ORIGINAL ARTICLE

Juara Sihat: assessing the sustained impact of a school-based obesity intervention

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ABSTRACT

Introduction: Obesity and physical inactivity among school children are among the most challenging health problems in Malaysia. The present study aimed to evaluate the sustained impact of Juara Sihat programme on physical activity level and anthropometric status at 18-month post-intervention.

Method: Participants of Juara Sihat (n=55) were followed-up at 18 months after completion of the intervention. Juara Sihat intervention was implemented over 12 weeks and focused on four key components: (i) five one-hour nutrition education classes, (ii) four one-hour physical activity education sessions, (iii) family involvement, and (iv) empowerment of Parents and Teachers Association. Anthropometric variables (body mass index, body fat percentage and waist circumference) were measured and physical activity level was evaluated by using Physical Activity Questionnaire for Children (PAQ-C) at baseline (P0), immediately upon completion of intervention (P1), at three-month post-intervention (P2), and at 18-month post-intervention (P3). Analyses of repeated measures analysis of covariance (ANCOVA) with intention-to-treat principle were applied.

Results: Sustained effects were found in BMI-for-age z-score which showed a reduction (P0 2.41±0.84 vs P3 2.27±0.81) and physical activity level which showed positive improvements (P0 2.46±0.62 vs P3 2.87±0.76) at 18 months after intervention was completed. Body fat and waist circumference had increased over the same time period.

Conclusion: Overall, this study successfully demonstrated sustained intervention effects of Juara Sihat intervention on BMI-for-age z-score and physical activity, but not on body fat percentage and waist circumference.

KEY WORDS:
Anthropometry; nutrition education; obesity; overweight; physical activity; school-based intervention; sustainability

INTRODUCTION

The high prevalence of childhood obesity is an emerging problem in developing countries, where the rates of overweight and obesity are becoming as high as in developed nations.[1] According to the National Health and Morbidity Survey (NHMS), the prevalence of childhood obesity (children below 18 years old) in Malaysia increased between 2011 and 2015 from 6.1 % to 11.9 %.[2,3] The South East Asian Nutrition Survey (SEANUTS) conducted in six regions of Malaysia reported 14.4% overweight and 20.1% obesity among urban children aged 7 to 12 years old.[4] A systematic review of the literature on the long-term health impact of childhood obesity on morbidity concluded that its consequences is extensive and includes both psychosocial and medical comorbidities.[5]

A number of systematic reviews have been published recently on treatment of childhood obesity [6,7] as well as the prevention of childhood obesity intervention,[8] however, the settings in which these childhood obesity interventions are implemented also needs to be considered to truly impact this global epidemic by targeting modifiable determinants of obesity.[9]

Schools are the ideal place to conduct childhood obesity interventions through promotion of healthy eating, physical activity, nutrition education and practice, policy and supportive environment[10-12] as students spend most of their time at school; and hence, school programmes can reach many students within a short timeframe.[13] There are also consistent male and female differential effects such as BMI, skinfold thickness and physical activity behaviours in school- based interventions[14,15] suggesting that sex differences may benefit from more targeted intervention approaches.

Many public health studies have focused on determining the factors that are critical to the success of initial implementation efforts.[16] Understanding the sustainability of childhood obesity interventions is vital to yielding long-term results.[17] Even when the initial implementation of an intervention is successful, it does not necessarily continue as intended by the study.[18] In addition, studies on sustainability of intervention effects are largely lacking[19,20] and only few obesity prevention programmes have assessed the maintenance of adiposity improvements in post-intervention assessments.[19] Studies have concluded that longer-term outcome measures and follow-ups should be included in future research to assess the sustainability of intervention effects on weight status.[21,22]

Therefore, the aim of this paper is to report the sustained impact of the Juara Sihat intervention, a 12-week school-based obesity intervention conducted in 2014 at a primary

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school in Kuala Lumpur, Malaysia to improve anthropometric status and physical activity level among overweight and obese primary school children.

MATERIALS AND METHODS

This sustainability study followed-up the participants of Juara Sihat intervention to determine the long-term impact of the programme in improving anthropometric status and physical activity level among overweight and obese children. Juara Sihat was a multi-component, quasi-experimental school-based intervention with control group conducted among 55 children aged 9 to 11 years in two randomly selected primary schools in Kuala Lumpur. The aim of Juara Sihat was 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 among overweight and obese children. The main components of the Juara Sihat intervention were nutrition education classes on healthy eating and active lifestyle; physical activity sessions; and active involvements of parents and teachers. The Juara Sihat 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 3km Fun Run Challenge!; and Fruits and Vegetables are My Best Friends! which involved the Parents and Teachers Association (PTA), teachers, parents, children and the school canteen operator to create a supportive environment at school and at home. Overall, all the six topics were covered over a 12-week period in nine different sessions as described in Table I. The control group did not receive any intervention. Outcome measures were assessed at three intervals: baseline, post-intervention 1 (3-month follow-up), and post-intervention 2 (six-month follow-up) and sustainability follow-up at 18-month. The Juara Sihat study protocol has been described elsewhere in greater detail.[23]

The sample size for Juara Sihat intervention was calculated using Snedecor and Cochran (1989) formula; and a sample size of 45 subjects per arm giving 90% power at the 0.05 significance level. The sample size estimation was adjusted to account for sample attrition at nine months of the intervention plus another 10% oversampling to account for dropouts. Therefore, the total number of children needed was 110 (55 in each arm). A total of 106 subjects aged 9-11 years old were selected using cluster sampling method (intervention group = 55; control group = 51). However, in this sustainability follow-up study, we employed only pre- and post-evaluation of the participants from Juara Sihat intervention school. Inclusion criteria for this sustainability study are overweight and obese Malaysian children with the ability to write, read, and understand Malay, and who were participants from Juara Sihat intervention school. Participants absent during data collection were excluded.

Height was measured barefooted in the standing position to the nearest 0.1cm using a portable stadiometer Model 217 (SECA, Germany). Body weight and body fat percentage were measured using Tanita Model SC-330 (Tanita Corporation, Japan) with the participants in light clothing. Z-scores for body mass index-for-age were then determined using WHO AnthroPlus version 1.0.3 (World Health Organization, Switzerland). Waist circumference was measured midway between the lowest rib and the superior border of the iliac crest at the end of normal expiration with a Lufkin tape Model W606PM (Apex Tool Group, USA) to the nearest 0.1 cm. Physical activity level was evaluated by using Physical Activity Questionnaire for Children (PAQ-C). Pedometer, Digi-walker CW-700 (Yamax Corp., Japan) was used to measure the step counts of the participants. The physical activity of the participants was assessed at baseline, and this was used to compare the effectiveness of our intervention programme to improve their physical activity level. All measurements were performed at baseline (P0), at post- intervention 1 which was conducted immediately upon completion of the intervention (P1), at post-intervention 2 conducted at three months after completion of intervention (P2), and during sustainability follow-up at 18 months after completion of intervention (P3).

Ethics approval for this sustainability study was obtained from the Research Ethics Committee of Universiti Kebangsaan Malaysia (Ref: UKM1.5.3.5/244/NN-074-2015 dated 29 October 2015). Permission to conduct the study was given by the Ministry of Education and the Kuala Lumpur Federal Territory Education Department. Parental written informed consent and child assent was obtained prior to participation in the study.

Statistical analyses were performed using the Statistics Package for IBM SPSS Statistics for Windows version 21.0 (IBM Corporation, United States). A two-sided p value of less than 0.05 was considered statistically significant. Analyses of repeated measure ANCOVA with intention-to-treat principle were applied to preserve the sample size. Intention to treat principle includes all randomized subject regardless of noncompliance or withdrawal. We applied this principle to lower the probability of reduced statistical power due to the dropouts excluded from the final analysis.[24]

RESULTS

This report focuses on the sustained impact of the Juara Sihat programme at 18 months after completion of the intervention. In this study, only participants from the intervention group were followed-up by applying the intention-to-treat principle. The participants were mostly Malays (81.8%), with some Indians (14.6%), and only few Chinese (1.8%) and other ethnicities (1.8%). All participants were either overweight (36.4%) or obese (63.6%). The demographic characteristics of participants at baseline are described in Table II.

Physical characteristics of the participants at baseline are described in Table III. We found significant differences ($p<0.05$) in BMI-for-age z-score, waist circumference and physical activity level at 18-month follow-up (P3) compared with baseline (P0). Table IV shows that BMI-for-age z-score reduced from 2.41±0.84 at P0 to 2.27±0.81 at P3 ($p<0.05$). However, body fat percentage and waist circumference increased from P0 to P3. On the other hand, physical activity level improved significantly ($p<0.05$) from 2.46±0.62 at P0 to 2.87±0.76 at P3.

Table I: Overview of the Juara Sihat programme components

Modules	Objectives
1. Am I Healthy?	To calculate BMI; to compare with BMI-for-age Growth Chart; to assess body image using Stunkard Figure Rating Scale for Children.
2. Cheerful and Healthy Chef!	To understand the Malaysian Food Pyramid; to learn to prepare simple and nutritious breakfast and lunchbox meal.
3. Choose Wisely for a Healthy Body!	To learn to differentiate between energy-dense and nutrient-dense foods.
4. Look at Me!	To identify ideal body image based on own body weight status.
5. We are Active!	To participate in physical activity and exercise in outdoor setting.
6. Fruits and Vegetables are My Best Friend!	To increase awareness on the importance of fruits and vegetables consumption.

Table II: Demographic characteristic of the participants

Demographic characteristics	n	Percentage
Gender		
Boys	38	69.1
Girls	17	30.9
Age		
12	16	29.1
13	19	34.5
14	20	36.4
Ethinicity		
Malay	45	81.8
Chinese	1	1.8
Indian	8	14.6
Others	1	1.8
BMI Categories		
Overweight	20	36.4
Obese	35	63.6

Table III: Physical characteristics of participants at baseline

	Boys mean (SD)	Girls mean (SD)
Weight (kg)	49.9 (10.6)	45.8 (12.8)
Height (cm)	143.5 (10.8)	137.2 (7.5)
Body Mass Index (kg/m2)	23.2 (2.7)	24.0 (4.6)
Body Fat (%)	32.9 (8.0)	32.4 (8.0)
Waist Circumference (cm)	75.6 (8.8)	74.0 (8.6)

Table IV: Anthropometry and physical activity level of Juara Sihat participants (n=55) at baseline (P0), post-intervention 1 (P1), post-intervention 2 (P2) and post-intervention 3 (P3) follow-ups

Outcomes	P0 Mean (SD)	P1 Mean (SD)	P2 Mean (SD)	P3 Mean (SD)	p value
BMI-for-age z-score	2.41 (0.84^{a})	2.34 (0.80^{b})	2.34 ($0.78^{a,b}$)	2.27 (0.81^{b})	0.038*
Body fat, %	32.8 (7.9^{a})	28.9 (6.4^{b})	34.3 (7.6^{a})	33.7 (8.5^{a})	<0.001*
Waist circumference, cm	75.1 (8.7^{a})	79.7 (8.9^{b})	80.1 (9.0^{c})	80.0 ($9.4^{b,c}$)	<0.001*
Physical activity level	2.46 (0.62^{a})	2.89 (0.62^{b})	3.14 (0.68^{c})	2.87 (0.76^{b})	<0.001*

Using General Linear Model for repeated measures. Adjustment for multiple comparisons: Least Significant Difference. Based on estimated marginal means, the mean difference is significant at p<0.05*

a,b,c, : values that do not share the same alphabets are significantly different from each other within the group based on general linear model analysis at p<0.05*

Table V: Anthropometry and physical activity level of boys (n=38) and girls (n=17) participating in Juara Sihat at baseline (P0), post-intervention 1 (P1), post-intervention 2 (P2) and post-intervention 3 (P3) follow-ups

Outcomes	Boys					Girls				
	P0 Mean (SD)	P1 Mean (SD)	P2 Mean (SD)	P3 Mean (SD)	p value	P0 Mean (SD)	P1 Mean (SD)	P2 Mean (SD)	P3 Mean (SD)	p value
BMI-for-age z-score	2.48 (0.80^{a})	2.41 (0.76^{a})	2.40 (0.75^{a})	2.34 (0.77^{a})	0.187	2.24 (0.94^{a})	2.18 (0.89^{a,b})	2.20 (0.85^{a})	2.09 (0.90^{b})	0.043*
Body fat, %	32.9 (8.0^{a})	27.5 (6.9^{b})	32.5 (7.9^{a})	31.8 (9.0^{a})	<0.001*	32.4 (8.0^{a})	32.1 (6.9^{a})	38.4 (7.9^{b})	37.7 (9.0^{b})	<0.001*
Waist circumference, cm	75.6 (8.8^{a})	80.4 (8.0^{b})	80.9 (8.1^{c})	81.5 (8.6^{b,c})	<0.001*	74.0 (8.6^{a})	78.2 (10.8^{b})	78.2 (10.8^{b})	76.7 (10.6^{a,b})	0.037*
Physical activity level	2.48 (0.70^{a})	2.82 (0.65^{b})	3.14 (0.66^{c})	2.90 (0.65^{b})	<0.001*	2.40 (0.38^{a})	3.04 (0.54^{b})	3.15 (0.74^{b})	2.80 (0.99^{a,b})	0.010*

Using General Linear Model for repeated measures. Adjustment for multiple comparisons: Least Significant Difference. Based on estimated marginal means, the mean difference is significant at p<0.05*

a,b,c : values that do not share the same alphabets are significantly different from each other within each sex based on gene ral linear model analysis at p<0.05*

Comparison between the sexes are described in Table V, where boys and girls shows similar changes in all anthropometric parameters, except for body fat percentage. Physical activity level also increased significantly (p<0.05) in both sexes from baseline to P3.

DISCUSSION

To date, evidence of long-term follow-up interventions targeting childhood obesity is limited; and in Malaysia, childhood obesity intervention studies have scarcely been reported. This study is one of the first to report the sustainability impact of a childhood obesity intervention programme conducted in Malaysia. We measured the sustainability which was started at post 1 intervention at three-month follow-up. After the completion of the intervention, we conducted an in-depth interview among the same participants, school teachers and school principal, whereby we ascertained that no other intervention had been conducted at the same school. We demonstrated that the Juara Sihat intervention has successfully sustained its impact on BMI-for-age z-score and physical activity level, but not on body fat percentage and waist circumference. Overall, a positive effect was found among the Juara Sihat participants who were all overweight and obese at baseline, and who showed significant reduction in BMI-for-age z-score and significant increase in physical activity level. This finding is supported by evidence from a meta-analysis, which reported that school-based interventions with physical exercise components can significantly reduce BMI among school children.[25] Similarly, some randomized controlled trials (RCTs) which involved longer term intervention follow-ups have found that modest improvements in BMI-for-age z-score over six to 12 months may lead to improvements in body weight status which is sustained for longer periods.[26,27]

It is noted that BMI-for-age z-score and physical activity level of participants were sustained during re-assessment at 18 months follow-up. However, a significant increase in body fat percentage and waist circumference during the sustainability follow-up could be due to the relative fatness (percentage of body fat), that is highest during early puberty of the participants, especially among girls.[46]

Some reviews have reported that boys and girls may respond differently to a given intervention.[28-30] The girls in this study showed statistically significant differences in anthropometric outcomes and physical activity level compared to boys. These findings are similar to Kropski's review that reported girls may respond better to educational intervention compared to boys, which consequently facilitates improvements in dietary intake and increased physical activity level.[30] Two school-based obesity interventions also reported that the effectiveness (BMI z-score) was greater in girls compared to boys.[31,32] In addition, a study also proposed that there may be gender bias in obesity interventions that could unintentionally favour girls.[33] However, studies on gender bias in obesity intervention is still lacking and it is recommended that future work examine potential gender bias.

Another promising aspect is the involvement of parents, school teachers and the PTA in this intervention. Parental involvement in Juara Sihat programme may also have helped to facilitate the behaviour change in children to increase healthy nutrition practices and physical activity level and to reduce sedentary lifestyles. A systematic review demonstrated that school-based obesity intervention involving parents directly adds to the beneficial intervention outcomes.[34] Parents or caregivers act as the primary mediator for behaviour change and have significant roles in improving their children's eating and physical activity behaviours.[35,36] The PTA played an important role in strengthening the bond between parents and school teachers, which in turn provided strong social and peer support to the participants throughout this intervention.

School teachers were involved in all the modules with the Juara Sihat participants, which means that teachers had the potential to positively influence the participants' behaviours. School-based obesity intervention with teacher-led activities has been reported to be effective in improving BMI-for-age z-score, as teachers also play an active role in the school environment by promoting healthy eating and physical activity through social interactions.[37] Given the importance of involvement of school teachers in the implementation of school-based obesity intervention, it is necessary to explore how teachers training should be designed in future research. A review article showed that the effectiveness of health

promotion interventions can be maximized by supporting school teachers during implementation.[19] If school teachers are properly trained, they will be more likely to be able to promote significant changes in the physical activity and other behaviour of the children involved.[38] As such, getting teachers to support the intervention and listening to their needs during intervention planning is important to sustain the intervention after the termination of the programme.[39]

The strengths of this study include the longer-term follow-up (at 18 months after completion of intervention), which enables us to assess the sustained impact of the Juara Sihat programme. The study also received strong support from children, parents, the PTA, school teachers and the principal, who were all actively involved in delivering and supporting the intervention. Despite the small intervention effects of this study, the Juara Sihat intervention can be viewed as a new platform for approaching schools in tackling childhood obesity.

There are some limitations in this study. Firstly, the intervention school is located in urban Kuala Lumpur; hence, some adjustments may be needed before the Juara Sihat intervention could be implemented in schools at other locations in Malaysia. Secondly, the effect may reflect fluctuations in body fat percentage and waist circumference not attributable to the intervention and is unlikely to be clinically meaningful.[30] Our finding shows girls had significant increase in body fat percentage during the 18 months sustainability follow-up; which is to be expected as physiologically girls are known to have increased body fat as they go through puberty.[40] However, we are not able to confirm the pubertal stages of our participants as conducting Tanner maturation staging was not part of the main study objective of the Juara Sihat intervention. Thirdly, it is noted the Juara Sihat intervention was implemented over a 18-month prior to the sustainability follow-up whereby participants may have been exposed to regular lessons on physical education which may have had a contextual effect that impact on sustained effectiveness. Understandably, this sustainability study involved only pre- and post-evaluation of the Juara Sihat intervention school participants and did not involve the control school that had not undergone any intervention previously; which could be an issue as comparison could not be done for the sustained effect.

CONCLUSION

We conclude that the Juara Sihat intervention had significant positive outcomes that were sustained after the programme ended. Despite the completion of the intervention in 2014, re-assessment at 18-month follow-up indicated that the positive effects were sustained for BMI-for-age z-score and physical activity level, but not body fat percentage and waist circumference. With the sustained positive outcomes, the contribution of Juara Sihat as a school-based intervention to combat childhood obesity can be considered important and the programme could be adopted and implemented at other primary schools in Malaysia.

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