood to manage childhood obesity. These interventions should target modifiable health-related behaviours; and must be aligned with the relevant age group, socio-demographic and psychosocial characteristics. The school-age years are a critical period for the development of long-term health-related behaviours. Dietary and physical activity habits established during childhood and adolescence have been shown to track into adulthood, which might lead to serious health consequences later in life (Kelder et al. 1994; Craigie et al. 2011). In Malaysia, childhood obesity intervention studies have scarcely been reported. These suggest the importance and urgency to recognize and treat overweight and obesity in Malaysian children, hence emphasizing the need for programmes specifically focusing on this age group.

This study particularly emphasizes strong empowerment of PTA members to play an important role in intervention design and implementation. PTA acts as a mediator between school teachers and parents. This is a promising approach to a school-based childhood obesity intervention programme, as we believe the positive influence of networking among parents and school authorities (principal, teachers, PTA members) is crucial to encourage active parental support and augment participants' involvement in the intervention (Perry et al. 1998; van der Kruk et al. 2013). Empowerment of PTA and good rapport with the intervention school principal and teachers have a central role in the success of delivery of the intervention programme as planned. This approach is likely to help us reach family unanimity and securing continuous support from the participants to follow the designed programme, as the programme is acknowledged by the school authorities.

Apart from that, school teachers are also involved in all the intervention modules with the participants. The effectiveness of school-based interventions can be maximised with continuous supports from the school teachers, as they are able to positively influence school environment by promoting healthy eating and physical activity through social interactions (Friend et al. 2014; Nayak & Bhat 2016). Given the importance of involvement of PTA and school teachers in the school-based childhood obesity interventions, it is important to provide opportunities for them to participate in the intervention planning and explore recommendations to better address their needs.

Besides that, parental involvement is a critical component in childhood obesity interventions, as it promotes positive behavioural changes and sustained participation among children (Perry et al. 1998; Burgess-Champoux et al. 2007). Ickes et al. (2016) provided evidence that the effectiveness of school-based programmes can be enhanced with parental involvement. This is because parents may influence home environment through food availability at home, food preferences and physical activity patterns of family members. Several studies have shown that school-based interventions with nutrition education, promotion

of physical activity and behavioural modification should involve parents as the potential mediator in developing effective and sustainable solutions to promote overall healthy school and home environments (Centis et al. 2012; Patino-Fernandez et al. 2013; Bergström et al. 2015; Nyberg et al. 2016).

The main strength of the *Juara Sihat*TM programme is that it represents a novel approach to examine the effectiveness of a nutrition education programme delivered in a school setting with strong empowerment and active involvement of parents and school teachers, specifically tailored for the execution among overweight and obese primary schoolchildren in Malaysia. The results of the analyses will help us gain more insights and allow us to contextualize the findings of this study. Further outcomes will be published in the near future.

CONCLUSION

In summary, we have described the study design, measurement procedures and intervention components comprehensively. The *Juara Sihat*TM programme targets to improve healthy nutrition practices and physical activities, as well as to reduce sedentary lifestyles among overweight and obese primary schoolchildren. We believe that this nutrition education programme could have significant positive impact on weight status and behavioural intentions of the children. We anticipate *Juara Sihat*TM programme could be a pioneer that can be implemented by the government and private sectors, as well as policy makers in formulating childhood obesity intervention in Malaysia, particularly. Besides that, this article will provide the much-needed information for the planning and implementation of future childhood obesity intervention programmes. We hope it will be beneficial to researchers, public health professionals and other parties seeking to develop similar prevention programmes.

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human subjects/patients were approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia. Written informed consent was obtained for all subjects by their parents and/or guardians.

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