THE EXTENT OF CHILDHOOD OBESITY AND THE SCOPE OF SCHOOL-BASED HEALTH PROMOTION INTERVENTIONS IN SAUDI ARABIA: A REVIEW OF LITERATURE

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Received: October 2023; Accepted: November 2023; Published: December 2023
Citation: Noura Khaled Nassar ALNassar. The Extent of Childhood Obesity and the Scope of School-Based Health Promotion Interventions in Saudi Arabia: A Review of Literature. Middle East Journal of Nursing 2023; 17(2): 3-13
DOI: 10.5742/MEJN2023.9378036

Abstract

Childhood obesity is a concerning trend and represents one of the most significant challenges to public health worldwide. Childhood obesity in Saudi Arabia has become a significant concern for scholars and healthcare professionals. An extensive amount of research has been conducted to identify the most effective interventions to prevent childhood obesity in light of its prevalence, health consequences, and associated costs. Studies indicate that identifying and addressing obesity-related behaviours can be valuable for developing and implementing effective interventions and prevention measures to mitigate childhood obesity in Saudi Arabia. It has been shown that obesity-related behaviours can be changed through school-based health promotion interventions. Therefore, the present review summarises the current evidence on childhood obesity, including its prevalence, health consequences, and obesity-related behaviours in children and adolescents in Saudi Arabia. In addition, it aimed to determine the scope of school-based health promotion efforts in Saudi schools to reduce childhood obesity.

Keywords: Childhood Obesity, Overweight, Children, Adolescence, Health Promotion, School, Saudi Arabia

Introduction

Childhood obesity is an emerging public health concern around the world. Over 340 million children and adolescents aged five to 19 were overweight or obese in 2016(؟1). Childhood obesity prevalence rates have climbed dramatically in developed and developing countries (؟2). In Saudi Arabia, childhood obesity has become a significant concern for scholars and healthcare professionals. According to WHO (؟3), the proportion of obese children between the ages of 5 and 18 has increased from 14.3% in 2010 to 17.4% in 2016. These percentages are particularly alarming, considering that children under 19 account for 30% to 35% of the Saudi Arabian population (؟4).

Several factors have contributed to the emergence of childhood obesity. The obesity epidemic has been attributed to urbanization and increased disposable income in both developed and developing countries (؟5). Saudi Arabia's economy has grown at one of the fastest rates (؟6). Saudi Arabia has also experienced rapid and massive urbanisation. According to the United Nations (؟7), urban residents in Saudi Arabia increased from approximately 20% in 1950 to about 80% in 2000 and are expected to reach about 90% by 2050. Consequently, family and individual lifestyles are changing rapidly in Saudi Arabia today, including physical activity behaviours, food preparation, marketing, and choices.

Significant attention has been paid to identifying the most effective interventions to prevent childhood obesity considering its prevalence, health consequences, and associated costs. Researchers claim that developing and implementing effective interventions and prevention measures to mitigate childhood obesity in Saudi Arabia can be achieved by identifying and addressing obesity-related behaviours (؟8,؟9). Additionally, school-based interventions were shown to change obesity-related behaviours (؟10); contributing to the reduction of childhood obesity. It has been found in a previous review that interventions and national programs are urgently needed in Saudi Arabia to combat the obesity epidemic plaguing the country, especially at the school level (؟11).

The present review summarises the current evidence on childhood obesity, including its prevalence, health consequences, and obesity-related behaviours among children and adolescents in Saudi Arabia. In addition, this literature review aimed to determine the scope of school-based health promotion efforts in Saudi Arabia to reduce childhood obesity.

Methodology

Six electronic databases - Medline (EBSCO host), PsycINFO (EBSCO host), SPORTDiscus (EBSCO host), Education Research Complete (EBSCO host), EMBASE, and Web of Science - were searched to identify relevant published literature based on the following keywords: child/childhood/children AND obesity/overweight AND school-based intervention AND Saudi Arabia. Additionally, the study utilised data from government and non-government sources such as WHO and the KSA Ministry of Health. The Critical Appraisal Skills Programme (CASP) tool was used to evaluate sources' credibility. The search results were combined into an Endnote library (bibliographic software).

Inclusion criteria included (a) peer-reviewed studies published in Arabic or English between October 1, 2000, and October 31, 2023; (b) studies that evaluated the prevalence, obesity-related behaviours, and/or impact of overweight and/or obesity in Saudi Arabian children (aged five to 19 years); and/or (c) School-based health promotion interventions aimed at preventing and managing overweight and/or obesity. Exclusion criteria included (a) Studies that targeted preschool children (younger than five years old), college or university students, and young adults (b) studies that examined specific diseases related to obesity, such as metabolic syndrome (c) non-empirical findings, such as letters, conference proceedings, commentaries, or case reviews; (d) studies with interventions outside the school (e.g., community settings, at home, hospitals, and camps) or in a clinical setting; (e) duplicated studies or, if the same data set was used in several studies, one study was selected; (f) non-Saudi Arabian studies.

Two stages were followed to identify papers for inclusion in this literature review. During stage one, the author screens and selects titles and abstracts based on inclusion and exclusion criteria. In stage two, the author screens and selects full-text articles. The author retained the search results and repeated the search a few days later, reflecting on any discrepancies and resolving them as necessary. A particular interest lies in articles that discuss the prevalence rates, obesity-related behaviours, and the impact of childhood obesity in Saudi Arabia. In addition, articles address school-based health promotion interventions for overweight and obesity.

The Literature Review

Definitions of Overweight and Obesity in Children

Several definitions of the terms overweight and obesity in children and adolescents have been developed by various organisations, including the WHO, the CDC, the IOTF, and the Saudi MoH. Table 2.1 illustrates the Definition of Overweight and Obesity in Children Based on BMI Depending on the age group. These criteria yield different estimates of overweight and obesity prevalence.

BMI's effectiveness and limitations have been extensively discussed. BMI is calculated using the total body weight of the individual without taking into account lean (muscle) and fat mass (12). Obesity is characterized by an increase in body fat mass that poses a health risk. The regional distribution of body fat is also essential when assessing obesity-associated health problems (12). It is possible to estimate body fat and body fat distribution using simple methods such as WC, skinfold thickness, and waist-to-hip circumference ratio. Despite this, BMI is commonly used as a measure of obesity in both population-based studies and clinical practice, especially among children and adolescents. The CDC (13) recommends BMI as a screening tool for weight-related and health-related problems in children and adolescents. The CDC (13) also recommends further assessments such as skinfold thickness measurements, family history, eating patterns, and PA evaluations for individuals with high BMIs. It has been found that BMI charts are useful for assessing children's efforts to lose weight and can provide a reasonably accurate assessment of the change in body fat over time (14). As a result, to capture the extent of childhood obesity and all efforts made to promote health in school programs, lifestyle outcomes and BMI/BMI-Z have been included in this literature review. BMI z score measures how many standard deviations a child or young person's BMI is above or below the average BMI for their age and gender. Instead of using BMI, BMI z scores provide a direct comparison of BMI (and any changes in BMI) across different ages and genders.

Epidemiological Features of Childhood Obesity in Saudi Arabia

In recent years, Saudi Arabia has experienced an alarming increase in obesity and overweight among children and adolescents, making it one of the Middle Eastern countries with the highest obesity rates (15). According to WHO's Global Health Observatory, in 2010, the prevalence of overweight and obesity among Saudi children (5-19 years old) was 31.6% and 14.3%, respectively (3). However, in 2016, the prevalence of overweight and obesity among Saudi children (5-19 years old) rose to 35.6% and 17.4%. Furthermore, based on national prevalence rates, El Mouzan et al. (16) estimated that 24% and 9% of Saudi children (5-18 years) were overweight and obese, respectively (WHO references). However, the rates were slightly lower when CDC references were applied. Furthermore, according to the same survey by El Mouzan (16), younger children (5-12 years old) had lower overweight and obesity rates than older children (13-18 years old), regardless of the references used for defining overweight and obesity.

Table 1. Definition of Overweight and Obesity in Children Based on BMI

	Age Group	Overweight	Obesity
WHO Growth Charts	<5 years	Weight-for-height greater than two standard deviations above the median of the WHO Child Growth Standards	Weight-for-height greater than three standard deviations above the median WHO Child Growth Standards
	5-19 years	BMI-for-age greater than one standard deviation above the median of the WHO Growth Reference.	Greater than two standard deviations above the median WHO Growth Reference
CDC Growth Charts	2–20 years	BMI-for-age = 85th ≤ 95th percentile	BMI-for-age ≥ 95th percentile, or BMI ≥ 30 kg/m2 whichever is smaller
Saudi Growth Charts	0–18 years	BMI-for-age percentile >85th ≤ 95th centile	BMI-for-age percentile >95th centile
IOTF	2–18 years	Age- and sex-specific BMI cut-off points* correspond to an adult BMI of 25 kg/m2	Age- and sex-specific BMI cut-off points* correspond to an adult BMI of 30 kg/m2

BMI= body mass index, WHO= World Health Organization, IOTF= International Obesity Task Force, CDC= US Centres for Disease Control, * For children younger than 2 years, the indicator is weight-for-length

Similarly, a survey of various regions that included young children found that 6% of children aged 2-6, 8% of children aged 6-13 and 11% of children aged 13-18 were obese (⁋17). The findings are consistent with other studies that report lower obesity rates among young children (⁋18,⁋19,⁋20,⁋21). However, the WHO data illustrate a different pattern, indicating that children 5–9 years of age have a higher prevalence of obesity than children 10–19 years of age (⁋3).

The prevalence of obesity among adolescents in Saudi Arabia was 6% based on CDC criteria and 9% based on WHO criteria based on a national survey published in 2010 (⁋16). In 2015, a national survey of 12,575 adolescents revealed that 16 % were obese and 14 % were overweight (⁋22), indicating that adolescents' obesity rate has increased (⁋16). However, another survey conducted in 2012 in seven regions of the country found that 11% of adolescents (13-18 years) were obese, compared with 25% who were overweight (⁋17). Nevertheless, this 2012 survey defined overweight as having a body mass index (BMI) of >85th centile without specifying how far overweight exceeds the 95th centile, indicating that 25% included both overweight and obesity (⁋17). Consequently, 14% of adolescents were overweight, excluding 11% who were obese, similar to the Al-Buhairan et al. study (⁋22). However, it should be noted that El Mouzan et al. (⁋17) conducted their study between 2004 and 2005 and did not include some of the more urbanised regions of Saudi Arabia, such as the western and eastern regions, where obesity and overweight rates are high. As an illustration, a study conducted in three major urbanised cities in Saudi Arabia (Riyadh, Jeddah, and Al Khobar) found a higher prevalence of obesity (19%) and overweight (20%) among adolescents (⁋23).

Overall, differences in the prevalence of overweight and obesity among Saudi children and adolescents may be partly explained by disparities in the definitions and regions from which the population was sampled. In turn, these differences have led to a high demand to unify the reference chart. This is to eliminate potential confusion in the definition of obesity and overweight in future studies.

Health Impacts of Childhood Obesity in Saudi Arabia

Overweight and obesity were estimated to cause 39% of deaths among adults (four million deaths) worldwide in 2015 (⁋24). The WHO (⁋25) notes that several adult diseases originate in childhood, so prevention and treatment strategies should address children and adults.

Numerous studies have examined cardiometabolic risk factors in Saudi children (⁋26,⁋27,⁋28,⁋29); however, very few have examined these factors concerning overweight and obesity. Cardiometabolic risk encompasses many factors associated with developing type II DM and CVD (⁋30). Abdominal obesity, smoking, insulin resistance, high BP, high LDL-C, low HDL-C, high TG, high fasting blood glucose, and a disturbing inflammatory profile are important factors associated with increased cardiometabolic risk. Prevention or reduction of these risk factors can reduce the burden of non-communicable diseases, such as cardiovascular disease and type 2 diabetes (⁋30).

Cardiometabolic risk factors

In a cross-sectional study of school children and adolescents from ten schools in Riyadh, the authors examined Saudi children's cardiometabolic risk and its relation to overweight, obesity, and lifestyle behaviours (⁋31). They reported that 51.5% of the children had elevated BP (>90th percentile), 13.6% had elevated TG >=1.1 mmol/L and 1% prevalence of elevated fasting blood glucose (>= 6.1 mmol/L). The study reported an association between high BP and BMI quartiles and WC. They found that WC (>75th percentile, using CDC reference data) predicted elevated TG >= 1.1 mmol/L in Saudi children after adjusting for age, gender, and activity level (⁋31). Nevertheless, the results of this study should be interpreted cautiously due to a lack of information regarding whether single or multiple BP measurements were performed, whether the children were given time to rest before BP measurements, whether the left arm or right arm was used for measurement, and how PA was determined. Furthermore, a review of three studies among Saudi schoolboys in Riyadh reached similar conclusions regarding BP and TG levels (⁋32). Al-Hazzaa et al. (⁋32) found boys with >=25% fat (based on skinfold thickness) had significantly higher mean systolic and diastolic BP and TG levels. In addition, mean HDL-C concentrations were lower in boys with fat levels >25%, while total cholesterol levels did not differ.

Furthermore, Al-Daghri et al. (⁋26) explored the relationship between adiposity indices (BMI and WC) and metabolic and hormonal markers in Saudi children from Riyadh. It was found that overweight, obese, and normal children had significant differences in insulin resistance as measured by HOMA-IR, LDL-C, HDL-C, TG, and systolic and diastolic BP (⁋26). The results of the study revealed that children with a higher BMI have a lower HOMA-IR, indicating greater insulin resistance (⁋26). Similarly, a study was conducted to examine Vitamin D Deficiency and Cardiometabolic Risks among Saudi adolescents in Riyadh (⁋33). Based on the findings of the study, approximately 20% of adolescents had elevated blood glucose concentrations (>=5.6 mmol/L), over 60% had low HDL-C concentrations (<1.03 mmol/L), and 15% had elevated TG concentrations >= 1.7 mmol/L (⁋33). Additionally, over 30% of these adolescents were overweight or obese, with 10% having abdominal obesity (>92 cm in boys and >86 cm in girls). Overweight and obesity were not examined in relation to cardiometabolic risk factors in this study,; however, higher BMI in males was associated with lower serum 25-hydroxyvitamin D levels, which is indicative of inadequate vitamin D levels (⁋33).

Thus, these studies suggest that obesity may contribute to adverse cardiometabolic health in Saudi children. However, there has been scant research conducted in other regions of Saudi Arabia besides Riyadh, so it is

difficult to draw conclusions about children in other areas. This necessitates conducting a national survey similar to that conducted by Al-Buhairan et al. (22) to determine the health consequences of childhood obesity in Saudi Arabia.

Sleep-disorders

Sleep-disordered breathing has also been linked to childhood obesity. It refers to sleep conditions in which the upper airway is blocked entirely or partially (34). Sleep-disordered breathing can affect a child's behavioural and emotional regulation, learning abilities, and alertness (35). In Saudi children, being overweight was positively associated with reported sleep disorders (36). Nevertheless, it is unclear how overweight status was measured or defined in this study, and the findings are based on parents' responses to a questionnaire determining sleep-disordered breathing. Therefore, objective methods of assessing sleep-disordered breathing, such as polysomnography, are required for Saudi children to provide more accurate results. Moreover, a cross-sectional study was conducted in three major Saudi Arabian cities (Al Khobar, Jeddah, and Riyadh) to determine the prevalence of short sleep duration and its association with obesity among adolescents between the ages of 15-19 years old (37). They reported that adolescents who were overweight or obese had a greater prevalence of short sleep duration than adolescents with a normal BMI, according to IOTF age- and sex-specific BMI cut-off reference standards. The same results were found in a study of young Saudi children (10-19 years of age) (38). In addition, more overweight and obese children reported intermittent rather than continuous sleep, suggesting lower sleep quality (38). Consequently, it can be concluded that short sleep duration and poor sleep quality have been implicated as risk factors and consequences of childhood obesity in Saudi Arabia.

Social and psychological consequences

Concerns have been raised regarding the social and psychological consequences of childhood obesity. Approximately 45% of Saudi adolescents responded that they needed to lose weight, indicating a negative body image (39). Compared to adolescents who reported feeling satisfied with their bodies, these adolescents were more likely to feel sad and hopeless. While there has been no study on bullying in Saudi Arabia regarding obesity or overweight, bullying rates in Saudi schools are high. A national survey of Saudi adolescents found that 27% of males and 23% of females had experienced bullying within the past 30 days before the survey was conducted (22). The result is higher than the 21% reported by US adolescents (40) and higher than the 19% reported by Australian children and adolescents (41). However, these differences in the prevalence of bullying in children may result from differences in the definition of bullying and the methods for measuring it. Despite the lack of studies assessing the relationship between bullying and overweight and obesity in Saudi Arabia, Ottova et al. (42) found that overweight children from ten European countries scored significantly lower on the social acceptance and bullying dimensions, suggesting that these dimensions of health-related quality of life are impaired in comparison with children and adolescents of normal weight. Furthermore, a meta-analysis of cross-sectional studies reported that bullying victimisation was associated with an increased likelihood of being overweight or obese (43). Nevertheless, most studies rely on cross-sectional designs, which makes it difficult to determine whether bullying is a cause or a consequence of obesity in children.

Obesity-Related Behaviour among Children and Adolescents in Saudi Arabia

Identifying risk factors is a crucial first step in reducing the burden of excessive body weight among vulnerable age groups in Saudi Arabia (8,9). Although genetic factors contribute to obesity, they are unlikely to explain the rapid increase in obesity rates in Saudi Arabia (28). Saudi Arabia has undergone numerous changes since the 1980s, including economic and social developments, such as the increasing number of women entering the workplace, which has improved the standard of living for the population. However, this positive lifestyle change has also been associated with increased physical inactivity and overweight/obesity rates (44). Given the complexity and multifaceted nature of obesity, properly identifying modifiable risk factors is crucial to combating obesity prevalence in Saudi Arabia. Several obesity-modifiable risk factors have been examined in Saudi Arabian studies, including PA, SB, and dietary habits.

Physical Activity

It is well-proven that regular PA benefits children and adolescents. It can improve cardio-respiratory fitness, weight control, self-esteem, and psychological well-being and reduce the risk of chronic diseases such as DM, stress, anxiety, and depression (45). In contrast, a lack of PA can lead to an energy imbalance (less energy expended than consumed through diet) and may increase the probability of becoming overweight or obese (46). This has also been observed in Saudi Arabia. For example, according to a study conducted in the Qassim region, children who engage in sports activities two hours a day are less likely to become overweight (20). Similarly, a study of students (15-19 years old) in the eastern region found a negative correlation between BMI and PA among males and a negative correlation between WC and reported PA among males and females (44). However, a study in Makkah that included girls only (8–11 years) found no significant relationship between the average number of daily steps (measured using an accelerometer) and BMI categories (47). Additionally, AL Kutbe et al. (47) reported that less than 10% of the participants achieved the recommended 10,000–12,000 steps daily. It has been suggested that living in the desert, where summers are extremely hot, and winters are very cold and windy, could contribute to reduced PA levels. In addition, a lack of facilities and equipment for exercise may also be a contributing factor. According to Mahfouz et al. (28), a lack of PA in class was also associated with an increased likelihood of obesity

among students. While several studies have examined PA as a risk factor for obesity among Saudi children, there is a lack of emphasis on the role of schools in providing PA.

Dietary Habits

Economic development has resulted in significant changes in food consumption patterns and eating habits in Saudi Arabia. Eating has evolved from a simple source of nourishment to a lifestyle marker and source of pleasure (48). In Saudi Arabia, several studies have examined diet as a risk factor for obesity. For instance, in a study conducted in Riyadh, 21% of adolescents did not consume fruits and vegetables daily, and 32% did not exercise on a regular basis (49). Despite this, there was no significant correlation between students' BMIs and their lifestyles or eating habits. In contrast, a study conducted on children in the Qassim region found that children who ate restaurant food twice a week were twice as likely to become overweight (20). Furthermore, it was found that children from Riyadh (12-16 years old) who consume sugary drinks have a higher BMI (50). These findings are similar to those of a study conducted in Makkah on girls between 8 and 11 (47). In addition, breakfast, fruit, and milk consumption by obese Saudi children was lower than that of non-obese Saudi children (51).

The consumption of unhealthy snacks and sugar-sweetened beverages is prevalent among adolescents and young adults in Saudi Arabia (52). However, a contradictory association was found between consuming sweets and sugar-sweetened beverages and childhood obesity in Saudi Arabia. Several epidemiological studies reported that sweets consumption was associated with weight loss in children (53,54), while a few studies reported that sweets consumption was associated with weight gain in children (55). The results of a systematic review examining several cohort studies and randomised controlled trials indicated that sugar-sweetened beverages might contribute to weight gain among children and adolescents (56). The contradictory results may be explained by the fact that sugar-sweetened drinks are commonly served alongside meals. Consequently, children consume more calories and are more likely to become overweight and obese. In contrast, sweets are usually consumed between meals. In turn, this may reduce children's appetites for lunch and dinner, reducing their calorie intake.

It has been demonstrated that eating a large breakfast can reduce obesity risk. An interventional study showed that people who consume a large breakfast are more likely to lose weight and reduce their WC than those who consume a large dinner (57), while skipping breakfast significantly impacts BMI and WC (58). However, the prevalence of skipping breakfast among children and adolescents in Saudi Arabia varies. This is because cultural norms may differ from region to region. In Abha, 72% of children between the ages of 8 and 18 consume breakfast frequently, while 28% do not (59). In contrast, a study in Jeddah found that more than half (54%) of the sample children did not consume breakfast (60). More urban areas were also associated with healthier dietary behaviours (61). In this regard, it is necessary to develop a program tailored to the needs of Saudi Arabia's different regions.

Sedentary Behaviours

Saudis' socioeconomic status has changed significantly since the oil discovery in Saudi Arabia (62). Although it has benefitted the region, people's lifestyles have become more sedentary. For instance, most Saudi children use cars for transportation to and from school, play video games, watch television for extended periods, and play less in open fields (63). Additionally, SB has been linked to childhood obesity in Saudi Arabia. It has been found that obese Saudi children are less active than their non-obese counterparts (51). Similar results have also been found in another region (64). Television viewing and the use of electronic devices are also associated with childhood obesity in Saudi Arabia. The results of a case-control study of children (9-14 years old) in Riyadh city indicate that watching television at the weekend is associated with a higher risk of obesity (65). Furthermore, the study found that children with obesity were more likely to watch television at night. In contrast, children whose mothers determined how much television they could watch were less likely to be obese (65). Furthermore, children (12-16 years of age) who reported watching television more than two hours a day had a higher BMI than those who reported watching television less than one hour a day (50). A similar study reported that children (2-18 years of age) who spent two hours daily on electronic devices had a higher BMI (66). The authors claimed that watching television can lead to obesity and overweight by reducing PA and increasing food intake (66).

Health Promotion to Combat Childhood Obesity in Saudi Arabia

General Health Promotion Approach

The Ottawa Charter defines health promotion as empowering individuals to have greater control over their health (67). Therefore, health promotion is considered an essential element of public health practice and can be applied anywhere in the world. Various strategies are used for planning, developing, implementing, and evaluating health promotion policies and interventions. These include health education, mass media, community development and community engagement processes, advocacy and lobbying strategies, social marketing, health policy, and structural and environmental strategies (68). However, the study asserts that it is vital to consider local settings and social and cultural factors to implement these principles effectively (68). Setting approaches have their roots in WHO's Health for All initiative and, more specifically, the Ottawa Charter for Health Promotion. The fundamental principles of Healthy Settings include community participation, partnership,

empowerment, and equity. There have been numerous ways in which Healthy Setting approaches have been implemented, including in health-promoting schools.

Health Promotion in the Saudi Context

Health promotion activities must be developed within Islamic rules to appeal to the Saudi population (69). It is, therefore, necessary to incorporate cultural and social norms when designing interventions for the Saudi community to avoid conflicts between health messages and sociocultural values. In the Saudi lifestyle, sociocultural values play an essential role, and excluding them may result in the ineffective implementation of any health promotion strategies (70). An example of this can be observed from a joint educational initiative operated between a British and a Saudi Arabian university, which indicated that religious beliefs have a positive influence on several aspects of women's health behaviours, including breastfeeding, birth spacing, eating habits, and condemning cigarettes and alcohol consumption (70), as these behaviours follow Islamic law. Furthermore, children's behaviour can also be changed by using culturally appropriate strategies, which have proven effective in other cultures. For example, Marlow et al. (71) stated that culturally relevant education led to an improvement in the eating habits and PA of adolescents on an Indian reservation in Nebraska, USA. Four children conducted a half-day workshop that encouraged behavioural adaptations by telling native American stories and engaging in activities (71). Thus, culturally appropriate strategies should be adopted to create positive behavioural changes in Saudi Arabia.

School Settings in Health Promotion

In the past three decades, several international initiatives have recognised and supported the role of schools in promoting and improving the population's health. For example, the WHO established a Global School Health Initiative in 1995, commonly known as 'Health Promoting Schools'. Children spend 40% of their waking hours at school, making it an appropriate place to implement obesity prevention interventions (72,73). In addition, the significant amount of time spent in schools can contribute to adopting a healthy lifestyle in the young population. This is because schools can provide children with the knowledge, attitudes, and skills needed to learn healthy behaviours through school health programs (74). In addition to improving academic performance, schools significantly impact students' health and social outcomes (75). Schools provide full contact, teach health education, provide meals, and model health-promoting settings that can assist in reducing obesity-related behaviours (76). Additionally, school-based interventions can benefit all students, regardless of their socioeconomic status (77), thus overcoming potential health inequalities (78).

In Saudi Arabia, schools and educational institutions play a significant role in improving the health status of the community (23). According to Al-Shehri et al. (79), approximately seven million students are enrolled in schools and colleges in Saudi Arabia. In recognition of schools' crucial role in promoting and improving population health, particularly in combating childhood obesity, the Saudi MoH has launched several initiatives. For example, in 2017, the MoH and the MoE launched a joint initiative named Rashaka (an Arabic word for fitness) to combat obesity among school children in Saudi Arabia (80). This initiative aims to promote a healthy lifestyle by improving dietary behaviour and increasing PA. The initiative was intended to run in four phases, and the fourth phase was scheduled to begin in 2020. Nevertheless, the pandemic and school closure hampered the initiative's prospects. This initiative screened 4,000 schools in 20 regions throughout Saudi Arabia (80). However, to our knowledge, no study has been conducted to determine the effectiveness of the (Rashaka) initiative in reducing obesity and overweight prevalence or whether obesity-related behaviours have changed among school children.

Research on school-based health promotion interventions targeting childhood obesity is lacking in Saudi Arabia (81,82,83). However, these studies have yielded mixed results regarding the effectiveness of school-based interventions. Notably, each of these studies employed a different method. This suggests that further research is needed to identify the most effective school-based interventions for reducing childhood obesity.

Nevertheless, several systematic reviews and meta-analyses have shown that school-based interventions positively influence children's obesity-related behaviour and/or BMI, including those conducted by (84,85,86,87). It is noteworthy that none of the reviews addressed Saudi Arabia. Since interventions must be aligned with the country's Islamic framework and sociocultural values, which set it apart from other countries, it is essential to evaluate the effectiveness of school-based interventions for obesity prevention and management in Saudi Arabia and to define the characteristics of the most effective intervention in reducing childhood obesity. This will enable policy makers to make use of theses interventions at the national level in order to mitigate childhood obesity.

Conclusion and Recommendations

This literature review attempts to interpret and synthesise data to comprehend the extent, nature, and effects of childhood obesity, and the implementation of school-based health promotion programs in Saudi Arabia to mitigate the problem. The review focuses on quantitative and qualitative studies and includes data gathered from international organisations. According to the findings, childhood obesity has been a subject of considerable scholarly interest in Saudi Arabia. Most studies in this area are conducted using a cross-sectional survey. These studies have revealed the severity of the obesity problem, which has prompted action from healthcare agencies and public institutions. School-based health promotion programs could significantly contribute to the reduction of obesity. Further studies on school-based

health promotion programs to prevent obesity in Saudi children and adolescents are needed. Such studies should incorporate improved methodologies and consider prior experience when developing evidence-based interventions. Randomized controlled trials are necessary to determine the effectiveness of such interventions, as they provide the most reliable data. Furthermore, studies should include long-term follow-up to evaluate the long-term effects of school-based interventions. Ultimately, this could lead to better interventions that effectively combat childhood obesity in Saudi children and adolescents.

Acknowledgement

I am deeply indebted to my sponsor (The Imam Abdulrahman bin Faisal University (Nursing College)) for their generous support, which enabled me to complete this literature review for my master's thesis at Swansea University.

Conflict of Interests

The author declares that there is no conflict of interest.

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