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The Impact of School Nutrition Education and Physical Education Programs on Weight Status of Obese Children Aged 5- 12 Years

Lamia Ayed Alotaibi
lalotaibi@eiu.edu

The Impact of School Nutrition Education and Physical Education Programs on Weight Status of Obese Children Aged 5-12 Years

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Lamia Alotaibi

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Melanie Tracy Burns
THESIS DIRECTOR

4/16/19
DATE

MS/RD
COMMITTEE MEMBER

4/19/19
DATE

COMMITTEE MEMBER

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Abstract

Epidemiological studies indicate that 12.5 million children and adolescents are considered obese (Center for Disease Control and Prevention, 2017). Obesity is on the rise globally, and while it affects both children and adults, early measures can be taken to reduce the number of children who are obese, and therefore, come into adulthood at a higher risk for obesity-related diseases, such as hypertension, cardiovascular disease, and sleep apnea. There are many studies in which programs are implemented and tested for effectiveness; therefore, a systematic review of these studies that examine which factors play into overall obesity prevention and health improvements among children is warranted. This study examined which factors of intervention strategies contributed to the success of a program, with success being defined as improved anthropomorphic measures, behavioral changes, environmental improvement, and increase in cardiovascular health. Results of this study indicate that successful intervention programs incorporated both nutrition education and physical activity. Additional factors that supported obesity intervention include community and environmental support, nutritional policies, and length of intervention.

Key words: Childhood obesity, nutrition education, physical activity, prevention program, school interventions

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Chapter 1

Introduction

Obesity is a significant global problem that affects people of all age groups. Globally, in 2010, an estimated 43 million children aged 5 years and below were considered obese (BMI > 95th percentile) (Ogden, Carroll, Kit and Flegal, 2012; Ahima & Lazar, 2013), and the number of obese children continues to rise (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018). Obesity is a global issue that affects both children and adults; however, early measures to prevent it in children can help in reducing its burden on adults (Cao, Wang & Chen, 2015). Today's children are the first generation of children to live shorter and less healthy lives compared to their parents. Epidemiological studies indicate that 12.5 million children and adolescents are considered obese (Center for Disease Control and Prevention, 2017).

Children who are overweight are at a higher risk for several chronic conditions, such as heart disease, high blood pressure, Type 2 Diabetes, sleep apnea, depression, and joint problems (Gundersen, Kreider, & Pepper, 2012; Manios et al., 2018). In addition, childhood overweightness and obesity affect a child's growth and development and can limit academic achievement (Jaime & Lock, 2009). To reduce childhood obesity, risk factors, such as lack of physical activity and poor dietary choices, need to be specifically identified and mediated to lessen the negative effects (Iannotti & Wang, 2013; Ogden, Carroll, Kit, & Flegal, 2014).

Prevention programs, such as the CATCH program and the Organ Wise Guys, have been implemented in school settings to reduce childhood obesity through the incorporation of physical activity and nutrition education interventions that include

behavior change strategies (Hoelscher et al., 2010; Hollar et al., 2010). School is the primary place children receive nutrition and physical education as children spend 6 hours or more in this environment for 9 months per year (Wilson, Adolph, & Butte, 2009; Fung, McIsaac, Kuhle, Kirk, & Veugelers, 2013). The school curriculum includes co-curricular activities and can positively influence the weight status and nutritional well-being of students. Engaging in physical activity is a major part of the learning environment where students get to realize and utilize their talents. The school environment holds much potential for developing interventions that promote weight loss and good health among students through physical activities and nutrition education. When students adopt healthier lifestyles and model those lifestyles to other siblings and friends, positive changes can occur throughout the home as well as the school environment (Guerra, Cardoso da Silveira, & Salvador, 2015; Friedrich, Caetano, Schiffner, Wagner, & Schuch, 2015).

Educating children about nutrition has positive health outcomes, including promoting children's positive perspective regarding food-related choices and eating decisions. It also provides accurate health knowledge in an era filled with marketing activities that promote unhealthy eating practices (Khambalia, Dickinson, Hardy, Gill & Baur, 2012; Gripshover, & Markman, 2013). When obesity intervention strategies are established and promoted from an early age (5-12 years old), there are reduced chances that the same children will be affected by obesity when they are adults and have a lesser change of being overweight and obese as adults (Bustos, Olivares, Leyton, Cano, & Albala, 2016)

Purpose of the Research

The issue of obesity in children between the ages of 5 to 12 years continues to raise alarm all over the world. The purpose of this study was to describe and compare the effectiveness of school nutrition and physical education programs on the weight status of obese children aged 5 to 12 years in order to give insight into obesity prevention and intervention in children.

Research Questions

This study was guided by the following questions:

1. What were similar characteristics of programs that were successful in promoting a healthy weight in children?
2. What were similar characteristics of programs that were not successful in promoting a healthy weight in children?

Significance of the Problem

Educating the public about obesity is a challenge in many nations due to the gradual, but sustained, increase in the number of obese individuals. Obesity education is more difficult in children within this age group since they are young and under the care of their parents or guardians. The issue of obesity in children continues to affect their health in ways that negatively impact their futures such as diabetes diagnoses or stress on the cardiovascular health. Teenagers are more informed about health hazards which makes them take precautionary measures, whereas infants and young children are closely monitored by their parents and physicians at all times. Once children begin traditional school, their parents often take a more hands-off approach and rely on their schools for

education and monitoring. Poor eating habits during childhood, such as consumption of unhealthy foods and sedentary lifestyle significantly contribute to the problem of obesity (Driessen, Cameron, Thornton, Lai, & Barnett, 2014). Coincidentally, children between the ages of 5 and 12 tend to consume low nutrient dense foods. Therefore, the consumption of extra calories from these foods can contribute to obesity (Feng et al, 2017).

Obese children are vulnerable to bullying by their peers (Jeong et al., 2015). As a result, most of these children are subjected to emotional distress caused by being victimized due to their weight (Sahoo, Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). For instance, in a class where only one child is obese, the child may feel inferior to the others despite assurances of equality in the class. This "inferiority complex" promoted by a person's physical appearance may lead to low self-esteem and self-hate (Jeong et al. 2015). As a way of reducing the chances of children falling into such pits of self-destruction, measures that address the challenge of obesity could be implemented (Jeong et al., 2015).

Methods of addressing obesity depend on the instruction of health experts. Physical exercise, change of diet, and nutritional education are some of the easiest and most cost-effective ways of addressing the problem of obesity. Increased time spent attending in Physical Education (P.E.) classes provides the children with opportunities to involve themselves in exercises that assist in losing weight according to the Body Mass Index (BMI) scale (Cawley, Frisvold, and Meyerhoefer, 2013). Observing healthy nutrition also significantly reduces the chances of gaining weight (Perera et al., 2015). Through engaging in nutritional education programs by watching movies, documentaries,

classwork, and discussion, the children acquire the knowledge of what types of food affect them negatively. For instance, they may learn about excessive consumption of unhealthy food and how they may substitute the undesired foods with healthy alternatives. Therefore, engaging in physical education as well as nutrition programs is important for the reducing of obesity in children aged 5-12 years (Perera et al., 2015).

Assumptions

The study proceeded under the following assumptions:

1. Obesity is a health hazard that exists in all societies across the world.
2. Obesity in children aged 5-12 is very high and needs to be addressed urgently.
3. The use of nutrition programs as well as physical education is the most effective way of reducing obesity in children aged between 5-12 years.
4. The school environment is the most appropriate place to implement measures to address obesity in children aged 5-12 years.

Definition of Operational Terms

The research paper occasionally utilizes the following terms in order to pass the intended information effectively.

1. **Childhood Obesity** - Obesity is the abnormal or excessive fat accumulation among children (WHO, 2017).
2. **Nutrition Education (NE)** - An amalgamation of learning strategies aimed at improving children's health needs. It seeks improvement in food and other nutrition-related behaviors (Burke, Meyer, Kay, Allensworth, & Gazmararian, 2014).

3. **Physical Activity (PA) -** A set of instruction aimed at improving and enhancing individual engagement in manual exercises (Guerra, Nobre, Da Silveria, Taddei, & De Aguiar, 2013)
4. **Body Mass Index (BMI)** –Ratio of body weight to height that is used by health specialists to determine healthy weights of individuals. (Center for Disease Control and Prevention, 2018).
5. **Waist Circumference (WC)-** This is a measurement used by health specialists to determine whether a person's abdominal area consists of too much fatty tissue (CDC, 2018).

Chapter 2

Methodology

A systematic review of the highlighted article's results guided the research. The review was conducted by a single researcher at Eastern Illinois University (EIU). The strategy used for identifying articles was carried out in three steps: search, distillation, and independent review.

Study Identification and Distillation

In the Search phase, articles were obtained via four databases: CINAHL, PubMed, Academic Search Complete and PsycINFO. During the search process, key terms including "nutrition education," "physical education," "school interventions," and "childhood obesity" were used in various combinations to identify the articles. Literature searches were combined into the DistillerSR software to assist in screening and removing duplicate articles. To ensure the inclusion of recent research, a time restriction was placed on the studies, ranging from publishing dates within January 1, 2007 to December 1, 2018.

In the Distillation phase, the identified articles included screening the titles and the abstracts of each the articles retrieved. The inclusion criteria for the articles in this systematic review were as follows: studies (1) were peer-reviewed with full-text, (2) were those conducted between 2007 and 2018, (3) involved children between the ages of 5 -12 years, (4) included obese children, (5) were conducted in a public elementary and middle school environment, (6) included the outcomes of BMI and dietary habits, and (7) included interventions of nutrition education and physical activity.

The studies excluded (1) were published prior to 2007, (2) were not conducted in a school, (3) included children who were younger than 5 or older than 12 years, (4) included participants who were not defined as obese (BMIs <95th percentile), (5) did not include interventions that included nutrition education and physical activity, and/or (6) did not include BMI and dietary habits as an outcome. These exclusion and inclusion criteria were then applied to the resulting articles.

In the final phase of the study selection process, the Independent Review phase, the researcher independently reviewed all of the remaining articles to determine if they met the inclusion criteria. After the remaining articles were reviewed, the final resulting set of articles were then added to this systematic literature review.

Data Synthesis and Analysis

Relevancy and validity of the studies were determined the protocol presented in the *Evidence Analysis Manual* as developed by the Academy of Nutrition and Dietetics (AND) (2016).

Relevancy

Based on the AND Evidence Analysis Library protocol, relevancy of the article to the field of dietetics is determined by the response to the following four questions: (1) "Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group?" (2) "Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group?" (3) "Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to dietetics

practice? and (4) “Is the intervention or procedure feasible?” If the article met these requirements and answered “yes”, then it was deemed relevant.

Validity

After a study was deemed relevant, it was then reviewed for validity. Per this Protocol, a study’s validity is determined by positive responses to the following ten questions: (1) “Was the research question clearly stated?” (2) “Was the selection of subjects/patients free from bias?” (3) “Were study groups comparable?” (4) “Was the method of handling withdrawals described?”, (5) “Was blinding used to prevent introduction of bias?”, (6) Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?”, (7) “Were outcomes clearly defined and the measurements valid and reliable?”, (8) “Was the statistical analysis appropriate for the study design and type of outcome indicators?”, (9) “Are conclusions supported by results with biases and limitations taken into consideration?”, and (10) “Is bias due to study’s funding or sponsorship unlikely?” (AND, 2016). The AND requires that, at minimum, six of these requirements be met, and questions 2, 3, 6, and 7 must be included in those six in order for the study to be valid.

All articles were tested for validity and included only if they met the AND’s specifications. The quality of the studies used in this review for each criterion is presented in (Table 1). The validity measures of the analysis manual were answered with “yes”, “no”, or “unclear”. If an article responded “yes” to criteria 2, 3, 6, and 7, it was determined as high quality. Articles with “no” responses to questions 2, 3, 6, and 7 were determined to be “low quality and subsequently removed from further analysis. If one of

the responses to questions 2, 3, 6, and 7 was “no” or “unclear”, the article was determined to be neutral. The overall validity of the sixteen articles reviewed, and the studies were of high quality.

Table 1. Quality Validation Rating of the Studies included within the Systematic Review (N = 16)

Author (Year)	Average Quality Rating of Researchers	(1) Research question stated	(2) Selection of participants clear of bias	(3) Study groups comparable	(4) Withdraws Discussed	(5) Blinding used	(6) Intervention Described	(7) Outcomes defined	(8) Statistical analysis appropriate	(9) Conclusions supported by results	(10) Unlikely bias
Amini et al. (2016)	+	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Bacardi Gascorn et al. (2012)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Burke et al. (2014)	+	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
Crespo, et al. (2012)	+	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Da Silva et al. (2013)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Elizondo-Montemayor et al. (2013)	+	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Fei Xu et al. (2015)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes

Hoelscher et al. (2010)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Hollar et al. (2010)	+	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Levy et al. (2012)	+	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Moore et al. (2009)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Rayess et al. (2017)	+	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
Safdie et al. (2013)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Sevenc et al. (2011)	+	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Topp et al. (2009)	+	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes
Wang et al. (2015)	+	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

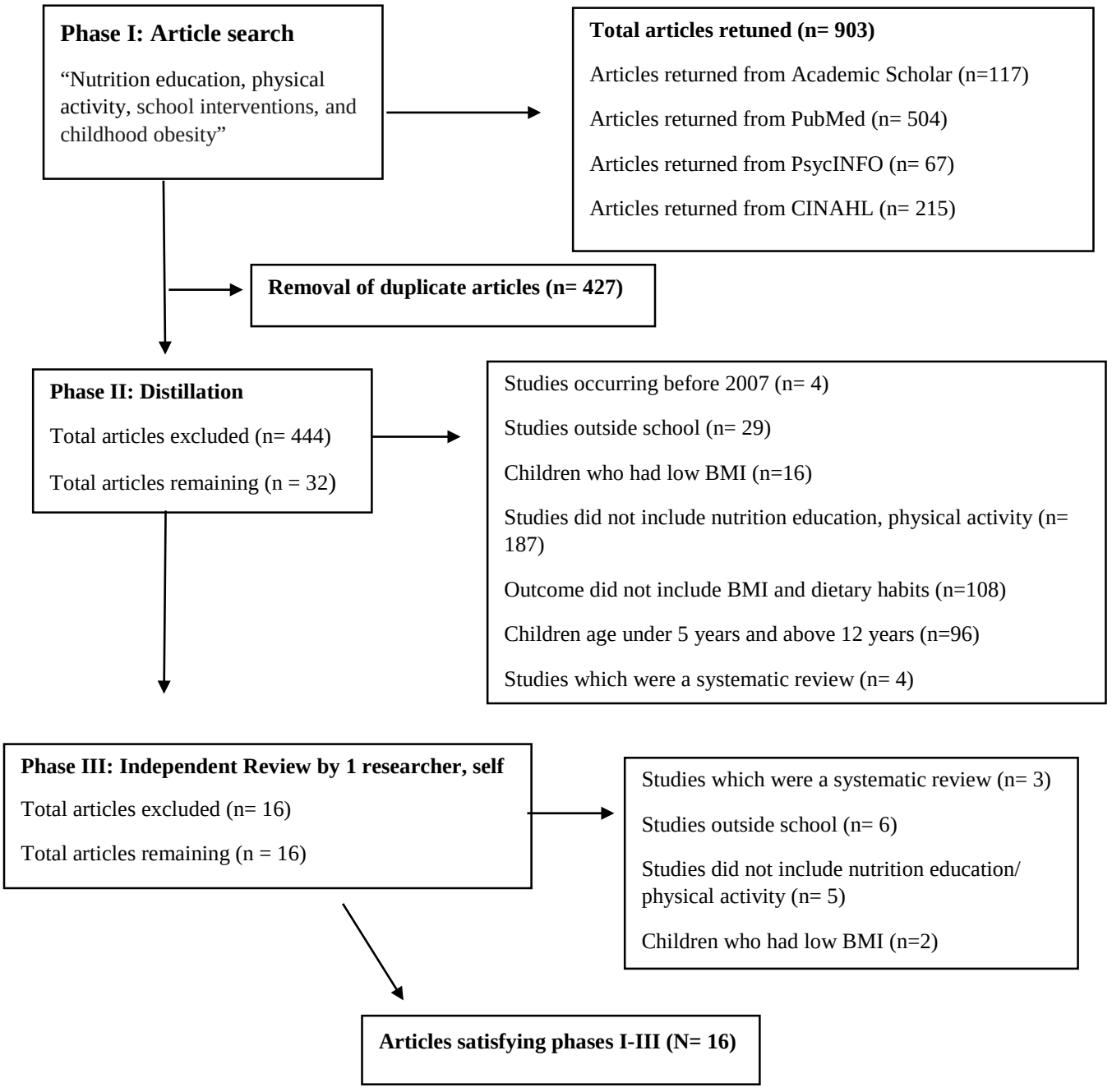
Chapter 3

Results and Discussion

Description of Studies

When the key terms were entered into the search engines of all four databases, 903 articles were obtained. Out of this number, 427 articles were duplicates and were therefore not included as part of the list for the literature review. In the second phase, articles were excluded if their publication date was not between 2007 and 2018 (n=4) Studies were then excluded for the following reasons: the children were younger than 5 years or older than 12 (n=96); the studies occurred outside school (n=29); the children in the study had a low BMI (n=16); the studies did not include nutrition education and physical activity (n=187); the outcomes did not include BMI and dietary habits as an outcome (n=108); and the studies were a systematic review (n=4). This third-phase distillation yielded 32 articles that warranted further review. After the researcher read these articles, the researcher agreed that a further 9 articles should be dropped as (n=3) were systematic reviews or did not occur in a school setting (n=6). The other 7 were eliminated for 2 main reasons: (1) the studies did not include nutrition education and physical activity (n=5) and (2) had children who had a low BMI (n=2). After these phases, 16 articles that met all the criteria (Figure 1). These 16 articles were reviewed using the relevancy and validity protocol outlined in the *AND Evidence Analysis Manual*.

Figure 1: Article Extraction



Data Collection and Abstraction

Data were extracted from the selected articles and entered into Table 2 to create a comprehensive, relevant view of the information. This data included the first author's last name, year of publication, age of the participants, geographical location, intervention modalities, evaluation measures, and intervention effects (outcomes).

There were 20,039 participants from the sixteen studies in this systematic review. On average, each study had over 1000 participants. All of the participants were primary school children, the majority of whom (81%) were between the second and the sixth grades. While 33% of the studies selected participants from high socio-economic status, 67% selected participants from low socio-economic backgrounds. No sex, racial, or geographical predilection were evident as the study participants were randomly selected from diverse racial and ethnic backgrounds. One of the studies only selected overweight children who did not participate in sports, were not on appetite-lowering drugs, and were without metabolic illness. The intervention programs in the study mainly focused on nutrition education and physical activity, while other studies further touched on nutrition self-care practices and nutrition status with regards to BMI and blood pressure. The average duration for the study interventions was a minimum of 6 weeks to as many as 2 years.

Table 2: Summary of Results of Systematic Analysis (n=16)

Authors (Year)	Location	Design/ Duration	Population/ Intervention Groups	Intervention Modalities	Evaluation Measures	Intervention Effects
Amini et al. (2016)	Iran (Tehran)	18 weeks	Age group 4th -6th graders Total group n= 334 Intervention= 167 Control= 167	Nutrition education Physical activity	BMI Physical activity	Significant reduction in BMI-Z (p=0.003) and HC (p=0.001) Increased from 3 to 6 in both control and intervention (p<0.001)
Bacardi Gascorn et al. (2012)	Mexico (Tijuana)	6-month intervention and 18 months follow up)	2nd and 3rd grade n=532	Physical activity Nutritional education	BMI Dietary assessment Behavioral change	Reduction in BMI percentiles by -0.82 (p=0.0001) An increase in fruits and vegetables consumption (p=0.26 and p=0.0007, respectively), decrease in sedentary activities (p=0.001) Decreased availability of snacks high in fat and salt (p = 0.01), sweetened beverages (0.0001), and cookies, chocolates and candy (p=0.05).
Burke et al. (2014)	U.S.A (Georgia)	One full school year	40 schools in Georgia. number of students per	Nutrition education Physical activity	BMI	Reduction in the BMI in overweight students (p < 0.0005)

			school averaged n=533		PACER test scores Nutritional knowledge	Increase in performance across all grades (p<0.0001) Increase in Nutritional knowledge (p<0.0001)
Crespo, et al. (2012)	USA (San Diego, CA)	3 years	13 Elementary Schools, Latino, n= 808	Nutrition education Physical activity	Parent and child BMI Children's activity levels Dietary knowledge	No significant change in BMI (p=0.49) Increased physical activities (p=0.008) Increased intake of fruits, and, thus, increased knowledge
Da Silva et al. (2013)	Brazil	28 weeks	Pupils aged 6-11 years Intervention group n=108 Control group n=130	Nutrition education Physical activity	BMI Nutritional state Physical activities	53.7% decrease in intervention group compared with 37.7% in control (p=0.013) 15.7% improvement compared to 10.4% in the control (p=0.016) Improvements in physical activities (decreased tv time, physical performance activities, etc.)
Elizondo-Montemayor et al. (2013)	Mexico	10 months	Control 1st-5th grades n= 96	Nutrition education Physical education	Dietary habits	Improved dietary behaviors and Decreased calories (p < 0.01); consumed acceptable ranges for macronutrients.

					BMI Physical activity per day Waist circumference Screen time	Significant decrease in percentile from 96.7 to 93.85 (p=0.01) Increased by 15 minutes/day (p=0.02) Reduced from 72% to 57% Reduced by 48 minutes/day
Hoelscher et al. (2010)	USA	1 year	4th grade n= 1107 BP: n= 554 BPC: n= 553	Nutrition education Physical activity	Behavior and knowledge BMI	BPC group positive behavioral changes (p < .02) Decreased by 1.3 points (3.1%) (p= 0.33) in students from CATCH BP schools compared to a decrease of 8.3 points (8.2%) (p= 0.005) in students from CATCH BPC schools.
Hollar et al. (2010)	USA	2 years	4th-5th grades n= 3769 Treatment: n= 3032 Control: n = 737	Nutrition Education Physical Activity	Behavior and knowledge BMI Blood pressure	Improved dietary habits and academic scores improved (p < .001) Decreased BMI (kg/m2) (p = .007) Improvements in blood pressure

Levy et al. (2012)	Mexico	2 years	Randomized Cluster 5th grade N = 1019 Intervention: N=510 Control: N = 509	Nutrition Education Physical Activity	Diet Behavior, knowledge, self-efficacy BMI	No significant changes in dietary intake Increase in knowledge (p = .001) No significant changes in BMI for females or males (p=0.6 and p=0.85, respectively)
Moore et al. (2009)	U.S. A	9 weeks	Sample n=126	Nutrition education Physical education	BMI Nutrition knowledge Activity time Blood pressure	No significant differences in BMI percentiles (p=0.362) Increase in nutrition knowledge (F=4.916, p=.029) Significantly increased activity time (t = 3.779, p = .001) Significant decreases in systolic blood pressure (p=0.001)
Rayess et al. (2017)	U.S.A (Providence)	9 weeks	5^{th} and 6^{th} graders Sample n=954	Nutrition education Physical activity	BMI Recommended screen-time adherence	Significant decrease in BMI from 21.13 to 20.82 (p=0.0183) Adherence increased from 73.6% to 77.4%

					Dietary Intake Behavioral change	Soft drink consumption decrease from 37.9% to 31.0% Increase in number of days where students worked out 4.17 to 4.37 in boys and 3.97 to 4.32 in girls
Safdie et al. (2013)	Mexico	18 months	Randomized control 4th-5th grades n= 886 Basic Intervention: n= 262 Plus Intervention: n= 264	Nutrition education Physical activity	Availability of healthy food Availability of non-recommended food Consumption of recommended foods at recess Consumption of non-recommended foods	Increased ($p<0.05$) Decreased from 50.7% to 15.7% in 18 months Increased from 16% to 33.9% in 18 months Decreased from 59% to 24.6% in Plus and 58% to 36% in basic
Sevinc et al. (2011)	Turkey (Denizli)	Eight Months	Sample n=6847	Nutrition education Physical activity	BMI	Insignificantly increased BMI (0.501 to 0.755) but at a lower rate in the intervention group than the comparison group ($p=0.0000$)

Topp et al. (2009)	U.S.	14 weeks	aged 5-10 years Sample n=63	Nutrition education Physical activity	BMI Waist-to-Hip ratio Behavior change Cardiovascular Fitness	BMI percentile did not change No change Participants consumed significantly more green vegetables and less fruit juice at the completion of the intervention Improved cardiovascular fitness
Wang et al. (2015)	China (Beijing)	One school Year	7-12 years old Sample n=438	Nutrition education Physical activity	BMI Dietary behaviors Physical activity Blood pressure	There was insignificant reduction in body fat and BMI (p=0.025 and p=0.801, respectively) Breakfast consumption significantly increased from 5.6 to 6.4 per week Significantly increased from 293.46 minutes to 315.63 minutes per week Significant reductions in systolic blood pressure (SBP) and diastolic blood pressure (DBP) (p=0.0001)

Xu et al. (2015)	China	One school Year	4th-grade students Intervention n=638 Control n= 544	Nutrition education Physical activity	BMI Lifestyle/behavior Awareness of obesity risk factors	Reduction of BMI in the intervention group by 0.5 kg/m2 or more (46.0% vs. 39.0%) (p=0.09) Intervention group was more likely to increase the frequency of jogging/running, and reduce screen time and red meat consumption. Increased in intervention group

Article Abstraction

The 16 articles included in this study are abstracted below.

A school-based intervention to reduce excess weight in overweight and obese primary school student.

Amini and colleagues (2016) evaluated the effect of an intervention for reducing obesity in primary school-age children in Tehran, Iran. Learners (n=334) were sampled from twelve primary schools with half of the participants serving in the control group. The 4.5-month intervention included four components: a change in lifestyles among families, prohibition of unhealthy foodstuff sold within the school environment, and increased physical exercise and nutritional education. A significant increase was noted in energy and protein consumption (p=0.001 and p=0.007, respectively) in the intervention group at the baseline for the participants who completed the study, a significant reduction in weight (p=0.001) among the participants involved in those with improved diet and physical exercise and a substantial decrease in BMI-Z and hip circumference (p=0.003 and p=0.001, respectively) in the intervention group. No significant variation (p=0.08) was noted in the time spent watching TV between the two groups. Overall, his study was effective in reducing excess weight gain in the pupils and improved time spent on some types of physical activity (Amini et al, 2016).

A six-month randomized school intervention and an 18-month follow-up intervention to prevent childhood obesity in Mexican elementary schools.

In 2012, Bacardí-Gascon and associates assessed the effect of a daily nutrition education/physical activity intervention on BMI, food consumption, and physical activity

of Mexican school children (n=532). In this community-wide intervention that included the children, parents, teachers, and school administrators, the children were taught the relationship between the kind of food they consume and their body weight. The intervention was randomly implemented for approximately six months, after which a follow-up to check on weight changes among the participants was performed for 18 months. Positive changes in the z-score BMI and a reduction in abdominal obesity were identified. Moreover, a significant improvement in vegetable consumption (p=0.007) and physical activity (p=0.0001) were proportional to the reduction in students living a sedentary lifestyle and consuming snacks that are rich in fat and salt. The results of this study indicated that with a comprehensive intervention there is a positive response to lifestyle changes and a reduction of BMI and abdominal obesity (Bacardí-Gascon et al., 2012).

A holistic school-based intervention for improving health-related knowledge, body composition, and fitness in elementary school students: an evaluation of the HealthMPowers program.

Burke and colleagues (2014) determined the effectiveness of the HealthMPowers program in improving student knowledge, behavior, cardiovascular fitness levels, and Body Mass Index (BMI). Researchers implemented the HealthMPowers intervention in 40 elementary schools with each school having a minimum of 533 students. The program lasted three-years with a school cohort for each year between 2010 and 2012 Consistent messaging on nutrition and physical activity was incorporated daily into curriculum and activities by trained school staff. All of the students involved demonstrated a significant improvement in knowledge and self-reported behaviors (p=0.0001). A reduction in BMI-

for-age Z scores across all the grades and gender was observed with a significant decrease (p= 0.0005) in the overweight and obese number of children at the baseline. The findings indicated the effectiveness of the HealthMPowers program in producing positive change in student fitness, BMI, student and knowledge and behaviors, supporting the use of interventions to address childhood obesity (Burke, Meyer, Kay, Allensworth & Gazmararian, 2014).

Results of a multi-level intervention to prevent and control childhood obesity among Latino children: The Aventuras Para Ninos Study.

Crespo and associates (2012) evaluated the effect of community-based intervention methods to promote healthy eating, PA, and prevent obesity among Latino children**.** Participants included Latino parents and children in grades kindergarten through 3rd at thirteen elementary schools in the greater San Diego area. Parent and child BMI, children's activity levels, children's sports participation, active transportation to and from school, availability and use of active toys, parental support for child's activity, TV viewing, child's dietary intake, parenting style for diet and activity, behavioral strategies for fat and fiber, family meals together, away-from-home eating, and demographic variables were monitored and measured over a period of three years. Interventions included individual and family environmental change (Fam-only), school and community environmental change (Comm-only), family-plus-community-environmental change (Fam + Comm). At the end of the study, the intervention reduced children's BMI z-score for those in the Fam-only and Fam +Comm interventions, and noted improvements in obesity-related child behaviors which were facilitated by parental behavior variables.

Researchers concluded that the intervention was effective at modifying parental factors and child obesity-related health behavior (Crespo et al. 2012).

The effectiveness of a physical activity and nutrition education program in the prevention of overweight in schoolchildren in Criciuma, Brazil.

In 2013, Da Silva and colleagues evaluated the effectiveness of a seven-month nutrition education and physical intervention program on the nutritional status, aptitude, and physical activity at the beginning and end of the intervention program as compared with a control group. In the intervention group (IG), the participants (n=108) engaged in a fifty-minute nutritional education session once a week and a fifty-minute physical exercise twice a week. Children in the control group (CG) (n=130) exclusively engaged in regular curriculum activities. The results showed a significant decrease in percentiles of BMI in the IG compared to overweight children in the CG (64.6% and 36.4% respectively, p=0.001). Positive change in healthy nutrition was observed in 27.2% of the group involved in the program, compared with about 11.4% of CG (p=0.114). A significant difference was not noted in an overall improvement in physical activities in the IG (p=0.112) nor in the control group (p=0.810). These findings indicated that students should actively engage in extra-curricular activities to effectively reduce the prevalence of obesity among children (Da Silva, Fisberg, de Souza Pires, Nassar & Sottovia, 2013).

School-based individualized lifestyle intervention decreases obesity and the metabolic syndrome in Mexican children.

Elizondo-Montemayor and associates (2013) examined changes in obesity prevalence after the implementation of a 10-month family lifestyle intervention. The study comprised a sample of 96 overweight/obese children aged 6–12 years from eight Mexican schools and their parents. Anthropometric and dietary intake measurements and 24-hour recalls were obtained for each of the 13 visits. The intervention consisted of the promotion of dietary modifications, such as setting structured meal times and consuming foods to meet dietary intake recommendations and increased physical activity. The prevalence of obese children decreased from 77% to 60%, and a significant decrease in waist circumference percentile and in body-fat percentage ($p=0.01$ and $p=0.01$, respectively) was noted. A significant decrease in prevalence of metabolic syndrome (44% to 16%, $p = 0.01$) and a decrease in those children with high blood pressure (19% to 0%, $p=0.01$) were noted. Physical activity increased significantly by 15 minutes daily ($p = 0.02$). A significant reduction in caloric intake ($p = .01$) was reported with the children consuming macronutrients from the acceptable ranges. The researchers concluded that the intervention was successful in reducing the prevalence metabolic syndrome in the sample of Mexican children (Elizondo-Montemayor et al., 2013).

Effectiveness of a randomized controlled lifestyle intervention to prevent obesity among Chinese primary school students: CLICK-obesity study.

Fei Xu and associated (2015) measured the effectiveness of a one-year school-based multi-component lifestyle childhood obesity prevention program to reduce childhood obesity in Mainland China. Chinese learners (n=638) were selected for the nutrition education intervention program with 548 serving as study controls. The intervention approach was a multi-component type (class curriculum, school environment

support, family involvement and fun programs/events) with routine health education. The intervention group dropped total weight score values after the intervention period (p=0.09). However, these results were insignificant. In comparison between the two groups, the intervention group illustrated a decrease in BMI, increased frequencies of jogging or running among the participants, reduced frequencies of computer and TV use, reduced meat intake and demonstrated changes in commuting to and from school. Researchers concluded that the intervention was practical and effective in reducing BMI and improving health behaviors of Chinese children (Xu, et. al., 2015).

Reductions in child obesity among disadvantaged school children with community involvement: The Travis County CATCH Trial.

In 2010, Hoelscher and colleagues compared the impact of two intervention approaches [Coordinated Approach to Child Health Basic Plus (CATCH BP)], and [CATCH BP and Community (BPC)] on the prevention of child overweightness and obesity. Schools (n = 97) in Texas districts were recruited to participate in the four-year project as either a CATCH BP or Community BPC program. The researchers implemented the CATCH intervention among school children, in which schools were provided an evidence-based approach with school medical trainings administered in all the selected schools while the program was monitored through facilitator visits. Evaluation of the results collected from 2007 to 2008 studies indicated that the adjusted frequency of obesity (≥85th percentile) was 42.0% and 47.4% in 2007 for the BP and BPC participants, respectively. From 2007 to 2008, a non-significant 1.3 % reduction in percentage of obese and overweight children (p=0.33) was identified in BP institutions, in relation to the significant reduction of 8.3 percentile points (p = 0.005) in children from

BPC institutions; the variation between other factors were not negligible (p = 0.05). The findings supported that the community-enhanced school program can play a major role in reducing the prevalence of child obesity (Hoelscher et. al., 2010).

Effective multi-level, multi-sector, school-based obesity prevention programming improves weight, blood pressure, and academic performance, especially among low-income, minority children.

Hollar and associates (2010) examined the effectiveness of the Organ Wise Guys (OWG) school-based program on reducing childhood obesity rates and improving health status. A quasi-experimental controlled pilot study was conducted. Five schools were sampled for the study: four intervention schools and one control school of the selected schools. The intervention included four components: (1) modified dietary offerings, (2) nutrition/lifestyle educational curricula; (3) physical activity component; and (4) enhance other school-based wellness activities, such as cultivating fruit and vegetable gardens. BMI and blood pressure were collected during the two-year study period. The results showed a significant improvement in BMI percentiles between the intervention participants (p=0.007) saw a and those in the control group. Additionally, a significant positive change in systolic blood pressure between the intervention and control group over the summer season (p= 0.0001, 101 to 102 mmHg, 100 to 102mmHg, respectively) was noted**.** These results further support that school-based program intervention obesity prevention interventions can improve health outcomes among children (Hollar et al., 2010).

Effectiveness of a diet and physical activity promotion strategy on the prevention of obesity in Mexican school children

Levy and colleagues (2012) evaluated the effectiveness of a nutrition and physical activity strategy in maintaining the BMI values of 1020 5th grade school children in from 60 schools in Mexico. Half of them were assigned to the intervention group (IG) and the other half to the control group (CG). Those participants in the IG participated in six workshops designed to enhance and expand knowledge, foster proper food choices and increase physical activity. No significant differences were found in BMI or dietary intake between the control and intervention groups; however, nutrition knowledge increased significantly (p=.001). The researchers concluded that the intervention was effective in maintaining the BMI of school children (Levy et al., 2012).

Childhood obesity study: A pilot study of the effect of the nutrition education program color MyPyramid.

In 2009, Moore and associates examined the effect of Color MyPyramid, a nutrition education program, on children's nutrition knowledge, weight status, activity levels, and self-care practices. The researchers engaged 126 students of different grades from two school, where their weights were noted before and after the intervention program. Nutritional education and exercise content and activities were taught in the study, in which six classes were administered every week for three months. Participants received the education and activity content and using individual computers to evaluate their diets in small groups.

A significant increase was noted in nutritional knowledge in school one and two in both the pre-test and post-test studies (p=0.029). A general improvement in self-care practices among the participants was postulated to have contributed to the improvement in weight status of the students after the intervention. A significant increase in physical

activity time (p=.001) after the nutrition intervention among children in both schools was identified. Although no significant change in BMI was observed between the two schools, general improvement in students' health status was noted. The findings indicated that nutrition education program can be successfully employed in school and provided a foundation for how notion of self-care can be developed at a young age (Moore et al., 2009).

Mark, Set, Go! school-based nutrition and physical activity program: A five-year evaluation

Rayess and colleagues (2017) evaluated the impact of the nine-week Mark, Set Go!: A School-based Intervention, by assessing participants' knowledge, attitudes and behavior related to nutrition, physical activity and screen time. The study selected 954 fifth- and sixth-grade public school students. Pre- and post-test evaluations of the effectiveness of a nutritional education program analyzed paired data from pre/post intervention knowledge, attitude and behavior surveys, heights, weights and 24-hour pedometer recordings. The Mark, Set Go! curriculum, lesson plans were used to teach each class topics including energy, physical fitness, fat, and the food pyramid. Weekly sessions were given to train peer educators. Application of the intervention program showed an increased number of children participating in daily physical exercise, improvement in knowledge concerning negative impacts of consumption of unhealthy food substances, and an improvement in self-reported screen time among the students. The variations were noted to be more common among the female students. A statistically significant reduction (p=0.0088) in individual weight was also noted for the male students and all overweight students among the 443 children with paired BMI data. This

intervention was effective in improving participant knowledge, healthy behaviors and reducing BMI (Rayess et al, 2017).

Impact of a school-based intervention program on obesity risk factors in Mexican children

Safdie and associates (2013) measured the impact of an 18-month school obesity prevention intervention on health behaviors of 886 4th and 5th grade Mexican students enrolled in one of 27 participating schools Participants were assigned into one of three groups: basic intervention, plus interventions and control. School environment measures, such as children's eating and physical activity behaviors and BMI were assessed. Reduction of the energy content of school meals, the addition of fresh fruits and vegetables, more physical exercise, education for parents on how to prepare a healthy lunch, educational and skills-based workshops with vendors, and educational and skills-based workshops with children were implemented. The results indicated that the availability of healthy foods increased, unhealthy food availability decreased, and a decrease in BMI (kg/m2) in the Plus intervention ($p = .05$) was noted. The intervention improved the school health environment and children's healthy behaviors (Safdie et al, 2013).

Evaluation of the effectiveness of an intervention program on preventing childhood obesity in Denizli, Turkey.

In 2011, Sevinc and associates evaluated the efficiency of an eight-month nutrition education and physical activity intervention program for preventing obesity in 6847 primary school students. Participants in the Intervention Group received education

on nutrition for forty-five minutes three times weekly and were engaged in physical exercise for thirty minutes for four days a week. The results showed an increased BMI of 0.51 in the control group and an average of 0.36 in the corresponding intervention groups. BMI increase in intervention group was lower than that of the control group. The study supported the potential effectiveness of the intervention program in a reduction of the number of obese children in the region thus, it could be employed for global reduction of obesity prevalence (Sevinc et al, 2011).

Reducing risk factors for childhood obesity: The Tommie Smith Youth Athletic Initiative

In 2009, Topps and associates investigated if the Tommie Smith Youth Athletic Initiative (TSYAI), a 14-week after-school intervention program, could reduce the risk factors for childhood obesity among children aged 5 to 10. The TSYAI was used among sixty-three grade K-4 children in the United States. Each session consisted of two days of physical activity and a single day of forty-five-minute nutritional education that was followed by another forty-five-minute group physical exercise. Children who finalized the two data collection points (n=49, 78%) lost an average of 2.3 pounds; however, no significant difference in the BMI, fat weight, or waist-to-hip ratio were noted. The researcher summarized that the intervention strategy should be implemented in early development as it improved the children's dietary habits and involvement in physical activity that eventually reduced the number of obese children (Topp et al., 2009).

Evaluation of a comprehensive intervention with a behavioral modification strategy for childhood obesity prevention: a nonrandomized cluster-controlled trial

Wang and colleagues (2015) tested the implementation of a year-long comprehensive intervention aimed at lessening overweightness and obesity in Chinese learners (n=638). Participants were divided into one of four groups: the comprehensive intervention group (combination of physical activity and nutrition education); the PA only group; the diet only group (nutrition education program); and a control group. The intervention effects were assessed for BMI and blood pressure. The results indicated that in the comprehensive intervention group, the percentage of body fat showed a significant decrease (−1.01 %, p=.001) compared with the PA only, diet only or control groups. Systolic blood pressure decreased in the comprehensive intervention group as did diastolic blood pressure compared with the other groups. No significant adjusted changes in BMI and waist circumference were observed. The comprehensive program had positive effects on body fat percentage and blood pressure in overweight and obese Chinese children compared with the diet or PA only intervention groups (Wang et al, 2015).

Outcomes and Discussion

In all the research studies reviewed, the nutritional education and physical activity approaches were incorporated with the aim of more effectively managing obesity among children. As speculated, the success of the programs, as determined by reduction in BMI, weight, and/or blood pressure and/or increase in nutrition knowledge or physical activity, varied substantially by intervention strategy and program. Three characteristics (anthropometric measure, change in knowledge and behavior, and cardiovascular health) that were mostly commonly tested in the reviewed studies were further examined to determine the overall successfulness of the programs (see Table 3).

Table 3: Summary of Program Success Criteria

Categories	Successful programs[1]	Unsuccessful Programs[2]
Anthropometric Measure	13	3
Change in Knowledge and Behavior	**Successful Programs[3]**	**Unsuccessful Programs[4]**
	14	2
Physical Activity to Promote Cardiovascular Health	**Successful Programs[5]**	**Unsuccessful Programs[6]**
	10	6

[1] Significant reduction in BMI and WC
[2]No significant reduction in BMI and WC
[3] Increased nutritional knowledge and improved dietary behaviors
[4] No change in nutritional knowledge
[5] Significant difference in physical activity and screen time
[6] No significant difference in physical activity or screen time

Anthropometric Measures

Several anthropometric measures including Body Mass Index (BMI), hip circumference, waist circumference, waist:hip ratio, blood pressure, and body fat were assessed in the 16 reviewed study with BMI being assessed in all reviewed studies. The researcher categorized the studies as "Successful" if a significant reduction of BMI was noted. Thirteen of the studies noted a significant reduction in BMI post intervention (Amini et al., 2016; Bacardí-Gascon et al., 2012; Burke et al., 2014; Da Silva et al., 2013; Elizondo- Montemayor et al., 2013; Hoelscher et al., 2010; Hollar et al., 2010; Rayess et al. 2017; Sevinç et al., 2011; Safdie et al., 2013; Xu et al., 2015; Topp et al., 2009; Moore et al., 2009)

Several overarching themes were examined when reviewing the studies that noted a significant reduction in BMI and those did not. These themes include compliance with the intervention protocol, length of intervention, country of program, and gender. While limited compliance with the intervention protocol was noted in two studies (Sevinç et al., 2011; Xu et al.,2015), the overwhelming majority of the studies reviewed noted compliance with the program. Those studies in which limited compliance took place still saw a reduction in BMI and waist circumference (Sevinç et al., 2011; Xu et al.,2015).

Secondly, the length of the intervention did not appear to have an apparent relationship with the successful significant reduction in BMI. While two of the three programs with shorter intervention times of 9 and 14 weeks (Moore et al., 2009; Topp et al., 2014) didn't lead to a significant reduction in BMI, the study with the intervention time of 18 weeks did (Amini, et al., 2016). However, approximately as many studies that were between 4 months and 3 years in length were successful in terms of BMI reduction

as were not. Thus, the length of the intervention, alone, is not indicative of a significant reduction in BMI.

No differences were noted between the studies completed in the US and those outside of the US. Country of study, therefore, did not appear to have an apparent relationship with the success of a program. Furthermore, no differences in success rates were observed due to age of participants.

Finally, the reduction in BMI by gender varied by study. Two of the studies assessed BMI by gender with one of those studies finding a significant difference between the two genders (Silva et al., 2013; Rayess et al, 2017). This could be, in part due to the differences in the male and female body and their muscle versus fat content. The average BMI readings for boys in the intervention group remained stable after the intervention program was implemented while the BMI average increased by 0.6 in the comparison group (Silva et al., 2013). In the same study, the adiposity results indicated a notable reduction of fat percentiles among girls in the intervention group because they participated in physical exercise and consumed healthy foods after the respective health education.

Change in Knowledge and Behavior

All of the studies reviewed included a nutrition education component designed to enhance the nutritional knowledge of the participant and/or to improve a specific dietary behavior, such as reduction of sugar-sweetened beverages (Bacardi-Gascorn et al., 2012; Safdie et al., 2013) or the increase in the consumption of fruits and vegetables (Topp et al., 2009; Crespo, et al., 2012) Fourteen of the studies noted significant differences in either knowledge gained or improvement in dietary behaviors. Upon further critical reflection of the reviewed studies that yielded positive changes in knowledge and/or

dietary behavior change, two common themes emerged: the inclusion of more than just the child in the intervention, i.e. the parents, families, and the larger school environment and the diversity of the learning activities that were age-appropriate.

Several studies (Burke et a., 2014; Safdie et al., 2013; Xu et al., 2015) included not only the children but also the families and the larger school environment. The success of the HealthMPowers program by Burke et al. (2014) enabled modifications in school policies and regulations in the promotion of heathy lifestyle. Xu and colleagues (2015) focused on the availability of healthy food options like fruits and vegetables. Safdie and colleagues (2013) also worked to increase healthy food options in the school environment as well as in the home environment by training parents to make healthy snacks for their children.

Programs that successfully took environmental factors, such as diet, exercise routine, school, and familial relationships, into consideration in their research process achieved the best results. An effective environmental intervention conducted on parents and children in elementary schools by Hoelscher et al., (2010) and Hollar et al., (2010) showed an improvement in the health status of the pupils in the Intervention Group. the number of participants who were obese or overweight was decreased by 8.5 % after the implementation of the program. The positive changes are a result of increased consumption of vegetables, decreased intake of sweetened and salted snacks, reduction in sedentary lifestyle among the participants, and increased participation in physical activity. Variation in results of the study from those of previous studies could be a result of differences in school environmental rules and time taken for the intervention. Additionally, studies by Xu et al. (2015) indicate that children regularly engage in

physical activity, increase their active commuting mode, minimize consumption of red-fatty meat, and spend less time working with computers or watching TV after the intervention programs thus significantly reducing the prevalence of obesity among the participants.

Parents were also equipped with dietary and physical activity knowledge, which were to be used to take care of their children. Elizondo-Montemayor et al (2013) determined that the involvement of parents in nutritional education programs effectively helped in the reduction of the number of obese and overweight children (Elizondo - Montemayor et al, 2013). Some parents are not knowledgeable about the kind of nutritional foods that children need to be offered as they grow, thus educating them on healthy living improves their children's weight. In four of the studies, parents were initially taught the types of healthy and unhealthy diets and advised to increase the quantities of fresh vegetables and fruits that they give to their young children (Levy et al., 2012: Wang et al., 2015: Hoelscher et al., 2010: Burke et al., 2014; Crespo et al. 2012). Keeping parents of participants informed of the program requirements better enabled them to assist their children with healthy eating habits and exercise. Without the cooperation of parents, the authors suggested that the execution of new eating behaviors may not been achieved. Additionally, teachers were instrumental in providing students with necessary lessons on both eating behaviors and exercising (Moore et al., 2009; Sevinç et al., 2011; Da Silva et al., 2013; Burke et al., 2014; Bacardí-Gascon et al., 2012; Safdie et al., 2013; Crespo et al., 2012; Hollar et al., 2010; Levy et al,. 2012). The researchers noted that school-based programs improved children's activity and their eating habits. Technological intervention also minimized incidences of obesity among

children as they can read some of the tips for healthy lifestyles on various computer platforms (Topp et al., 2009; Moore et al., 2009).

In research by Wang et al. (2015) and Burke et al. (2014), the majority of the children studied came from families of lower socioeconomic status. Such families were not able to provide balanced food with sufficient amounts of vegetables and fruits for their children after school. Children only consumed quality and nutritional food products while in the school environment. Significant changes in weights among children in the intervention groups and the control groups were noted.

A variety of learning activities were included in the reviewed studies. These included fun, physical activities such as extracurricular sports, meal planning, and nutritional curriculum. Programs that included hands-on activities, such as preparation of snacks and meals provided opportunities for children and parents to learn together and implement healthier behaviors into their lifestyles (Da Silva, et al., 2013; Safdie et al., 2013).

Physical Activity in the Promotion of Cardiovascular Health

Seventy percent (n=10) of the reviewed studies included a cardiovascular health component, such as increased time spent engaging in physical activity either during recess, after-school, or during scheduled physical education course or a decreased amount of time spent viewing a screen (Amini et al.,2016; Burke et al., 2014; Crespo et al., 2012; Da Silva et al., 2013; Elizondo- Montemayor et al., 2013; Moore et al., 2009; Levy et al., 2012; Topp et al., 2009; Xu et al., 2015; Wang et al., 2015). Twenty percent (n=2) of the studies with a cardiovascular fitness component included at least one significant

improvement in a cardiovascular health measure with sixty percent (n=6) showing a significant improvement in two or more measures.

For the programs that successfully intervened in the cardiovascular health of the participants, the researchers were able to encourage self-dependency of the children in planning their own physical activities. Most researchers gave the participants an opportunity to engage in as many activities as possible. Also, children were taught to engage in personal care (Moore et al., 2009). Notably, Moore et al. (2009) were able to motivate the school-going children to participate in physical activities and, additionally, taught them to support each other in enhancing independent self-care.

Chapter 4

Conclusion

The results of this study suggest that manipulation of the school-based programs, physical activity, and nutritional education significantly reduce the prevalence of obesity among children. By offering sufficient nutritional education, schools can combat the prevalence of obesity in their students. Limiting unhealthy food choices and providing balanced healthy foods is also correlated, in conjunction with proper nutritional education, with reducing the occurrence of obesity and its comorbidities. Schools can reduce the prevalence of obesity-related diseases by encouraging physical activity and providing their students with accountability. By involving parents and the community in these interventions, schools can truly provide their students with the context to become healthy children, free from the effects of a sedentary, unhealthy lifestyle.

Limitations

The current study focuses on the context of nutrition and physical education among obese children. The study considered lack of physical activity and unhealthy diet as major risk factors for obesity. However, the factors that accounted for maternal obesity and family lifestyle were not addressed. Additionally, some studies did not include any control conditions, such as control groups in the methodology in order to compare results; this makes it difficult to determine whether the improvement in dietary habits, cardiovascular health and body compositions identified in the findings resulted from the intervention or from other confounding factors.

This study assessed the possible adverse outcomes of intervention programs. Besides known adverse effects, such as gaining or losing weight, very few studies have

explored the adverse psychological outcomes of such interventions. This is an area that needs to be investigated. The overall findings of the systematic review indicate that intervention programs should include nutrition education and physical activities in conjunction. The studies did not include recommendations for actual time that should be given to nutrition education and physical activities in the intervention programs. They could not clearly point out how long a successful intervention program is supposed to take, though they highlighted an average duration of about eight months. There is, therefore, a need for more in-depth studies in this particular area. There is also a need for long-term and follow-up studies to evaluate whether these programs are sustainable. Studies have also produced mixed results regarding gender, for which there is no practical solution. Future interventions and studies should therefore put gender into consideration. Age of students was also not discussed as being related to successful program completion. Age may factor in to program compliance as well as lifestyle, so future studies should investigate its effect on program adherence.

Recommendations for Future Research

Obesity is a lifestyle disease that has been linked to the increasing prevalence of cardiovascular disorders and diseases, such as heart failure, hypertension, and even diabetes (Gundersen, Kreider, & Pepper, 2012). The condition has become a global problem as children as young as five years suffer from its effects and develop reduced self-esteem (Jeong et al. 2015). However, the problem can be contained with the effective incorporation of several intervention strategies such as school-based programs, physical exercise, and the promotion of self-care (Moore et al., 2009). Since learning institutions are the most significant place where children spend their time, school-based programs should be adjusted to ensure that causes of obesity are prevented. Moreover, these interventions should be based on the children's cognitive

development so that they are most effective in producing an understanding of nutrition and physical education's benefits.

Provision or accessibility to sweetened drinks, salted snacks, red meat, and junk foods such as chips should be restricted within the learning environment (Xu et al.,2015). The government could set laws and regulations that restrict the marketing of unhealthy food products or drinks to young children. Additionally, programs in which schools are able to provide healthy options for their students should be implemented (Safdie et al., 2013). Various community agencies and community members could also be involved to create awareness of the increasing prevalence of obesity among children and develop ways of preventing further incidence.

Based on the Socio-ecological model, community-based partnerships will effectively help address the challenge of obesity as the expansion of intervention programs are observed to ensure appropriate nutrition and healthy living among children even when they are outside the school environment (Bandura, 1986). Disparity in income status for different families is noted to also contribute to obesity as some families are not able to adequately provide balanced food for their children. Due to this challenge, a multi-level intervention strategy should be engaged to overcome the problem. Children should continue to be taught the importance of engagement in physical exercise and the risks that are associated with unhealthy lifestyles with parental guidance and knowledge being paramount. A healthy lifestyle is a lifelong process. Therefore, this analysis should be used as a guide to promote healthy lifestyles among children for an increased lifespan.

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