

*Review Article*

## The gaps and opportunities in primary care programs to address childhood obesity in Saudi Arabia: A comprehensive review

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### ARTICLE

### ABSTRACT

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Childhood obesity is a significant health concern globally, and it is associated with lethal disorders such as diabetes, hypertension, cardiovascular and cancers in later years of life. We review the numerous aspects of childhood obesity to identify the gaps and opportunity to combat the increasing prevalence and translation of current knowledge into nutritional practice, doable recommendations, and strategic actions at primary health care settings, particularly in Saudi Arabia. Based upon methodology meetings, knowledge-to-action (KTA) framework, population/ patient problem, intervention, comparison and outcome, formulated research questions, and reporting guidelines of preferred reporting items for systematic reviews and meta-analysis (PRISMA), the gaps and opportunities are identified in this systematic review. The key findings revealed that the main determinants of childhood obesity are lack of adequate knowledge, nutritional facilities, unhealthy dietary practices or behavioral factors, and rapid urbanization. At present, most countries, including Saudi Arabia, have not implemented childhood obesity prevention and control interventions. Based on the evidence gathered by the practical application of the knowledge translation approach, the community-based multi-sectoral and multicomponent approaches at schools and primary healthcare settings are certainly substantial to confront the increasing burden of childhood obesity.

## 1. BACKGROUND

Childhood obesity and its associated maladies, mainly in adulthood, have become a significant public health concern in Saudi Arabia (El Mouzan et al., 2010). This condition may instigate numerous acute disorders such as psychological dysfunction, social isolation, bulimia, asthma, orthopedic issues, and sleep apnea. It may also cause long-term lethal complications such as hypercholesterolemia, hypertension, stroke, diabetes (hyperglycemia/hyperinsulinemia), various forms of cancer, gastrointestinal, cardiovascular disorders, endocrine problems, and anomalies of the reproductive system (Freedman et al. 2007; Li et al. 2009). The prevalence of childhood obesity increases within the Arabian Gulf region because of rapid urbanization or adaptation to modern lifestyle, absence of physical activity, watching TV or playing video games, and intake of an imbalanced diet. Several studies conducted on children aged 7-15 years indicated that several underlying factors are prevalent in early childhood years that serve as determinants of the incidence of obesity during adulthood. These underlying factors are inadequate intrauterine nutrition,

less than average birth weight, insufficient levels of breastfeeding, the period of adiposity rebound from 5 to 7 years of age, age at which maturity takes place, levels of recommended physical activity, and the quality of diet in childhood or adolescent years (Al Shehri et al., 2013; Han et al., 2010; Lobstein, Baur, Uauy, & IASO International Obesity TaskForce, 2004). Several studies on childhood obesity have highlighted the association between obesity and disease in early life (Booth, Dobbins, Okely, Denney-Wilson, & Hardy, 2007). Childhood obesity mainly results from imbalances in the number of calories taken in and the corresponding number utilized by the child in growth processes, developmental activities, and metabolic and physical tasks. The excess calories in food items or drinks are not utilized in energy-expending activities. They are stored in the form of body fatty tissue and cause future obesity. A recently carried out evidence-based systematic review has identified the main determinants of childhood obesity as genetic, behavioral, and environmental factors that impact the child (Karnik & Kanekar, 2012). The capacity for inheriting obesity from parents is a significant genetic determinant of the incidence of

obesity in children. Many behavioral and environmental factors are also responsible for obesity (Al-Hazzaa et al., 2012; Al-Qahtani et al., 2013; Al Shehri et al., 2013). Childhood obesity is also used as a screening tools for identifying multiple risk factors like hyperlipidaemia, insulin resistance, and health issues related to the development of high blood pressure in children (Mirmiran, Sherafat-Kazemzadeh, Jalali-Farahani, & Azizi, 2010).

### 1.1. The issues associated with childhood obesity in Saudi Arabia

At present, the population of Saudi Arabia and Middle East countries is facing the major health issue known as childhood obesity. Such health issues in adolescents now also include the prevalence of type 2 diabetes, which was prevalent only in middle-aged or older adults in the past (Mirmiran et al., 2010). The impact of genetic, environmental, and behavioral determinates on the health of children suffering from obesity is a significant public health problem that needs immediate action at the national (Saudi Arabia) and international levels (Al-Hazzaa et al., 2012). To reduce and possibly mitigate the issues of overweight and obesity amongst Saudi children, there is an urgent need for the implementation of interventions that show efficiency when executed. This is only possible when the gaps and opportunities present in the healthcare system designed to address childhood obesity in Saudi Arabia can be examined (Al-Hazzaa et al., 2012; Al-Qahtani et al., 2013; Al Shehri et al., 2013). Therefore, the present study is designed to review available literature and possibly identify the gaps and opportunities present in the healthcare system designed to address childhood obesity in Saudi Arabia.

## 2. METHODOLOGY

### 2.1 Research design and formulation of the research questions

The present study is designed to conduct translational research using a mixed methodology. Four separate systematic literature reviews were reviewed to answer the current study research questions. The PICO methodology was used to formulate and develop the main research question for this study. The PICO methodology formulated four research questions that served as the breakdown of the leading research aims and questions. This PICO methodology helps determine the gaps in knowledge and opportunities in primary care programs to address childhood obesity in Saudi Arabia. The use of the PICO format for the breakdown and formulation of answerable research questions is shown In Table 1. This methodology was chosen because epidemiological appraisal tools validate it like Health Evidence™ (Health Evidence, 2013). The five formulated and answerable research questions and their purpose in helping to synthesize knowledge for answering the main research question (question 5) are given in the next section.

### 2.2 Formulated research questions and their purpose

The population of interest is children and the issue being studied is childhood obesity in Saudi Arabia.

### Research Question-1: “What do we know about the global child obesity factors contributing to obesity?”

This research question was basically designed to review previous studies and determine the background of childhood obesity and the different factors that contribute to it.

### Research Question-2: “What is the prevalence and incidence of childhood obesity in Saudi Arabia?”

The second research question was designed to collect data and knowledge on the level of prevalence and the incidence of childhood obesity in Saudi Arabia.

### Research Question-3: “What interventions have been implemented successfully in primary care settings?”

This research question was designed to collect knowledge and data on which interventions have been implemented regarding childhood obesity in other countries through evidence-based determination from literature review and synthesis of data.

### Research Question-4: “What is currently being done in primary care obesity interventions for children in Saudi Arabia?”

This research question was designed to gather knowledge on presently utilized interventions for childhood obesity in Saudi Arabia.

### Research Question-5: “What are the gaps or opportunities for evidence-informed obesity in Saudi Arabia?”

This is the main research question. The comparison of data collected from Research Question-4 and 5 will be used to find possible answers.

## 2.3 Search Strategies and Literature Review for Research Questions Raised

### 2.3.1 Search Strategy

The entire research project used the methodology of carrying out four different short literature reviews for answering research questions 1, 2, 3, and 4, respectively, as shown in Figure 1.

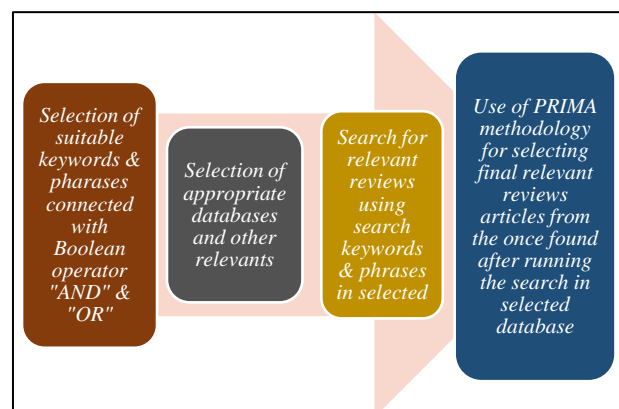


Figure 1 Search strategy for the selection of relevant review articles for each Research Question

The PRISMA guidelines were utilized as a validated methodology in selecting the relevant reviews from identified published literature for research questions 1, 2, 3, and 4 current. The reason for choosing PRISMA guidelines is that this study's general concepts, aims, and answerable research questions are included in the

PRISMA. In addition, a summary of different aspects of any particular health care policy relevant to previously formulated PICO-based research questions and the PRISMA guideline was also studied (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009).

### **2.3.2 Selection of keywords, search phrases, and relevant databases**

Following the four research questions, the keywords and phrases were created for use in search of selected databases (during each of the four short literature reviews) for identifying relevant systematic reviews. The primary and secondary concepts of each research question were identified. The possible relationship between these two concepts was identified, and additional synonyms of the keywords and relevant phrases were also considered before selecting the most relevant search keywords. It has already been documented that when the correct keywords aren't utilized in a search strategy, there is a very high possibility that the identified literature may not be relevant, and this, in turn, could cause errors that create an overall systemic review of relatively poor quality (Beller et al., 2013). All strategies for the the four research questions were carried out on the basis of the selected keywords, phrases, and Boolean operators to enhance the search results. The databases selected include the following:

- Public/Publisher Medline (PubMed).
- The Cochrane Collaboration.
- The World Health Organization (WHO) website.
- The website, <http://www.healthevidence.org>
- Scopus.

The keywords and phrases used for the search for each research question are shown in Table 2. The databases and the other sources for grey literature and government reports were selected on the basis of the following criteria:

Only scientific databases that are published in journal articles from the fields of public and environmental health, medicine, epidemiology, or reviews were selected.

### **2.3.3 Methodology to Explore Research Question-1: Childhood Obesity contributing factors**

For Research Question-1, the literature review of selected systemic review studies was performed using simple keywords and phrases like “reviews on factors contributing to childhood obesity” from previously selected databases (Table 2).

The short literature review was designed to examine previous systematic reviews and determine the background of childhood obesity and what factors serve as determinants to contribute to it. In addition, the short reviews relating to the current study aim also reviewed to determine if any factors in particular affect childhood obesity in Saudi Arabia. The search selection criteria for

including reviews in this literature review were strictly evidence-based systematic reviews from 2004 to the present day from the WHO website, PubMed, and the Cochrane collaboration.

### **2.3.4 Methodology to Explore Research Question-2: Prevalence of Childhood Obesity**

For Research Question-2, a second literature review was done using previously formulated keywords and phrases to search PubMed, the Cochrane Collaboration, the WHO website, and the Scopus database. Simple keywords and phrases such as “reviews of the prevalence & incidence of childhood obesity in Saudi Arabia” were used (Table 2). The search selection criterion for including reviews in this literature review was the selection of only those reviews dated from 2004 to the present day. This second short literature review was designed to gather knowledge or data on the level of prevalence and incidence of childhood obesity in Saudi Arabia.

### **2.3.5 Methodology to Explore Research Question-3: Interventions in the primary care setting**

For Research Question-3, a third literature review was carried out with the utilization of previously created keywords and phrases to search the site HealthEvidence.org, The Cochrane Collaboration, and the WHO website. The keywords and phrases selected for the search were “systematic reviews on childhood obesity interventions” and “review articles on childhood obesity interventions” (see details of the search strategy and use in Table 2 above). The reviews rated “high score” on Evidence.org along with relevance to the research question were selected. The selected reviews were further assessed for quality through the HealthEvidence.org quality assessment tool, as shown in Table 4. This third short literature review was designed to collect knowledge and data on the most successful childhood obesity prevention and mitigation interventions previously implemented, evaluated, and gave significant success in other countries.

### **2.3.6 Methodology to Explore Research Question-4: Childhood obesity interventions in Saudi Arabia**

For Research Question-4, the literature was reviewed using previously formulated keywords and phrases to search PubMed, The Cochrane Collaboration, the WHO website, and the Scopus database. The keywords and phrases selected for the search were the same as research question 3 (Table 2). This last short literature review was designed to gather knowledge or data on existing childhood obesity interventions in Saudi Arabia to compare with best-practice interventions identified in research question three. This comparison formed the basis of the determination of answers for the main research question, which is question 5 what are the gaps or opportunities for evidence-informed obesity in Saudi Arabia? Additionally, an attempt was made to collect information or data through personal communication with health care experts in the child health department of the Saudi Arabia Ministry of Health.

**Table 1: PICO components for the formulated Research Question**

PICO Component	Research Question-1	Research Question-2	Research Question-3	Research Question-4	Research Question-5
Population (P)	Children suffering from overweight or obesity in Saudi Arabia				
Issue (I)	Determination of the background of childhood obesity and what factors or determinants contribute to it.	What is the level of prevalence and incidence of childhood obesity in Saudi Arabia?	Which childhood obesity interventions have been implemented with the best results regarding childhood obesity everywhere in other countries?	Knowledge on presently utilized interventions for childhood obesity in Saudi Arabia.	Find the gaps or opportunities for evidence-informed obesity intervention that can be used in Saudi Arabia.
Outcome (O)	Determinants of childhood obesity	Prevalence of childhood obesity in Saudi Arabia	Determinations of what components make an intervention successful	Comparison with interventions in other countries.	Determination of suitable targets for successful future interventions.
Study kind	Synthesis of data collected from the reviews selected				

**Table 2: Search terms and/or phrases used in the search for relevant reviews and sources searched**

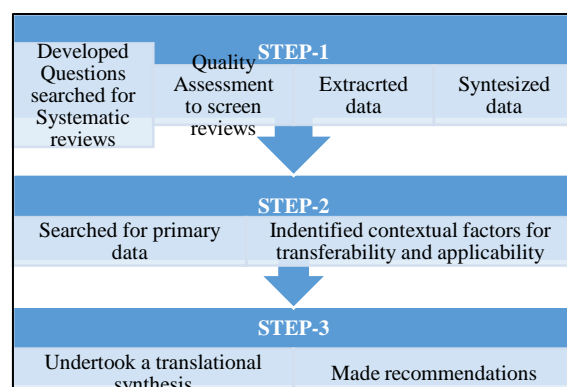
Research Questions	Dates searched	Keywords & Search Phrases Used	Databases and other sources used for the search and collection of data
<b>Research Question-1:</b> “What do we know about the global child obesity factors contributing to obesity?”	Studies that were published before 2004 were excluded	“Reviews on factors contributing to childhood obesity.”	a) The Cochrane collaboration. b) PubMed. c) The WHO website <a href="http://www.who.int/dietphysicalactivity/childhood/en/#content">http://www.who.int/dietphysicalactivity/childhood/en/#content</a>
<b>Research Question-2:</b> “What is the prevalence and incidence of childhood obesity in Saudi Arabia?”	Studies that were published before 2004 were excluded	“Reviews of the prevalence and incidence of childhood obesity in Saudi Arabia.”	a) PubMed. b) The Cochrane Collaboration. c) The WHO website <a href="http://www.who.int/dietphysicalactivity/childhood/en/#content">http://www.who.int/dietphysicalactivity/childhood/en/#content</a> d) Scopus
<b>Research Question-3:</b> “What interventions have been implemented successfully in primary care settings?”	Studies that were published before 2004 were excluded	“Systematic reviews on childhood obesity interventions” and “review articles on childhood obesity interventions.”	a) The Cochrane Collaboration. b) The WHO website <a href="http://www.who.int/dietphysicalactivity/childhood/en/#content">http://www.who.int/dietphysicalactivity/childhood/en/#content</a> c) The website, <a href="http://www.healthevidence.org">http://www.healthevidence.org</a>
<b>Research Question-4:</b> “What is currently being done in primary care obesity interventions for children in Saudi Arabia?”	Studies that were published before 2004 were excluded	Two simple search terms: “childhood obesity interventions implemented/used in Saudi Arabia and “childhood obesity prevention in Saudi Arabia.”	a) From experts in the child health department in Saudi Arabia (personal communication). b) From government websites, including The Saudi Arabia Ministry of Health website <a href="http://www.moh.gov.sa/en/Pages/Default.aspx">http://www.moh.gov.sa/en/Pages/Default.aspx</a> c) The Cochrane collaboration. d) PubMed. e) The WHO website <a href="http://www.who.int/dietphysicalactivity/childhood/en/#content">http://www.who.int/dietphysicalactivity/childhood/en/#content</a> f) The website <a href="http://www.healthevidence.org">http://www.healthevidence.org</a>

**2.3.7 Methodology to Explore Research Question-5: Gaps & opportunity to combat obesity in Saudi Arabia**

The knowledge synthesis of knowledge and data collected from Research Question-3 and 4 were used to compare the aspect of the PICO format. The synthesis of knowledge for answering this study's main research question was done using the three-step methodology outlined in the previous survey (Ntshekisang, 2013), as shown in Figure 2.

**2.4 Aims and main research question**

In this research project, the main research question was: What are the gaps or opportunities in primary care programs to address childhood obesity in Saudi Arabia?



**Figure 2: Knowledge synthesis methodology for the main research question (Question 5) [Source: Ntshekisang 2013]**

**2.5 Knowledge-to-Action (KTA) Framework**

**2.5.1 Importance of the Knowledge-to-Action Framework**

If a piece of research results in theoretical knowledge that fails to show the capacity to be applied to practice, it is not useful. Failure to translate knowledge (acquired during research) into practical action in health care is a significant contributor to health inequities. Furthermore, it results in the wastage of expensive and time-consuming research (Graham et al., 2006; WHO, 2004). The knowledge gap between what is identified and what is translated into action results in both the under-use of efficient interventions or treatments and their inappropriate utilization while over-using unsuitable, non-validated interventions. This continues to result in undesirable outcomes for the target population. The identification that failure to utilize research findings in practical health care has a negative effect on primary care or patient care has resulted in a heightened focus on the transfer of attained knowledge into action during health care practice. The process that takes place is known as “knowledge transfer” or “knowledge translation.” Thus, it can be said that, in a broad sense, knowledge translation can include all exchange, synthesis, and application of research results as well as other evidence between academic and practice settings (Graham et al., 2006; Greig, Entwistle, & Beech, 2012). Identifying issues and their formulation into answerable research questions that can be answered using proven scientific methodology forms the foundation of problem-solving in health care. The solutions may be readily found in present knowledge sources such as previously published research, grey literature, and government-published guidelines for specific problems. In this study, new options for solving the issues relating to childhood obesity were found using proper research.

In health care interventions and policies, experience has often indicated that implementing research-based knowledge in actual medical practice is complicated and fraught with obstacles. Thus, the existing research data must be synthesized and the resultant knowledge contextualized before implementation in any public health issue setting. Also, interventions designed to introduce evidence-based knowledge in health care practice have requirements of adaptation to tackle unique local barriers. The creation and implementation of knowledge from existing solutions or the design of new ones is an inter-connected cyclical process summarized in Figure 3.

**2.5.2 The Knowledge-to-Action Framework used in this project**

For any process like a health care intervention to function efficiently, it is essential to be aware of any problems that may occur at every stage during knowledge generation, synthesis, and translation. There is a need to document issues encountered in reports, discussion forums, or research so that such problems can be recognized by other researchers and appropriate solutions developed accordingly. For example, it is

possible to identify the gaps in knowledge during the research stage itself by the researcher (as seen in this project). These gaps may also be found in the process of knowledge creation or synthesis and guideline development, wherein the strength of the reviewed knowledge can be analyzed through the use of evidence-grading systems. The practical and constant integration of these steps in the field of health care interventions is essential and a part of the research process now (WHO, 2004).

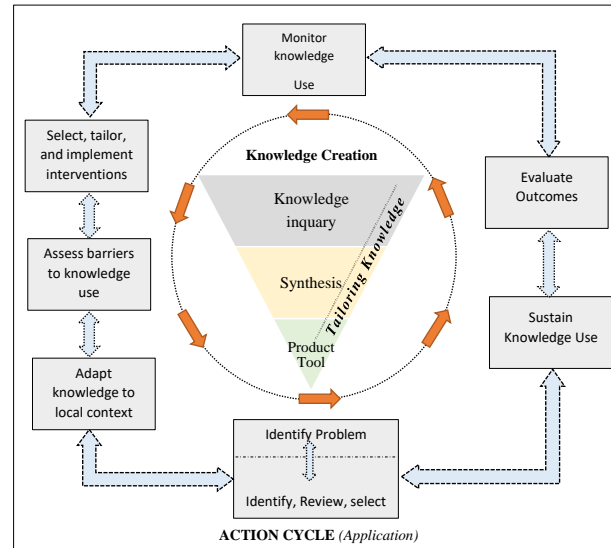


Figure 3: Steps involved in the Knowledge to Action Framework [Source: Graham et al., 2006]

In this project, the five-step framework designed by Ward et al. (2009) has been used for knowledge creation and transfer or translation to the Saudi Arabian context. Ward et al. (2009) reviewed 28 different models or frameworks that, in full or part, attempted to explain the knowledge transfer process. They identified five components of this knowledge transfer process as common to all the reviewed models.

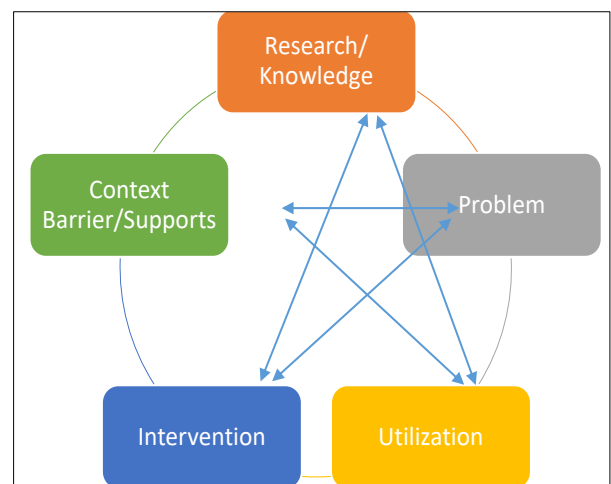


Figure 4: The conceptual framework of knowledge transfer & translation [Source: Ward et al., 2009].

These are issue identification and communication; knowledge or research development and selection; analysis of context; knowledge transfer actions or interventions; and knowledge or research use (Ward et al., 2009). We also identified three kinds of knowledge

transfer processes: linear, cyclical, and dynamic, multidirectional. Based on these, a conceptual framework of knowledge transfer and translation was designed and used in this study, as shown in Figure 4.

### 3. RESULTS

#### 3.1 Results for Research Question-1 (Childhood Obesity contributing factors)

“What do we know about the child obesity factors contributing to obesity globally?”

A total of 15 reviews were identified from the databases, and after the elimination of duplicates, 12 reviews were left. Using the selection criteria, studies that were published before 2004 were excluded resulting in a remainder of 4 reviews. The abstracts of these four reviews and their full text were examined. Later, these four articles were selected and reviewed on the basis of their relevance to the research question (see Appendix 1 for the PRISMA flowchart for the Research Question-1 selection process) (Beller et al., 2013; Moher et al., 2009).

#### 3.2 Results for Research Question-2 (Prevalence of Childhood Obesity)

Research Question-2: “What is the prevalence and incidence of childhood obesity in Saudi Arabia?” A total of 93 reviews were identified from the databases, and a further 42 were found on the WHO website. After eliminating the duplicates, 51 reviews were left. Using the selection criteria, studies published before 2004 were excluded, resulting in a remainder of 16 reviews. The abstracts of these 16 reviews were further examined for relevance to the research question, and nine reviews were found not relevant to the determinants of prevalence and incidence of childhood obesity in Saudi Arabia and hence excluded. The remaining seven reviews were used for this second short literature review based on their relevance to the research question and being recent (see Appendix 2 for the PRISMA flowchart for Research Question-1 selection process) (Beller et al., 2013; Moher et al., 2009). The specific reviews selected for Research Question-2 (specific reviews selected to determine the contributing factors and prevalence) were Al-Dossary et al. (2010); Al-Hazzaa et al. (2012); Al-Qahtani et al. (2013); Al Shehri et al. (2013); El Mouzan et al. (2010); Mirmiran et al. (2010); Ng et al. (2011).

#### 3.3 Results for Research Question-3 Interventions at primary care setting

Research Question-3: “What interventions have been implemented successfully in primary care settings?”

A total of 24 reviews were identified from the two databases. In addition, 42 were found on the WHO website. After eliminating the duplicates, 51 reviews were left. Using the selection criteria, studies published before 2004 were excluded, resulting in a remainder of 16 reviews. The abstracts of these 16 reviews were further examined for relevance to the research question. Nine studies were excluded for not being relevant as systematic reviews on successful childhood obesity

prevention interventions. The remaining 11 reviews were included in this third short literature review based on their relevance to the research question (see Appendix 3 for the PRISMA flowchart for Research Question-1 selection process) (Beller et al., 2013; Moher et al., 2009). The selected reviews for Research Question-3 include the following: (De Bourdeaudhuij et al., 2011; Dobbins et al., 2001; Flynn et al., 2006; Grieken, Ezendam, Paulis, Wouden, & Raat, 2012; Micucci, Thomas, & Vohra, 2002; Oude et al., 2009; Poobalan, 2008; Reilly & McDowell, 2003; WHO, 2009; Wofford, 2008; Wolfenden et al., 2012).

#### 3.4 Results for Research Question-4 (Childhood Obesity interventions in Saudi Arabia)

Research Question-4: “What is currently being done in primary care obesity interventions for children in Saudi Arabia?”

A total of 4 reviews were identified from PubMed, The Cochrane Collaboration, the WHO website, and the Scopus database searches. Using the selection criteria, studies published before 2004 were excluded, resulting in a remainder of 3 reviews.

The abstracts of these three reviews and their full-text length were examined in detail to determine their relevance to research questions four and three studies were then excluded for not being relevant as they did not evaluate any existing childhood obesity prevention interventions being implemented in Saudi Arabia. The remaining review was critically examined in this last short literature review (see Appendix 4 for the PRISMA flowchart for the Research Question-1 selection process) (Beller et al., 2013; Moher et al., 2009). Furthermore, several experts in the child health department in the Saudi Arabia Ministry of Health were contacted, but only one expert responded. They stated that, at present, there are no functional childhood obesity interventions that target Saudi children, and this statement was confirmed by the Saudi Arabia Ministry of Health website (<http://www.moh.gov.sa/en/Pages/Default.aspx>). The Surgical intervention for fat removal from a highly obese individual is the only intervention mentioned there, and this does not qualify as a childhood obesity prevention intervention. A critical review of the one selected article by Musaiger et al. (2011) mentions and discusses a general guideline in planning and a strategy for a future childhood obesity intervention in primary care in Arab nations. Since no childhood obesity interventions have been implemented in Saudi Arabia; therefore, it was not possible to compare them with the successful interventions implemented elsewhere in other countries.

### 3.5 FINDING OF RESULTS

#### 3.5.1 Summary of findings for Research Question-1 (Childhood Obesity contributing factors)

The findings of the short literature review done for Question 1 from the four selected review articles are shown in Table 3. These findings indicated that the determinants of childhood obesity could be genetic

(genetically inherited factors that may affect metabolism and pre-dispose the child for obesity), environmental (obesogenic environment at school and home that may serve as risks for developing obesity), or behavioral (lifestyle factors like bad food choices and lack of physical activity (Karnik & Kanekar, 2012)). The overall incidence rate of obesity for males and females has been estimated to be about 35.6% in Saudi Arabia (Low et al., 2009). It has been estimated that at present, 10% of the world's children (school-going age groups) are overweight and at significantly high risk for developing type 2 diabetes, heart disease, and several other kinds of comorbidities before and in the years of adulthood. The incidence of childhood overweight is overall far higher in economically advanced countries like the United States of America (USA). Still, this problem is steadily increasing in developing countries of Asia and the Middle East also. This might be due to increasing trend of adaptation of urbanized lifestyle with minimal physical activity and consumption of excess sugary drinks and junk food that are available in very large portions (Booth et al., 2007; Lobstein et al., 2004).

### **3.5.2 Summary of findings for Research Question-2: Prevalence of Childhood Obesity**

Limited information is available regarding the prevalence of childhood obesity in Saudi Arabia; However, Mirmiran et al. (2010) provide detailed information in their review of obesity in Middle Eastern countries from 1990-2007 (Table 3). Several studies reported that changes in lifestyle and rapid increase in urbanization are the major contributing factors to childhood obesity in Saudi Arabia (Al-Dossary et al., 2010; Al-Hazzaa et al., 2012; Al-Qahtani et al., 2013; Ng et al., 2011). In addition, several other factors such as lack of adequate vigorous physical activity, skipping breakfast, consumption of an imbalanced diet, and excessive intake of sugary drinks in school also increase childhood obesity in Saudi Arabia (Al-Hazzaa et al., 2012; El Mouzan et al., 2010).

The studies published from 2000 to 2012 on childhood obesity in Saudi children reported that the prevalence of overweight and obesity in school-going children is 23% and 9.3%, respectively. However, the prevalence rates of overweight and obesity in the preschool age group was estimated to be about 15% and 6%, respectively. In addition, a varying prevalence of childhood obesity and overweight in children was observed in different regions of Saudi Arabia. Noteworthy, the highest prevalence of obesity and overweight was observed in eastern and central regions as compared to the south part of Saudi Arabia. Furthermore, it is reported that the threat of childhood obesity and overweight in children is increasing in Saudi children each year (Al Shehri et al., 2013).

### **3.5.3 Summary for findings for Research Question-3: Interventions at the primary care setting**

The findings from the results of the third literature review for research question three are summarized in Table 4.

### **3.6 Community-based population-level interventions**

The WHO report (WHO, 2009) provides evidence from childhood obesity intervention spanning across the globe. It has been summarized that childhood obesity interventions are implemented in several countries like the USA, Australia, India, and the countries of the WHO Pacific region. Countries with significant success rates in preventing or reducing childhood obesity are mainly focused on community-based population-level interventions carried out by national and local governments. Different organizations actively help the local government create supporting policies and interventions for the control of childhood obesity. The most successful interventions are: population-wide policies and initiatives that influenced the food environments, physical activity environments, and food advertising or marketing campaigns. Several successful community-based interventions are i) a school-feeding program in Jamaica, ii) a 3-year school-based nutritional education and physical activity intervention for children and their parents in China, iii) a school-based multi-part nutrition and lifestyle intervention in India, and iv) the community-based obesity prevention strategy for small children, "Romp & Chomp," in Australia were highly successful. The common factor between these successful interventions was the high levels of action undertaken by the community or school setting and multiple component strategies that included combinations of nutritional improvement combined with increased physical activity (De Bourdeaudhuij et al., 2011; Flynn et al., 2006; Silveira, Taddei, Guerra, & Nobre, 2013; Waters et al., 2011; WHO, 2009).

### **3.7 Combination of behavior and lifestyle interventions**

Scientists in 2009 reported that a combination of behavior and lifestyle interventions is more successful than conventional care or intervention in reducing obesity in children Oude et al. (2009). School-based interventions that aimed to increase physical activity (Dobbins et al., 2001) and fruit and vegetable consumption were also successful in significantly preventing and mitigating childhood obesity rates (Wolfenden et al., 2012).

Lifestyle interventions have also shown a significant degree of success in reducing childhood obesity and its prevention (Ho et al., 2012). The review done by Ho et al. (2012) has indicated that lifestyle interventions which have combinations of a dietary component together with physical activity or behavioral section are reasonably successful in mitigating childhood obesity and enhancing the cardio-metabolic outcomes for several obesity-related health issues for up to a minimum of 12 months. These findings are supported by several other reviews (De Bourdeaudhuij et al., 2011; Kamath et al., 2008; Micucci et al., 2002; Reilly & McDowell, 2003).

### **3.8 Characteristics of successful childhood obesity prevention interventions**

A successful population-based childhood obesity prevention intervention broadly has three parts. The first

**Table 3: Results from the short literature review done for Research Question-1: Childhood Obesity contributing factors**

Review Author	Year of publication	Study characteristics	Study findings	Study recommendation
Lobstein, T., Baur, L., & Uauy, R.	2004	A qualitative review of the global & regional trends in childhood obesity and the concurrent rise in resulting health issues.	Use of prevention strategies is the only realistic option.	Need for multi-sectoral action in public health to manage the rising childhood obesity epidemic
Low, S., Chin, M. C., & Deurenberg-Yap, M.	2009	A review on the prevalence, trends of obesity in children. Use of datasets on the prevalence of obesity and in the Global Database on Body Mass Index on WHO, the data available on the International Obesity Task Force website, and other databases was used for this review.	There is a steady increase in the number of adults obese with age. It gives specific figures on the obesity trend in Saudi Arabia.	The need for urgent implementation of suitable interventions for tackling obesity at an early age to reduce future health issues, severe disability & premature deaths.
Karnik, S., & Kanekar, A.	2012	A detailed review of articles published between 1999 and 2011 on factors which act as determinants of childhood obesity from the CINAHL, MEDLINE, ERIC, Academic Search and Premier databases.	The determinants of childhood obesity can be genetic, environmental, or behavioral (lifestyle-related) in nature.	Childhood obesity needs to be prevented and managed at the population level through interventions that use education, prevention, and sustainable policies related to healthy nutritional practices and increases in physical activities.
Booth, M. L et al.	2007	Determination of the secular trends of obesity in children and adolescents in the 7 to 15 age group in the years 1985, 1997, and 2004 in Australia.	The increases in the prevalence of overweight and obesity and socioeconomic status did not have any significant relationship in these periods in Australia. Boys showed a higher trend of being obese but not girls.	The need for further research to understand the determinants of obesity in young Australians in the future.

**Table 4: Results from the short literature review done for Research Question-2: Prevalence of Childhood Obesity**

Review author	Publication year	Study type	What the review results indicate
Mirmiran, P., Sherafat-Kazemzadeh, R., Jalali-Farahani, S., & Azizi, F.	2010	A review done using the <i>Medline</i> database to study the prevalence of obesity in children & adolescents in the Middle East from 1990 to 2007.	The prevalence rate of childhood obesity in Saudi Arabia has recorded an upward trend compared to the prevalence rate ten years ago.
Al-Dossary, S. S., Sarkis, P. E., Hassan, A., El Regal, M. E., & Fouda, A. E.	2010	A review on the prevalence of obesity in Saudi children.	Suggests the association of rapid increases in urbanization and lifestyle factors as one of the leading causes of the increasing prevalence of childhood obesity in Saudi Arabia.
Al-Hazzaa, H. M., Abahussain, N. A., Al-Sobayel, H. I., Qahwaji, D. M., & Musaiger, A. O.	2012	Studies the lifestyle factors and prevalence of childhood obesity	Provides evidence that rapid increases in urbanization and lifestyle factors are the main determinants of the increasing prevalence of childhood obesity in Saudi Arabia.
Al-Qahtani, A., Al-Al-Ghamdi, R., & Al-Ghamdi, K.	2013	A review on childhood obesity, its prevalence, risk factors and lifestyle behaviour in primary school children in one region of Saudi Arabia.	The provided prevalence rates and determinants may not be representative of other regions in Saudi Arabia, but the obesity epidemic in Saudi children is on the rise.
Al Shehri, A., Al Fattani, A., & Al Alwan, I.	2013	Studies the prevalence rates of childhood obesity in Saudi Arabia.	Providing accurate prevalence rates on childhood obesity and overweight in children was observed in different regions of Saudi Arabia, indicating that the overall increase in childhood obesity and overweight in Saudi children is rising sharply each year.
Ng, S. W., Zaghoul, S., Ali, H. I., Harrison, G., & Popkin, B. M.	2011	A review on the prevalence and trends of overweight as well as obesity and the corresponding increase in nutrition-associated non-communicable diseases in the Arabian Gulf States.	Strongly indicates a significant association between the increase in childhood overweight & obesity with an increase in nutrition-associated non-communicable diseases in the Arabian Gulf States, including SA.
El Mouzan et al.	2013	A review of the prevalence of obesity in Saudi children and determination of underlying factors that cause this obesity.	Summarizes that obesity incidents in Saudi children were significantly associated with lack of adequate vigorous physical activity, skipping breakfast, insufficient consumption of fruits and vegetables & excessive intakes of sugary drinks in school.



**Table 5: Results from the short literature review done for Research Question-3: Interventions in the primary care setting**

<b>Review Author</b>	<b>Quality of Review &amp; strength of evidence as discussed by the reviewer through use of assessment tool</b>	<b>Type of childhood obesity prevention intervention recommended as being successful</b>	<b>Size of the effect outcomes</b>	<b>Components &amp; Outcomes</b>	<b>Countries with successful interventions being run</b>
WHO (2010)		Community-based population level interventions	24	Local and national government health care organizations	USA India China Jamaica Australia
Waters, E., de Silva-Sanigorski, A., Hall, B.J., Brown, T., Campbell, K.J., Gao, Y., Armstrong, R., Prosser, L., Summerbell, C.D. (2011).	Strong, 9/10	Childhood obesity prevention interventions with multiple component strategies that included combinations of nutritional improvement combined with increased physical activity.	55	Multiple stakeholders like local and national governments, school authorities and community leaders as well as NGOs.	USA India China Jamaica Australia Countries of the European Union (EU).
Oude Luttikhuis, H., Baur, L., Jansen, H., Shrewsbury, V.A., O'Malley, C., Stolk, R.P., et al. (2009).	Strong, 10/10	Childhood obesity prevention interventions which make use of a combination of behaviour and lifestyle interventions in different settings such as schools and communities on population levels.	64	Multiple stakeholders like local and national governments, school authorities and community leaders as well as NGOs.	USA India China Jamaica Australia United Kingdom (UK) New Zealand Bangladesh
Dobbins, M., Lockett, D., Michel, I., Beyers, J., Feldman, L., Vohra, J., et al. (2001).	Strong, 9/10	A review of childhood obesity school-based physical activity interventions	19	School authorities, school staff, and parents.	USA Australia UK New Zealand Canada
Wolfenden, L., Wyse, R. J., Britton, B. I., Campbell, K. J., Hodder, R. K., Stacey, F. G., & James, E. L et al. (2012).	Strong, 10/10	Childhood obesity prevention interventions which make use of strategies designed to increase fruit and vegetable consumption.	Five trials, with 13 trial arms and 3967 participants were reviewed.	Various setting like home visit programs and other settings.	UK
Ho, M., Garnett, S. P., Baur, L., Burrows, T., Stewart, L., Neve, M., & Collins, C. (2012)	Strong, 9/10	Childhood obesity lifestyle intervention evaluated cardio-metabolic outcomes in overweight children.	38	Schools, home, community centres and primary care settings.	USA Australia UK New Zealand Canada
De Bourdeaudhuij et al. (2011).	Strong, 9/10	Childhood obesity prevention school-based interventions that target both diet and physical activity behaviour in primary and secondary school children in Europe.	11 studies in 27 articles reviewed.	School authorities, school staff and parents.	European countries.
Flynn, M.A., McNeil, D.A., Maloff, B., Mutasingwa, D., Wu, M., Ford, C., et al. (2006).	Strong, 10/10	A range of childhood obesity prevention interventions which span policy interventions, dietary, educational, lifestyle and physical activity based strategies.	158 articles, representing 147 intervention programs.	A range of implementing authorities.	USA India China Jamaica Australia UK New Zealand Bangladesh Iran

part is the government structure that makes decisions for supporting childhood obesity prevention policies and designing plans. The structure provides competent leadership, "health for all" policies, has adequate funds to implement interventions and maintain and evaluate them. Successful interventions have a strong network of partnerships that help to improve and facilitate their implementation within-population or communities (DeBourdeaudhuij et al., 2011; Kamath et al., 2008; Reilly & McDowell, 2003; Waters et al., 2011; WHO,

2009).

The second part is the use of population-based policies and programs. Successful interventions are based on direct policy acts which assist in making such environments that promote healthy eating with improved levels of physical activity. The choice of policy tools utilized as an integral part of this component of any successful childhood obesity intervention is the legislation, taxes or subsidies, and regulation of

advertising campaigns that have an impact on the child population as a group (De Bourdeaudhuij et al., 2011). Laws that control and mitigate obesogenic food environments that are parts of successful interventions include limitations on marketing unhealthy food items and sugary drinks to children, accurate nutritional labelling and strict implementation of food taxes (Greig et al., 2012; Waters et al., 2011; WHO, 2009). Policies that impact available physical activity environments have been documented to be successful.

The third part of successful childhood obesity prevention and control interventions is their being designed and carried out in community-based settings. In addition, the use of multi-part strategies which are applicable across the whole population and tailored to suit national conditions has a significant impact (Waters et al., 2011; WHO, 2009).

### **3.9 Summary of findings for Research Question-4: Childhood obesity interventions in Saudi Arabia**

At present, the evidence regarding functional interventions is available to combat childhood obesity and has the potential to be implemented in Saudi children. Unfortunately, the Saudi Health Ministry website only offers individual advice and assistance for obesity-related questions. Still, it does not have any plan or strategy for future childhood obesity intervention in primary care settings. The Saudi government and the Saudi Ministry of health have only implemented a surgical intervention for the highly obese in Saudi Arabia.

In 2011, researchers reported that physical activity could overcome childhood obesity in Arab countries (Musaiger et al., 2011). However, the plan presented here is fundamental and not specifically designed to address the childhood obesity determinants identified for Saudi Arabia specifically.

## **4. DISCUSSION**

### **4.1 Statement of principal findings**

The present study was designed to determine the significant factors of childhood overweight and obesity in Saudi Arabia. These important factors associated with obesity are rapid urbanization, imbalance diet, watching television, little or no physical activity and (Al-Hazzaa et al., 2012; Al-Qahtani et al., 2013; Al Shehri et al., 2013). Furthermore, it is unfortunate that childhood obesity prevention interventions are still not implemented in Saudi Arabia at present. Therefore, it is necessary to implement primary prevention of childhood obesity through the use of modified school-based or other community-based lifestyle interventions such as giving education about a balanced diet and encouraging physical activity or a combination of both can be adapted at a national level in Saudi Arabia (Al-Qahtani et al., 2013; Ho et al., 2012).

The review of literature in Research Question-4 also shows that there is a significant evaluated success of

three kinds of interventions in other countries:

- Community-based population-level interventions that have multicomponent strategies which make use of both dietary changes and changes in physical activity levels.
- School-based childhood obesity interventions aim to increase fruit and vegetable consumption or physical activity levels.
- Life-style based or behavioral interventions.

### **4.2 Strengths and weaknesses of the study**

The strength of the current study is that these comprehensive findings are derived from published national and international studies and make this research a valuable document for future researchers in this field. The main limitation of this research is that a single researcher carried out the entire study, and it might be possible that the obtained results may be subject to subconscious manipulation bias. This is because the interpretations are drawn on previous review findings by this research project's author and be biased. In addition, there may have been errors while searching, cataloging, and selecting the reviews used for all the research questions resulting in selection bias.

- Based on previous evidence-based reviews on successful interventions, the following points can be considered suitable policies for planning childhood obesity interventions:  
School-based interventions combine awareness of healthy food choices and diet, increases in vigorous physical activity, and education on correct body image.
- The use of interventions that increase the number of physical activities and help develop an essential increase in movement skills at school.
- Planning and implementation of interventions that enhance the consumption of fruits and vegetables and also provide better nutritional quality food items (both food and drinks) available in schools cafeterias and canteens
- Policy interventions can target advertising of unhealthy food choices on television to reduce the number of excess calories consumed in unhealthy snacks while watching television.
- Community-based interventions that encourage family-based cultural practices allowing parents to help their children in making more health food choices.
- School-based educational interventions and follow-up support for teachers and physical education staff for implementing childhood obesity interventions that promote healthy diets with enjoyable physical activities. In addition, these staff members can be trained to give advice and counselling to overcome cultural norms that prevent gender-based obesity in female children.

### 4.3 Meaning of the study

The interventions to overcome childhood obesity in Saudi Arabia are needed to implement in multiple settings and should involve every level of government. There is no Saudi policy to control childhood obesity on a national or population level (Al Shehri et al., 2013; WHO, 2009). In addition, in this country, the policies for childhood obesity prevention have to account for all income groups and thus mitigate the vast inequity in the health care system. Furthermore, various community-based strategic actions are required for caregivers (healthcare professionals) and caretakers to reduce the escalating burden of childhood obesity in Saudi Arabia. The knowledge translation of various systematic reviews also offered evidence-based recommendations and interventions for policy-makers, particularly from the perspective of Saudi Arabia. The cultural factors and pre-existing norms combined with gaps in education on healthy food choices may render previous successful interventions ineffective unless they are made according to Saudi Arabia's needs. Furthermore, the prioritization of policy actions needs to be explicit, with defined processes for selecting interventions for implementation in a step-based manner (WHO, 2009; Wofford, 2008).

## 5. CONCLUSION AND RECOMMENDATION

The lack of childhood obesity interventions at the primary health care level in Saudi Arabia is a significant public health issue because of a steep increase in overweight and obesity prevalence. Some viable solutions such as a balanced diet, zero or less consumption of high energy food with sugar-based beverages, and physical exercise in both males and females can help prevent and treat the childhood obesity epidemic experienced in Saudi Arabia. Additionally, the Saudi government needs to adapt and implement the WHO Global Strategy on Diet, Physical Activity, and Health to overcome childhood obesity (Al Shehri et al., 2013; WHO, 2009). To successfully implement interventions, a pilot-scale project on childhood obesity prevention needs to be tested and evaluated in the Saudi Arabian setting. This can help policymakers make informed decisions. Furthermore, the government has to create and maintain an accurate database that can be used to research interventions that have been modified to work in Saudi Arabian settings (Waters et al., 2011).

### AUTHORS' CONTRIBUTION

PB, MA, AA, AA, HA carried out literature search and manuscript drafting. SA and WAA designed the study and manuscript drafting.

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### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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### AVAILABILITY OF DATA AND MATERIAL

The data used in this study are available and will be provided by the corresponding author on a reasonable request.

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