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Kertas Asli/*Original Articles*

The Characteristic of Obesity Intervention Studies Among School Children in Malaysia: A Scoping Review

Ciri-ciri Kajian Intervensi Obesiti Dalam Kalangan Murid Sekolah di Malaysia:Suatu Tinjauan Penskopan

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ABSTRACT

Obesity among school children has now reached an alarming level in most developing countries, including Malaysia. Thus, numerous strategies to curb the rising of obesity focusing on school children have been taking place. However, this issue management is complex, and a holistic approach is needed to address it comprehensively. This scoping review aimed to identify the characteristics of obesity interventions conducted among school children in Malaysia as a principal recommendation to develop a comprehensive obesity intervention. Arksey and O'Malley's framework used to guide the scoping review process. Published articles on intervention studies conducted for school children in Malaysia from 2007 to 2020 retrieved based on keyword using the selected electronic and local databases. The NVivo 12 Plus software used to place findings in the systematic framework matric form and evidence tables. The final results reported in descriptive tables. Eighteen studies only reviewed among 3417 extracted articles. Thirteen aspects of the characteristics of the interventions identified. The influence of environmental intervention (family and school communities) on children lifestyle identified as a research gap. Combined environmental interventions and educational guides with technology application recognised as one of the potential components for future obesity intervention design amongst school children.

Keywords: Scoping review; obesity; intervention characteristic; school-based; technology-based

ABSTRAK

Obesiti dalam kalangan pelajar kini telah meningkat dengan mendadak di negara yang sedang membangun, termasuk Malaysia. Oleh itu, banyak strategi untuk membendung peningkatan obesiti dalam kalangan pelajar sekolah telah dilakukan. Namun, pengurusan masalah ini kompleks dan memerlukan pendekatan holistik untuk mengatasinya secara menyeluruh. Kajian ini bertujuan untuk mengenal pasti ciri-ciri intervensi obesiti yang dilakukan dalam kalangan murid sekolah di Malaysia bagi memperkukuhkan pelaksanaan intervensi obesiti yang akan datang. Kerangka kerja Arksey dan O'Malley digunakan bagi proses tinjauan ini. Artikel yang diterbitkan dari tahun 2007 hingga 2020 mengenai intervensi yang dilakukan terhadap pelajar sekolah di Malaysia telah diambil dari pangkalan data elektronik dan tempatan yang dipilih dengan menggunakan kata kunci. Perisian NVivo 12 Plus digunakan untuk mengkategorikan penemuan dalam bentuk matrik kerangka sistematik dan jadual bukti. Hasil akhir dilaporkan dalam jadual deskriptif. Hanya lapan belas kajian telah dikaji diantara 3417 artikel yang dipilih. Tiga belas aspek ciri intervensi telah dikenal pasti. Pengaruh persekitaran (keluarga dan komuniti sekolah) terhadap gaya hidup kanak-kanak telah dikenal pasti sebagai jurang penyelidikan. Justeru, gabungan faktor persekitaran dan panduan pendidikan dengan aplikasi teknologi diakui sebagai salah satu komponen yang berpotensi untuk meningkatkan keberkesanan reka bentuk intervensi obesiti dalam kalangan murid sekolah pada masa hadapan.

Kata kunci: ulasan penskopan; obesiti; ciri intervensi; berasaskan sekolah; berasaskan teknologi

INTRODUCTION

In the 21st century, childhood overweight and obesity have become arising public health issue that requires urgent attention from public healthcare to address this issue (Mohammad & Sazlina, 2019). The prevalence of childhood overweight and obesity in Malaysia has increased substantially from 5.6% in 2006 to 13.3 % in 2017 for children aged 10-17. Primary school children aged 10-12 found to have a higher prevalence of obesity at 17.7% compared to secondary school children aged 13-17 who were at 16.1% and latest findings reported that 29.8% of children, from 5 to 17 years of age were overweight (15.0%) and obese (14.8%) (National Health and Morbidity Survey Malaysia NHMS, 2006, 2017 & 2019).

The impact of being obese and overweight on health and psychological wellbeing has been significant and well-described. Previous studies concluded that lifestyle interventions improved healthy weight along with cardiometabolic outcome (Malakellis et al. 2017 & Park et al. 2012). However, the evidence limited to the long-term effectiveness and sustainability of the childhood obesity intervention. Therefore, interventions targeting school children need to be improved over time to bridge the gap and reduce the burden of health complications due to obesity (Langford et al. 2014).

School-based interventions offer great promise to curb the rising rate of childhood obesity. The finding from systematic review and meta-analysis conducted by Liu et al. (2019) figured that school-based interventions were generally effective in reducing excessive weight gain among obese children. However, intervention components varied between each intervention and the variability existed in terms of frequency, content or module used, outcome measured and duration (Bleich et al. 2018). Intervention focusing on strategies for improving either diet or physical activity levels, or both, for school children, help avoid them becoming overweight or obese and yet, it was effective in making modest reductions in BMI z-score (Brown et al. 2019). But, the topic of health and nutrition, as well as physical activities intervention, were varied. Some studies focused more on nutrition education with few physical activities and vice versa (Scherr et al. 2017).

Apart from the diet and physical activities components, parental involvement in school-based intervention for obese and overweight children recognized to be one of the practices for consideration (Hung et al. 2014). Parental involvement will affect children's behaviour towards diet and physical activities (Lloyd & Wyatt 2015; Meiklejohn et al. 2016). The school-based intervention on improving children's weight status, physical activity, and sedentary behaviour become better with direct parental involvement (Black et al. 2017; Sacha et al. 2018; Kolk et al. 2019). Parents play the primary role in improving a healthy home environment because their attitude influences kids' food selection, sedentary habits and eating habits. Some studies involving parents or community in school-based interventions still produced moderate effects on students' diet and physical activity (Wang et al. 2015).

World Health Organization (WHO) Health Promoting School (HPS) framework developed to prevent childhood obesity by a holistic approach focuses on three areas, namely integrated teaching on nutrition and health in the school, emphasis on promoting a healthy school environment, and link the activities with families and communities (Langford et al. 2011 & Cooper et al. 2017). HPS's implementation help to influence children to adopt and practice health-enhancing behaviours like a routine healthy eating lifestyle (Hung et al. 2014). Three focus areas under the HPS framework suggested for all stakeholders and implementers to obtain better efficiency. For example, school canteen operators encouraged to sell healthy food and drinks to create a healthy school canteen. Although the Healthy Nutrition guideline by the Ministry of Health Malaysia adopted in the school setting, the nutritionists and teacher's involvement will confirm meals provided to schoolchildren meet the guidelines (Teo et al. 2019).

Hence, intervention for obesity among school children needs comprehensive intervention components, interdisciplinary team approaches, and family involvement through the school setting or community setting (Mohammad & Sazlina 2019). For example, a systematic review conducted by Black et al. (2017) suggested that obesity intervention by educating school communities (such as parents, teachers and canteen operators) is needed to build a supportive environment and should be one of the approaches to support the healthy eating lifestyle among obese children. Providing simple nutrition education and convincing dietary advice to parents with regular follow up has been proven to reduce fat intake significantly among obese children.

The use of educational materials in the interventions like tablets, the internet, interactive applications, printed materials activities, follow up phone calls to targeted individuals may reduce the barrier and facilitate the intervention (Fernandez et al. 2019). Great efforts like adopting technology-based methods needed to provide nutrition guides for school communities towards making changes to the healthy environment at school and home.

This scoping review aims to describe obesity interventions for school children conducted in Malaysia from 2007 to 2020. The characteristics included in this study as listed: study setting (type of school), study location, study design, participants BMI criteria, intervention

component, intervention period, use of theory in intervention activities evaluation, delivery method for intervention group (IG), involvement of school communities in the intervention for school children, outcomes measure, evaluation design, involvement of process evaluation, and use of theory in module development. We also highlighted the outcome for each study that can consider improving element for school-based intervention studies.

This review expects to provide insight into the intervention strategies and characteristics of the intervention components to fulfil the gaps that need to be studied to improve the effectiveness and, most importantly, sustainability of the intervention management among school children. It was parallel to The National Research Priority Malaysia (NRPM) 2016 - 2025 by the Ministry of Health (2016) as the Technical Working Group on Nutrition Research (TWGNR) addressing three main scopes of overweight and obesity research priority focused on the epidemiology of obesity, the effectiveness of the intervention and developing new modalities. Numerous studies have been conducted in Malaysia to improve healthy eating among school children, including obesity intervention. Until to date, the exact number of obesity interventions carried out unreported in a systematic review. Therefore, more studies can propose to fill the gap in the intervention of obesity among school children in Malaysia.

MATERIALS AND METHODS

STUDY DESIGN

Scoping review was applied for this topic to map obesity intervention studies among school children conducted in Malaysia. It was a preliminary literature mapping that might lead to future research in childhood obesity. Scoping review also used for past research mapping without the analysis process (Arksey & O'Malley 2005). Researchers can also use scoping studies to clarify a complex concept and refine subsequent research inquiries (Davis et al. 2009). The six stages of scoping review framework proposed by Arksey and O'Malley (2005) applied in this review and listed below:

STAGE 1: IDENTIFYING THE RESEARCH QUESTION

The following research questions used to summarize the current scoping review:

1)What are the characteristics of obesity intervention studies among school children in Malaysia conducted from 2007 until 2020?

2) What are the fundamental elements needed to develop comprehensive strategies that affect intervention sustainability, specifically school-based intervention design?

STAGE 2: IDENTIFYING RELEVANT STUDIES

A comprehensive literature review conducted using the search engine from EBSCOHOST, Medline & Ovid, Web of Science, Cochrane Library and Google Scholar. The manual searches of local journals like Malaysian Journal of Nutrition and Malaysia Nutrition Research Bibliography (1985 - 2010 and 2011-2014) also conducted. The researchers also conducted additional manual searches in the reference list to supplement relevant articles. The following keywords used to find the relevant article: Obese OR Overweight schoolchildren AND Intervention OR Prevention OR Treatment OR Program AND Effectiveness OR Impact OR Outcome OR Evaluation AND Components OR Activities OR Module OR Element AND Technology-based OR Web-based OR Computer-based AND Malaysia.

STAGE 3: STUDY SELECTION

Published articles from January 2007 to Jun 2020 that related to the obesity intervention among school students selected. The inclusion and exclusion criteria for article selection as disclosed below:

INCLUSION CRITERIA OF THE STUDY

1. Primary and secondary school students involving 7-17 years old.

2. All intervention components considered (nutrition education, physical activities (PA), a combination of nutrition education and PA, direct or indirect involvement of parents, teachers, and other stakeholders).

3. All intervention study involving (experimental and non-experimental)

4. Involve school-based, web-based, clinic-based or community-based intervention.

5. Involve the use of printed materials and technology-based materials in implementing the intervention.

6. Malay and English publication

EXCLUSION CRITERIA OF THE STUDY

1. Intervention design for adults aged 18 years and above.

2. Intervention design for preschool (aged 3-6 years).

3. Cross-sectional design or prevalence study.

4. Unpublished data/journal

STAGE 4: DATA EXTRACTION INTO A CHART FORMAT

PRISMA statements used as a guide in the current data extraction for the review as suggested by Moher et al. (2015). Selected titles and abstracts were then screened and reviewed to see if the contents potentially answered the research questions. Irrelevant study abstracts excluded, and later the researchers retrieved the full article of the selected abstracts. However, the quality assessment of articles excluded, which incorporate with the scoping review guideline suggested by Levac et al. (2010). The full-text articles retrieved evaluated systematically according to the study objective of interventions, characteristics of the study (study design, participant, age, duration of the study), component of intervention module, intervention provider, outcome (primary or secondary) and silent findings. The flowchart for data extraction explained in the results section.

STAGE 5: COLLATING, SUMMARIZING, AND REPORTING THE RESULTS

The researchers developed standard charting categories to map the evidence to find the gap. Each reported study summarised based on determinant characteristics of the research questions and objectives of this study. The researchers used the NVivo 12 Plus software to sort the findings based on the charting categories. The preliminary results as (table 3 in supplementary file) were converted into framework matrices in excel worksheets and were summarized as evidence tables and reported in the descriptive table.

RESULTS

FLOWCHART OF THE DATA EXTRACTION USING PRISMA

Total of 3412 articles identified through database searching, whereas additional five articles found through other sources. Among the number of the articles, a total of 276 articles determined as duplicate and removed from the list. During the title and abstract screening, 2825 articles excluded and shrink the study list to 316. Among them, only 18 articles selected based on the inclusion and exclusion criteria and the overall data extraction flow

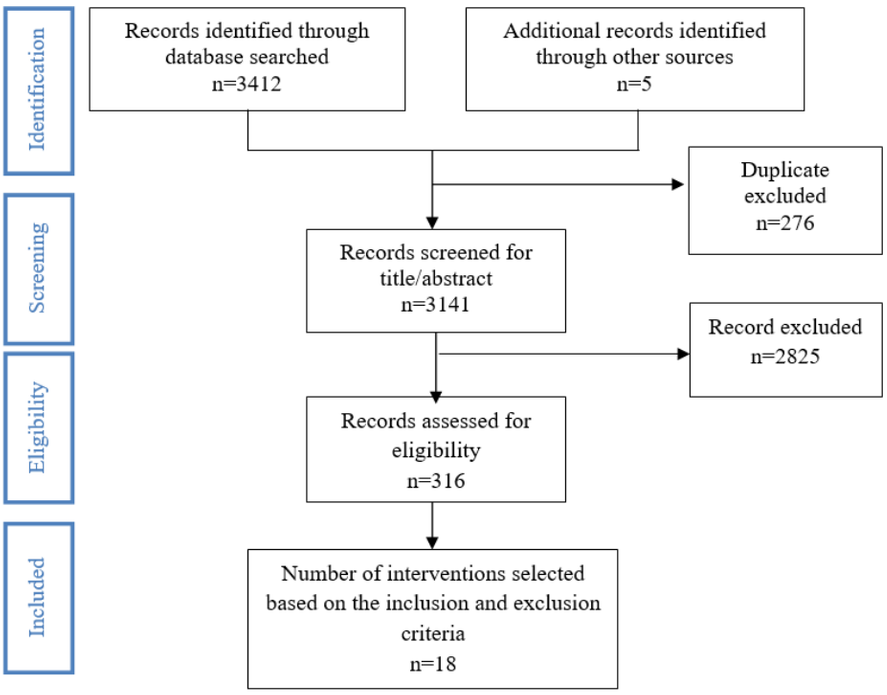

FIGURE 1. The method of data extraction (PRISMA 2009)

TABLE 1. The characteristics of the intervention study conducted in Malaysia from 2007 to 2020

Author's Name & publication year	Study characteristics	n (%)
	Setting	
Teo et al. (2019); Ruzita et al. (2007); Norkhalid et al. (2015); Zalilah et al (2008); Tee et al. (2017); Wan Putri et al. & Hafzan et al. (2017); Zahari et al (2017); Devanthini et al. (2018); Wilfred et al. (2018); Normah & Rasidah (2018); Normah et al. (2019); Koo et al. (2019)	a. School-based i. Primary School	15 (83.3)
Lau et al. (2019); Sharifah et al. (2016 & 2020); Azmawati & Farrah (2015)	ii. Secondary school	3 (16.7)
Azmawati & Farrah (2015); Norliza et al. (2018)	b. Web-based	2 (11.1)
Sharifah et al. (2011) & Nor Baizura et al. (2018)	c. Clinic-based	2 (11.1)
	Study location	
Teo et al. (2019); Ruzita et al. (2007); Zalilah et al. (2008); Sharifah et al. (2016 & 2020), Tee et al. (2017); Wan Putri et al. & Hafzan et al. (2017); Zahari et al. (2017); Devanthini et al. (2018); Wilfred et al. (2018); Normah & Rasidah (2018); Normah et al (2019); Lau et al. (2019); Koo et al. (2019); Azmawati & Farrah (2015); Norliza et al (2018); Nor Baizura et al. (2018); Sharifah et al. (2011)	a. Urban	17 (94.4)
Norkhalid et al. (2015)	b. Rural	1 (5.6)
	Study design	
Normah et al. (2019); Zalilah et al. (2008); Tee et al (2017)	a. Pilot study	3 (16.7)
Nor Baizura et al. (2018); Sharifah et al. (2011); Azmawati & Farrah (2015); Norliza et al. (2018); Wan Putri et al. (2017); Zahari et al. (2017)	b. Randomized Controlled Trial (RCT)c	6 (33.3)
Normah & Rasidah (2018); Ruzita et al. (2007)	c. Pre-experimental	2 (11.1)
Norkhalid et al. (2015); Sharifah et al. (2016 & 2020); Devanthini et al. (2018); Wilfred et al. (2018); Teo et al. (2019); Lau et al. (2019); Koo et al. (2019)	d. Quasi-experimental	7 (38.9)
	Participants BMI criteria	
Nor Baizura et al. (2018); Norkhalid et al. (2015)	a. Obese	2 (11.1)
Wan Putri et al. (2017); Devanthini et al. (2018); Wilfred et al. (2018); Normah et al. (2019); Lau et al. (2019); Koo et al. (2019); Azmawati & Farrah (2015); Norliza et al. (2018); Zahari et al. (2017); Normah & Rasidah (2018); Sharifah et al. (2011	b. Overweight & obese	11 (61.1)

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Ruzita et al. (2007); Zalilah et al. (2008); Tee et al. (2017); Sharifah (2016 & 2020); Teo et al. (2019)	c. Include all BMI categories	5 (27.8)
	Intervention component	
Ruzita et al. (2007); Zalilah et al. (2008); Normah & Rasidah (2018); Koo et al. (2019); Tee et al. (2017)	a. Nutrition education (NE)	5 (27.7)
Norkhalid et al. (2015)	b. Physical activity (PA)	1 (5.6)
Devanthini et al. (2018); Wilfred et al. (2018); Normah et al. (2019); Nor Baizura et al. (2018); Azmawati & Farrah (2015); Norliza et al. (2018); Lau et al. (2019); Wan Putri et al. (2017); Teo et al. (2019); Sharifah et al. (2011)	c. NE + PA	10 (55.6)
Zahari et al. (2017); Sharifah et al. (2016 & 2020)	d. NE + PA + Psychology	2 (11.1)
	Intervention period	
Ruzita et al. (2007); Zalilah et al. (2008); Norkhalid et al. (2015); Norliza et al. (2018)	a. < 3 months	4 (23.5)
Teo et al. (2019); Devanthini et al. (2018); Wilfred et al. (2018); Normah et al. (2019); Lau et al. (2019); Koo et al. (2019); Azmawati & Farrah (2015); Norliza et al. (2018)	b. 3 months	7 (41.2)
Nor Baizura et al. (2018); Sharifah et al. (2011); Sharifah et al. (2016 & 2020); Tee et al. (2017); Wan Putri et al. & Hafzan et al. (2017); Zahari et al. (2017)	c. > 3 months	6 (35.3)
Normah & Rasidah (2018)	d. Not mentioned	1 (5.6)
	Use of theory in intervention activities	
Sharifah et al. (2011); Nor Baizura et al. (2018); Lau et al. (2019); Sharifah et al. (2016 & 2020); Normah & Rasidah (2018); Normah et al. (2019)	a. Reported	6 (33.3)
Ruzita et al. (2007); Norliza et al. (2018); Koo et al. (2019); Zalilah et al. (2008); Norkhalid et al. (2015); Tee et al. (2017); Wan Putri et al. (2017); Zahari et al. (2017); Devanthini et al. (2018); Wilfred et al. (2018); Teo et al. (2019); Azmawati & Farrah (2015)	b. Not reported	12 (72.3)
	Delivery method for intervention group (IG)	
Azmawati & Farrah (2015); Norliza et al. (2018)	a. Web-based	2 (11.1)
Wan Putri et al. (2017); Teo et al. (2019)	b. Interactive multimedia-based	2 (11.1)
Sharifah et al. (2011); Nor Baizura et al. (2018); Norliza et al. (2018); Koo et al. (2019); Lau et al. (2019); Zalilah et al. (2008); Sharifah et al. (2016 & 2020); Zahari et al. (2017); Devanthini et al. (2018); Wilfred et al. (2018); Normah et al. (2019); Teo et al. (2019); Norkhalid et al. (2015); Normah & Rasidah (2018)	c. Classroom activities + printed material + hands on activities	14 (77.7)

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	Involvement of school communities in the intervention for school children	
Ruzita et al. (2007); Norkhalid et al. (2015); Normah & Rasidah (2018); Normah et al. (2019)	a. Student only	4 (22.2)
Sharifah et al. (2016 & 2020)	b. Student + peer	1 (5.6)
Zalilah et al. (2008); Tee et al. (2017); Zahari et al. (2019); Lau et al. (2019)	c. Student + teacher	4 (22.2)
Norliza et al. (2018); Azmawati & Farrah (2015); Nor Baizura et al. (2018); Sharifah et al. (2011)	d. Student + parent (Web-based & clinic-based)	4 (22.2)
Devanthini et al. (2018); Wilfred et al. (2018); Koo et al. (2019); Wan Putri et al. (2017)	e. Student + parent + teacher	4 (22.2)
Teo et al. (2019)	f. Student + parent + teacher + canteen	1 (5.6)
	Outcomes measure	
Tee et al. (2017); Ruzita et al. (2007); Norkhalid et al. (2015); Zahari et al. (2017); Normah & Rasidah (2018); Sharifah et al. (2011)	a. Not reported in response rate	6 (33.3)
Ruzita et al. (2007); Zalilah et al. (2008); Normah & Rasidah (2018)	b. Knowledge, attitude & practices (KAP)	3 (16.7)
Norkhalid et al. (2015)	c. Anthropometric measurement	1 (5.6)
Normah et al. (2019); Tee et al. (2017)	d. KAP + Anthropometric measurement	2 (11.1)
Devanthini et al. (2018); Wilfred et al. (2018); Nor Baizura et al. (2018); Norliza et al. (2018); Koo et al. (2019); Lau et al. (2019)	e. KAP + Anthropometric measurement + Percentage of fat + Dietary assessment + Physical activity assessment	6 (33.3)
Wan Putri et al. (2017); Zahari et al. (2017); Sharifah et al. (2011); Azmawati & Farrah (2015); Sharifah et al. (2016 & 2020)	f. KAP + Anthropometric measurement + Percentage of fat + Dietary assessment + Physical activity assessment + Health related quality of life assessment (HRQoL)	5 (27.8)
Teo et al. (2019)	g. KAP + Anthropometric measurement + Percentage of fat + Dietary assessment + Physical activity assessment + Health related quality of life assessment (HRQoL) + Cognitive performance	1 (5.6)
	Evaluation design	
Zalilah et al. (2008); Norkhalid et al. (2015); Tee et al. (2017); Wan Putri et al. & Hafzan et al. (2017); Normah et al. (2019); Normah & Rasidah (2018); Azmawati & Farrah (2015)	a. Pre & post-intervention	7 (38.9)
Wilfred et al. (2018); Devanthini et al. (2018); Koo et al. (2019); Nor Baizura et al. (2018)	b. Pre, intermediate & post-intervention + Follow up	5 (27.8)
Ruzita et al. (2007); Sharifah (2016 & 2020); Teo et al. (2019)	c. Pre, post & follow up	3 (16.7)

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Zahari et al. (2017); Norliza et al. (2018); Sharifah et al. (2011)	d. Pre, intermediate & post-intervention	3 (16.7)
	Involvement of process evaluation	
Tee et al. (2017); Wan Putri et al. (2017); Sharifah (2016 & 2020); Wilfred et al. (2018); Azmawati & Farrah (2015); Lau et al. (2019); Nor Baizura et al. (2018); Norliza et al. (2018); Teo et al. (2019)	a. Reported	9 (50.0)
Ruzita et al. (2007); Zalilah et al. (2008); Norkhalid et al. (2015); Zahari et al. (2017); Normah & Rasidah (2018); Normah et al. (2019); Sharifah et al. (2011); Koo et al. (2019)	b. Not reported	9 (50.0)
	Use of theory in module development	
Sharifah et al. (2011); Nor Baizura et al. (2018); Norliza et al. (2018); Koo et al. (2019); Lau et al. (2019); Zalilah et al. (2008); Sharifah et al. (2016 & 2020); Zahari et al. (2017); Devanthini et al. (2018); Wilfred et al. (2018); Normah et al. (2019); Teo et al. (2019)	a. Reported (*SCT, TTM, SEM,Kolb's Model in learning and teaching, BCT, IM Protocol, SDT)	12 (66.7)
Ruzita et al. (2007); Norkhalid et al. (2015); Tee et al. (2017); Wan Putri et al. (2017); Normah & Rasidah (2018); Azmawati & Farrah (2015)	b. Not reported	6 (33.3)

* SCT=Social cognitive theory, TTM= Transtheoretical model, SEM = Socio ecological model, BCT = Behavioural change theory, SDT = Self-determination theory

displayed in Figure 1.

The intervention characteristics of 18 studies summarized in Table 1. The attributes of the interventions divided into 13 aspects as followed: setting, study location, study design, participants BMI criteria, intervention component, intervention period, use of theory in intervention activities, the delivery method for the intervention group (IG), involvement of school communities in the intervention for school children, outcomes measure, evaluation design, involvement of process evaluation, and use of theory in module development.

The majority of obesity interventions among school children in Malaysia from 2007-2020 conducted in school-based 14 (77.7%), followed by web-based 2 (11.1%) and clinic-based 2 (11.1%), respectively. For the school-based setting, 7 out of 14 interventions conducted using quasi-experiments, followed by 2 randomized controlled trial (RCT) and five pre-experiments and pilot study. The quasi-experimental design was the preferred approach compared to RCT for school-based intervention as most schools allowed certain classes to include the intervention due to the limitation of the teaching schedule. For example, a study conducted by Teo et al. (2019) mentioned that children in standard six excluded from the study as upon request from school and the Ministry of Education (MOE) Malaysia, they would be attending the National Primary School Evaluation Test. The remaining four studies consisted of 2 web-based and two clinic-based studies using RCT. RCT was more suitable to conduct for the web- and clinic-based compared to school-based because students and parents were allowed to choose their session to attend the intervention session.

Fifteen obesity interventions performed in primary schools, and only three interventions conducted among secondary schools. It was in line with the higher prevalence of obesity among primary school children in Malaysia (Balkis et al. 2013). The participant selection criteria mainly on obese and overweight students with 72.2% and 27.8% involved in all BMI categories. Educating good healthy eating habits at an early age is the best start for all school children, regardless of BMI. Yet, targeting specifically obese and overweight students was the practical choice for obesity intervention.

Intervention studies performed at a minimum of 3 months of intervention period with 7 (41.2%) studies followed by a follow-up intervention from 3 months to above nine months, with 8 (41.2%) case studies to measure the significant effectiveness of sustainability. However, a substantial connection was found at post-intervention and insignificant at follow-up intervention. It might be that the nutrition behaviour was very complex, and it takes time to see the effectiveness of dietary habits changes. Thus, it may be likely that longer duration interventions will be more effective (Wang et al. 2015). However, this possible association between intervention duration and nutrition behaviour outcome has not explored, as the majority of the studies were relatively short term (one year or less) except for one study conducted by Wilfred et al. (2018). The sustained effects found in BMI z-score and physical activity (PA) level. However, the waist circumference (WC) and body fat percentage had increased over the same period.

Throughout the review, it found that process evaluation for each study was still lacking, and it may be implemented but not reported in detail. Process evaluation is one of the interesting components that need to explore like monitoring of participants' attendance, feedback and comments during the intervention to improve the effectiveness. It helps to understand the implementation of a trial and assure that the interventions detailed were delivered as designed, and it also helps to ensure that components were implemented successfully (Griffin et al. 2017). Half of the obesity intervention studies did report the process evaluation; however, details of the evaluation process not mentioned

Most of the components and activities in the obesity intervention design specifically targeted children. The nutrition and PA towards school communities (parents, teachers and school canteen operators) were still limited, as 1 out of 18 studies involved direct education on whole school communities to make healthy environmental changes (Teo et al. 2019). Whereas 4 out of 18 case studies involved parents and teachers to educate the children regarding healthy lifestyle changes (Devanthini et al. 2018; Wilfred et al. 2018; Koo et al. 2019; Wan Putri et al. 2017). The use of web and multimedia interactive on nutrition and PA interventions still lacking, as only 4 (22.2%) studies reported. Among that studies, only three were internet-based (Azmawati & Farrah, 2015; Tee et al. 2017; Norliza et al. 2018), and other involved technology without using the internet by Wan Putri et al. (2017). It was not surprising that the use of technology in obesity programmes was relatively new (Ajie & Chapman, 2014). The use of web-based intervention reported having a significant impact on BMI, WC, and percentage of body fat reduction among obese and overweight school children. The school-based intervention alone without supporting web- or technology-based found inconsistent between studies depending on the various components involved.

The knowledge, attitude, practices, anthropometric measurement, dietary assessment, and PA assessment combination generally used in each intervention study with 6 (33.3%) studies followed by health-related quality of life assessment among participants with 5 (27.8%) studies. One study (5.6%) reported having cognitive performance as an evaluation outcome (Teo et al. 2019). The exploration of cognitive performance on obesity intervention meaningful finding that can share among parents and schoolteachers.

TABLE 2. Result of the school environment mapping for obesity intervention of school-based setting

School-based setting for obesity intervention (n = 14)		
	Yes (%)	No (%)
Curriculum & education resources		
The nutrition education topic in intervention component involving food pyramid and food model	14 (100%)	0 (0.0%)
Education material provided to students	14 (100%)	0 (0.0%)
Education materials provided to school communities (parents, teachers, and canteens)	1 (7.1%)	13 (92.9%)
Education materials provided to teachers	3 (21.4%)	11 (78.6%)
Education materials provided to peers	1 (7.1%)	13 (92.9%)
Education materials provided to parents	4 (28.6%)	10 (71.4%)
Intervention activities involving public, family and community		
Students only	4 (28.6%)	10 (71.4%)
Student + peer	1 (7.1%)	13 (92.9%)
Student + teacher	3 (21.4%)	11 (78.6%)
Student + parent	2 (14.3%)	12(85.7%)
Student + parent + teacher	3 (21.4%)	11 (78.6%)
Student + parent + teacher + canteen	1 (7.1%)	13 (92.9%)
Criteria for political environment		
Deliver the nutrition guideline to school canteen handlers	1 (7.1%)	13 (92.9%)
Monitoring and training the school canteen towards adherence of the National Nutrition guidelines	1 (7.1%)	13 (92.9%)
Deliver the nutrition information on creating healthy school environment to schoolteachers	7 (50.0%)	7 (50.0%)
Rules and information to families to prepare healthy meals at home and for lunch box	1 (7.1%)	13 (92.9%)

The impact of conducting the intervention provides both health benefits and help to achieve success in life. A recent Cochrane systematic review found that multicomponent intervention in children with overweight or obese, compared to standard school routine, physical activity interventions can enhance cognitive process (Martin et al. 2018), and unachievable of the educational outcomes found to be associated with increased weight status in children (Carey et al. 2015). The details of the school-based intervention provided in Table 2.

THE SCHOOL ENVIRONMENT MAPPING FOR OBESITY INTERVENTION OF SCHOOL-BASED SETTING

Table 2 is the assessment of school environmental mapping by school-based setting in 14 studies. The school setting mapping criteria adapted using studies by Hayati Adilin et al. (2015) and Sharifah & Rasyidah (2020). Four (28.6%) studies targeted only students in the intervention activities (Ruzita et al. 2007; Norkhalid et al. 2015; Normah & Rasidah 2018; Normah et al. 2019); while remaining ten intervention studies combined involvement of education activities for children and school communities including teachers, parents, peers and canteen operators (Teo et al. 2019; Zalilah et al. 2008; Sharifah et al. 2020; Tee et al. 2017; Wan Putri et al. 2017; Zahari et al. 2019; Devanthini et al. 2018; Wilfred et al. 2018; Koo et al. 2019; Lau et al. 2019). The majority of intervention studies educated parents and teachers to guide students to change their lifestyle (Zalilah et al. 2008; Tee et al. 2017; Wan Putri et al. 2017; Devanthini et al. 2018; Wilfred et al. 2018; Koo et al. 2019; Lau et al. 2019). An intervention study conducted by Teo et al. (2019) targeted canteen operators as one of the school communities to promote healthy school environment, and 1 (7.1%) study by Sharifah et al. (2020) targeted peers as the school communities to educate school children towards healthy eating and lifestyle habits.

DISCUSSION

The results indicate that most intervention studies in Malaysia conducted in a school-based setting with

comparatively fewer interventions in web-based and clinic-based settings. Findings from a systematic review on global interventions to prevent childhood overweight and obesity conducted by Bleich et al. (2018) also found that most of the obesity intervention efforts concentrated in the school-based setting. The Ministry of Health Malaysia (MOH) also recognised the school as the most suggestive approach in promoting a healthy lifestyle and managing obesity among Malaysian school children (Sabramani et al. 2015). The school environment perceived as a factor that influences children's health-related behaviour, regarded as the optimum setting to establish healthy eating behaviours and lifestyle among children (Sharifah et al. 2020).

Most interventions of school-based involved multiple settings with the inclusion of parent's outreach and school communities (Sacha et al. 2018; Wang et al. 2015; Oosterhoff et al. 2016) and multicomponent intervention (e.g. combined diet and PA) that found to be most effective in past reviews (Meiklejohn et al. 2016; Wang et al. 2015; Brown et al. 2016). Thus, managing the obesity intervention among school children in Malaysia needs to co-joint by multiple settings (school communities' involvement) and needs to be multicomponent. It should consist of education modules for targeted children and comprehensive education modules for school communities to enhance the effectiveness of obesity intervention.

The education materials for children found to be effective as it showed to have a significant improvement in enhancing the knowledge for most school-based intervention studies (Ruzita et al. 2007; Zalilah et al. 2008; Sharifah et al. 2020; Tee et al. 2017; Wan Putri et al. 2017). While the involvement of school communities (parents, teachers, canteen operators) in school-based interventions activities found to have a significant impact on changes in BMI z-score and WC in children after the intervention (Devanthini et al. 2018; Wilfred et al. 2018; Koo et al. 2019; Lau et al. 2019).

Therefore, further studies required to identify the suitable combination of school communities and the education components in promoting healthy school environments. Future research should incorporate the school communities like parents, teachers and school canteen operators' involvement in activities with comprehensive education guides to improve healthy environmental changes to enhance the effectiveness and sustainability of obesity intervention.

Parental awareness of risk factors and health outcome of obesity is the main focus in obesity management among school children (Mawia et al. 2020). Parents need to know how to maintain healthy food, a healthy lifestyle and good eating habits for their children (Qasim et al. 2015). Parents have a significant role to play, and successful obesity intervention efforts are supposed to come directly from the parents. They are usually responsible for preparing and suggesting the proper food for the child to eat, introducing the physical activity and indirectly creating a social environment right on the child's needs that contribute to the healthy environment changes (Pamungkas et al. 2019). Thus, educational guides for parents on eating habits can enhance the children's development of lifelong habits that contribute to a healthy weight.

Exposing and training teachers on the nutrition programmes implementation in schools will be an essential component of creating awareness among school children to promote better weight status (Park et al. 2013). Findings of Hayati Adilin et al. (2015) mentioned that teachers faced obstacles in promoting healthy eating to children as they lacked ideas, skills, time and resources to plan suitable programs to promote a healthy environment at school. They also need more information or modules on healthy eating and PA to implement healthy educational activities in school

The guide on the Management of Healthy Nutrition Selling Guideline in school canteen implemented since 2012 in all primary and secondary schools in Malaysia. The MOH 2018 and MOE 2011 guidelines emphasize food types allowed to sell and prohibited food in school canteens. However, the guideline compliance has not been encouraging (Sharifah & Rasyidah 2020). In contrast, canteen operators found the guidelines handy in preparing healthy meals for the school children, but unfortunately, the food and beverage recommended in the guidelines were not being the preferred choices among school children, as this food and beverages tended to be lower in fat, sugar, and sodium (Chan et al. 2018). Therefore, canteen operators tend to sell food and beverages preferred by the school children, such as fast food (Ishak et al. 2013). Some of the school canteen operators also highlighted they had incompetent ideas to prepare the nutritious food sell at the school canteen (Hayati et al. 2015). The promotion of healthier school canteens needed to support the effectiveness and sustainability of the nutrition program for obese children. Research findings suggested that improved school food environments enable students to make healthier choices and lower their BMI (Suhaila et al. 2019).

Therefore, providing a comprehensive education guide to school communities (teachers, parents and school canteen operators) will be part of the component that may improve the ability to conduct obesity intervention to promote long term effectiveness. The lack of guidance on nutrition education places limits on the power of delivering information to the communities regarding obesity prevention. The advancement of technology can influence and improve educational information delivery through the interactive phase, which creates a high impact on health intervention implementation (Bandura, 2004; Fergi et al.

2016; Hsu et al. 2018).

Evidence showed that parents and teachers consider the use of technology as an instrument to practice healthy habits, as it promotes effective learning strategies to raise the awareness for healthy eating and contribute to enhancing self-esteem in school children (Whittemore et al. 2013; Carrion et al. 2016). The exploration towards technology in delivering an intervention will be one of the potential mediums as it has a good impact on commitment in changing lifestyle behaviour towards reducing weight compared to routine technique (printed/teaching in class), as well as significant in increasing PA level and reduction of body weight among school children (Antwi et al. 2013; Trost et al. 2014).

Following the technology trend, there are possibilities to explore the use of technology towards managing overweight and obesity among school children by designing an interactive and user-friendly application for school communities to improve the effectiveness of obesity intervention. The technology innovations and social environment interaction needed as these devices attract more attention by doubts clarification, desire to learn, and reflection about the subject (Smith et al. 2014). Thus, educational materials development for future obesity intervention programme in school communities should company with technology applications.

THE KEY RECOMMENDATION FOR OBESITY INTERVENTION AMONG SCHOOL CHILDREN

1.The sustainability of changes is difficult in any intervention studies. Thus, closer attention needed to assess the impact of the school environment changes on the target group.

2.Intervention setting and components alteration must carefully revise to investigate their contributions to sustaining the intervention effects.

3.The multicomponent involvement and holistic approach are needed to retain the interventions' impact in a school-based environment.

4.The possibilities of technology in managing overweight and obesity among school children need to explore to promote healthy changes at school and at home.

5.Guides or modules used in the intervention programme need to be more practical for both children and school communities.

6.Suggestion to have additional follow up sessions and activities with the school communities. It will produce fruitful outcome through reinforcement of intervention message over the long term in the school and home environment.

CONCLUSION

Combining environmental interventions with educational interventions for school communities becomes an additional potential component to improve school-based intervention targeting overweight and obese children. Furthermore, it may contribute towards achieving a healthy weight among obese children and sustain the effectiveness of obesity intervention. The evidence in Malaysia provided limited information on the influence of school environment factors on health-related behaviours and the emerging trend of childhood obesity. The description given on intervention studies conducted in Malaysia will provide some insight to researchers and policymakers in designing and implementing a comprehensive and structured intervention to tackle the increasing rate of obesity among school children. This finding will also help to strengthen the management guideline of obesity intervention in Malaysia. The main focus on monitoring, evaluation and development mechanism in each conducted intervention needed to be adopted and modified to be interactive, practical and comprehensive by exploring the use of technology in obesity intervention programmes to enhance the effectiveness and, most importantly, for long term impact.

CONFLICT OF INTEREST

None to declare.

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