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The Effect of Social Cognitive Theory-Based Interventions on Dietary Behavior within Children

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Abstract

Background and Objective: According to the World Health Organization (WHO), childhood obesity is one of the most serious public health challenges of the 21st century. Both behavioral and environmental factors have been shown to contribute to children's eating behavior. Furthermore, researchers propose that personal factors such as self-esteem and self-efficacy are also key influences. Findings suggests that nutrition education programs may be more effective if it is derived from theoretically sound information. Bandura's Social Cognitive Theory (SCT) is an interpersonal theory that emphasizes how environmental and personal characteristics influence behavior. SCT is one of the most commonly used theoretical frameworks underlying interventions to promote physical activity and healthy eating and prevent obesity in youth, however, no review of the literature examines the efficacy of individual SCT strategies on obesity prevention and dietary behavior modification within children and adolescents. Therefore, the purpose of this review was to test the effectiveness of SCT strategies in explaining health behavior to prevent childhood obesity around the world.

Methods: A total of 16 studies that focused on health behavior change and/or physical activity within children were reviewed. Articles were categorized based on research design, individual SCT principles, including, Environmental, Cognitive, Behavioral, in addition to behavior change and/or BMI outcome effects.

Results: All of the articles reported at least one SCT principle. However, methods and procedures varied vastly among the studies. There was a total of nine randomized control studies, three case-control studies and four cross-sectional studies. The studies revealed consistent significant correlations between behavioral factors and dietary behavior within children, such as reports of high self-efficacy being related to increased intake of fruits and vegetables and lower intake of fat, sugar and sodium. Significant correlations also existed between environmental factors (Socio Economic Status (SES), parental influence and school cafeteria) and dietary behavior within children, including low SES being related to poorer nutrition knowledge and higher BMIs and parental influence effecting the accessibility of fruits and vegetables. Results also showed that cognitive factors played a role in influencing dietary behavior by increasing one's nutrition knowledge and self-efficacy to choose healthier foods.

Conclusion: Although methods and procedures are varied, current literature suggests that environmental, cognitive and behavioral factors act together to influence children's nutrition knowledge, self-efficacy and healthy lifestyle choices. It is important to note that not one factor alone influences dietary behavior change, but instead a continuum of factors working together. Future research needs to define and practice the same methods and procedures in order to gain consistent results and better control for confounding variables.

Keywords: Childhood Obesity; Social Cognitive Theory; Nutrition Behavior;

Abbreviations

BMI: Body Mass Index; CATCH: Child and Adolescent Trial for Cardiovascular Health; SCT: Social Cognitive Theory; SES: Socio Economic Status; SPSS: Analytical Software;

Introduction

Obesity is defined as a condition of excess body fat, resulting from excessive energy intake that leads to serious health consequences, including increased risk for cardiovascular disease, type 2 diabetes, stroke and different types of cancer [1, 2]. It is commonly assessed by using Body Mass Index (BMI), which is one's weight in kilograms divided by the square of one's height in meters (kg/m^2) [1].

Many children today grow up in a sedentary world that promotes inactivity along with intake of calorically dense, nutrient poor foods [3-5]. This excessive energy consumption, combined with physical inactivity has led to the global epidemic of childhood obesity [6]. The World Health Organization [1] reports that childhood obesity is one of the most serious public health challenges of the 21st century, with an estimated 170 million overweight and obese children around the world (children are defined by being less than or equal to 18 years of age). According to the U.S. Center for Disease and Control [6], the U.S. alone spent an estimated $147 billion on obesity-related medical costs, nearly 9% of all U.S. health expenditures.

Causes of childhood obesity include environmental, behavioral and personal factors that often act in combination [7-9]. Environmental factors include life at home, parenting style, peer influence and school/community setting. Behavior factors involve one's choice of foods and food acceptance, whereas personal factors include nutrition knowledge and self-efficacy, which is an individual's confidence in performing a particular behavior and overcoming barriers to that behavior [7, 10].

Improvement in youths' dietary habits will reinforce beneficial long-term nutrition behavior to effectively protect against

excessive weight gain and future development of obesity-related diseases [11-14]. Keep in mind however, childhood nutrition interventions are not a "one size fits all" matter. Programs must be tailored to specific ages and/or cultural groups and become incorporated into the family, school and community setting, in order to improve effectiveness [15, 16].

Bandura's Social Cognitive Theory (SCT) is an interpersonal theory that emphasizes mutual interactions of persons, behavior, and environment [17]. Accordingly, this theory proposes that environmental and personal characteristics influence behavior [14]. Therefore, nutrition intervention studies have decided to use principles of Social Cognitive Theory (SCT) to measure one's ability to participate in beneficial nutrition behavior and explain how other variables, such as self-regulation and self-efficacy are essential to integrating healthier nutrition into lifestyles [9, 10].

According to Bandura [17], nutrition interventions are more successful if they:

1. Strengthen individuals' knowledge of the topic, such as understanding the benefits of a healthy diet
2. Improve environmental factors, including family/peer social support
3. Encourage self-efficacy, by fostering confidence in performing a specific behavior
4. Develop the use of self-regulatory behaviors by means of modeling behavior and interactive learning
5. Interventions are appropriately tailored for demographic groups.

SCT is the one of the most commonly used theoretical frameworks in interventions to promote behavior change, however, no review of the literature examines the efficacy of nutrition interventions based on specific SCT concepts (i.e. cognitive, environmental and behavioral) on preventing childhood obesity and improving health behavior within children. This is important because poor nutrition habits are often observed among this population [1, 18]. Therefore, the aim of this review was to examine the effectiveness of SCT-based interventions based on improving health behavior within children around the world.

Methods

Articles were searched on Psych Info, PubMed and Social Services Abstracts using key terms such as "social cognitive theory" and "obesity" with a published date between January 1996 to September 2015. The primary search from each database combined yielded 308 articles that were further evaluated based on whether or not the title obtained the words, "children," and/or "adolescents" and were also published between 1996 and 2015. After further review, 68 articles were read to determine whether or not they met the final inclusion criteria, which consisted of original studies that obtained at least 15 subjects and provided substantive information regarding social cognitive theory strategies and its efficacy on modifying health behavior for children, including better dietary choices and increased physical activity. The final selection yielded 16 articles. The efficacy of social cognitive theory components on improving health behavior in children were summarized (Table 1). Studies that used validated nutrition education techniques and/or questionnaires along with multilevel linear regression models were evaluated to compare SCT strategies to anthropometric and/or behavior modification outcomes. P values of <0.05 were considered statistically significant. All analyses in the reviewed studies were completed using SAS or SPSS software.

Results

The studies chosen and analyzed for this review focused on children's' (ages 4-18 years old) ability to learn nutrition knowledge, environmental effects on making better health choices such as increasing intake of fruits and vegetable intake and lowering intake of foods high in fat and sugar, improving self-efficacy and increasing physical activity and/or measureable outcomes such as BMI. Studies used either an intervention followed by a series of pre- and post-tests and/or questionnaires and/or a single administered questionnaire with no intervention. The purpose of each study was to determine statistically significant relationships between cognitive, behavioral and environmental factors with one's attitude and/or ability for participating in optimal health behaviors, including better dietary choices and improved physical activity (Table 1).

a. Cognitive Factors

Adequate nutrition knowledge is essential for an individual to assess their own diet quality, in order to compare it to accepted norms, especially in regards to social influence by peers and/or parents [12, 13]. However, it is unknown whether nutritional knowledge alone influences food choices and behavior [7, 12].

A cross-sectional study conducted by Gracey et al. [12] sought to determine high school students' nutritional knowledge in relation to dietary patterns. Students were given a questionnaire including eight items on nutritional knowledge, and seven items on eating patterns; results showed that there was a significant relationship between students' food variety scores and their nutritional knowledge scores ($p<0.05$), indicating that if a student presented with a high nutritional knowledge score, s/he would more like have more variety in their diet – hence more "balanced" nutrition. Studies also showed significant correlation between nutrition knowledge and dietary self-efficacy and better improvements in overall dietary behavior in children [19-21].

The purpose of the study conducted by Cortes et al. [11] was to understand the effect of nutrition education on changes in shopping practices among 20, low-income, Latino families. Nutrition education consisted of three to five home visits and a supermarket tour. Researchers analyzed grocery store receipts at the beginning and end of baseline and measured nutritional content. Findings indicated that families decreased the total number of calories ($p=0.008$) from baseline to post-education.

On the other hand, a randomized control trial by Kocken et al. [13] examined the effects of school lessons about healthy food on

Table 1: Studies Examining Effects of Cognitive, Behavioral and Environmental Components on Health Behaviors

Reference/ Research Design	Sample	Location/ Duration	Environment Component	Cognitive Component	Behavior Component	Results
Coleman et al., 2005/ RCT [22]	n=896 I=423 C=473	El Paso, TX 8 schools 2 years	• Food policies implemented to lower fat and sodium in school food	• NE based on current knowledgev	• PE activities • Eat Smart activities	• n.s. effect on BMI or waist to hip ratio • Higher participation in MVPA compared to control (p<0.01) • Lower fat content in school lunches compared to control (p<0.01)
Coleman et al., 2010/ Case Control [15]	n= 144	La Jolla, CA 1 school 10 weeks Ten 90-minute sessions	• Parental demonstrations • Healthy meals cookbook • Identified perceived benefits of eating healthy	• Food demonstrations • Healthy meals cookbook • Identified perceived benefits of eating healthy	• Practice of bringing healthy snacks to class	• n.s effect on BMI • Significant increase in self-reported PA (p<0.01). • Significant increase in knowledge regarding healthy lifestyles (p<0.008) • Significant increase in V intake (p<0.01)
Cortes et al., 2013/ Case Control [11]	n=95	Massachusetts 20 low-income Families 16 months 3-5 sessions	• Home visits • Grocery store tours • Family-centered approach	• NE based on current knowledge • Identified perceived benefits of eating healthy and avoiding sugary drinks	• Participant observations • Practice of reading nutrition labels • Choosing healthy option in the grocery store	• n.s. effect in total calories from sugary beverages • Near significant decrease in calories from processed foods (p=0.06) • Families decreased the total number of calories (p<0.009) and calories per dollar (p<0.009)
Cusatis & Shannon, 1996/ Cross-sectional [18]	n=242 M:107 F:137	Eastern Pennsylvania 1 school	• Students conformity to peers & conformity to parents scales	• Self-esteem & Self- image questionnaire	• Self-efficacy scale • FFQ	• Males: High levels of self-efficacy was associated with low consumption of high-fat and high-sugar foods (p<0.001) • Females: High levels of self-efficacy was associated with low consumption of high-sugar foods (p=0.008) • Children who ate in the cafeteria reported eating significantly more fat and sugar (p<0.02).
Fahlman et al., 2008/ RCT [19]	n=576 I=407 C=169	Michigan18 schools1 month8 lessons	• Navigating fast- food restaurants and the school cafeteria • Peer presentation on health benefits of each food group	• NE based on current knowledge • Identified perceived benefits of each food group • Recognize range of body types to promote positive body image	• Practice of reading nutrition labels • Gather nutrition information from local food stores • Select new foods from each food group to add to diet • Find differences b/w foods that are nutrient dense and foods that are low in nutrients	• Intervention group ate significantly more FV compared to control (p<0.05) • Intervention group demonstrated significant improvement in nutrition knowledge compared to control (p<0.001). • Intervention group significantly improved self-efficacy compared to control (p<0.002).
Fitzgibbon et al., 2006/ RCT [3]	n=389 I=196 C=193	Chicago, IL 12 schools 2 years	• Parents received weekly newsletters mirroring the children's curriculum • Interactive homework assignments b/w parents and children	• NE based on current knowledge • Culturally proficient curriculum for Latin community	• Aerobic activities • Nutrition activities through use of hand puppets from each food group	• n.s. effects for change in BMI (p=0.89) • n.s. differences between groups with reported dietary intake and physical activity

Gracey et al., 1996/ Cross-sectional [12]	n=391 M:191 F:200	Perth, Australia 3 schools	• Barriers to change questionnaire • SES measurement	• Health beliefs and values questionnaire • Nutrition knowledge questionnaire	• Self-efficacy questionnaire • FFQ	• n.s. differences in self-efficacy and healthy food choices between schools • Children with higher self efficacy reported healthier food choices compared to children with low self-efficacy ($p<0.05$) • Children from low SES schools had significantly higher BMIs compared to students from Private and High SES schools ($p<0.05$). • Significantly more females than males believed that benefits of a healthy diet r/t to improving health, feeling good about oneself, weight control, improving appearance & feeling energetic ($p<0.05$)
Kocken et al., 2015/RCT [13]	n=614 I=303 C=311	Netherlands 26 schools 5 lessons	• Lower calorie foods in school vending • machines Food labeling of vending machine foods • Lower prices for lower- calorie foods	• NE based on current knowledge • Tips on how to choose healthier foods in school • Perceived benefits of avoiding soft drinks	• Interactive board games to make healthy food choices • Self-evaluation of food and beverage choices	• Significant difference in nutrition knowledge between groups ($p<0.01$) • Significant difference in soft drink consumption from home between groups ($p<0.05$)
Long & Stevens, 2004/RCT [25]	n=121 I=63 C=58	2 schools 1 month 15 hours	• Peer discussion about which foods are healthy	NE based on current knowledge Perceived benefits of having a healthy diet	Interactive web- based games to choose healthy food options Students moved at their own pace to complete activities	• n.s. effects between groups for FV and fat consumption. • Students in intervention group had higher self-efficacy for healthy eating of FV ($p<0.001$) • Significant effects with intervention group for self-efficacy for healthy eating of lower fat ($p<0.001$). • Significant effects for dietary knowledge of fat with intervention group compared to control ($p<0.05$). • Significant relationship between self-efficacy for lower-fat and fat consumption ($p<0.01$).
Najimi & Ghaffari, 2013/ RCT [14]	n=130 I=63 C=67	Isfahan 4 schools 1 month 4 sessions	• Najimi & Ghaffari, parents • Peer discussion about FV intake • Observation of parents cooking food	• NE based on current knowledge • Perceived benefits of consuming FV	• Practice preparing foods with FV • Taste testing new FV	• Significant improvements in intervention group: Nutrition Knowledge ($p<0.001$), self-efficacy in difficult situations ($p<0.05$), self efficacy in selecting FV ($p<0.01$), social support ($p<0.05$), and observational learning ($p<0.003$) • Significant improvement on mean daily intake of fruits and vegetables in the intervention group ($p<0.001$).

O'Dea & Wilson, 2006/ Cross-Sectional [20]	n=4441	Australia Schools in all states	• Identification of SES	• Nutrition nowledge questionnaire • Perceived benefits of PA questionnaire	• Self-efficacy questionnaire • FFQ	• n.s. associations b/w SES and dietary self-efficacy • n.s. relationship b/w importance of PA beliefs and BMI • Significant correlation between nutrition knowledge and dietary self-efficacy with BMI ($p<0.01$) • Low SES children had significantly greater BMIs ($p<0.01$) and poorer nutrition knowledge ($p<0.01$).
Pérez-Lizaur, Kaufer-Horwitz & Plazas, 2008/ Cross- sectional [7]	n=327 M:163 F:164	Mexico City 2 schools	• Assessment of FV accessibility	• Nutrition knowledge questionnaire • Expectancies questionnaire • Food preference/ attitude questionnaire	• Self-efficacy questionnaire • FFQ	• n/s. association b/w nutrition knowledge and FV consumption Significant correlation b/w mother eing responsible for cooking and FV consumption ($p<0.02$) • Significant correlation b/w accessibility to FV and FV consumption ($p<0.01$) • Significant relationship b/w preference to V & FV consumption ($p<0.03$) • Significant relationship b/w self-efficacy & FV consumption ($p<0.05$)
Perry et al., 1998/ RCT [23]	n=977 I=441 C=536	St. Paul, MN 20 schools 8 weeks 16 lessons	• Team competition to eat FV among peers • Interactive parent-student homework assignments • Improved school policy offering morve FV	• NE based on current knowledge	• Snack preparation • Taste- testing	• n.s. difference in total fat consumption between groups • Significant increase in FV consumption compared to control ($p=0.05$)
Raby Powers et al., 2005/ RCT [21]	n=1100 I=702 C=398	Alabama 64 schools 8 weeks 6 lessons	• Nutrition educators of classes served as role models, eating with the students in the lunchroom • Discussion with peers on how to properly set table with correct foods	• NE based on current knowledge • Classes focused on dairy consumption, FV intake, Food Guide Pyramid knowledge, nutrient-food association and nutrient-job association	• Self-evaluation of dietary behavior • Interactive board game component on how to properly set table • Practice skills on how to select healthy foods at school and home	• Children in the intervention group had significantly better improvements in overall dietary behavior compared to control Children in the ($p<0.001$). • Children in the intervention group exhibited significantly greater improvements in overall nutrition knowledge compared to control ($p<0.001$).
Rinderknecht & Smith, 2004/ Case-control [9]	n=104	Minneapolis, MN 1 afterschool program 7 months 7 sessions	• Exposing students to more healthful foods • Participate learning activities w/ peer groups • After school dinner menus modified to be lower in fat & higher in FV • Water or juice offered instead of soda	• NE based on current knowledge & experiences • Discussing ways to achieve balance through healthy eating & PA	• Provide opportunities to choose more healthful alternatives (taste-testing)	• n.s. effect on BMI • n.s. effect of self-efficacy and improved dietary behavior • Overweight children significantly improved their dietary self-efficacy($p<0.02$)

te Velde et al., 2008/ RCT [24]	n=1492 I=798 C=674	Norway, Spain, Netherlands 62 schools 2 years	• Provision of free FV in the school cafeteria • Special FV snack break given at school • Parental newsletters on how to encourage FV intake for their children • Local media was used to raise awareness	• NE based on current knowledge • Classes on recommended FV intake • Technology-based FV education software • FV cookbook	• Taught specific skills to prepare or ask for FV • Self-evaluation of current FV intake	• Significant intervention effects for FV intake at first follow-up in total sample. ($p<0.05$) • 2 year follow-up, a significant impact was only observed in Norway ($p<0.02$) • n.s. effect for FV intake at 2 year f/u for Spain or Netherlands

BMI=Body Mass Index, C=Control, F=female, FFQ=Food Frequency Questionnaire, f/u=follow up, FV=Fruits and Vegetables, I=Intervention, M=Male, MVPA=Moderate to Vigorous Physical Activity, NE=Nutrition Education, PA=Physical Activity, RCT=Randomized Control Trial, SES=Socio Economic Status

303 children's self-reported beliefs and behavior regarding the purchase and consumption of soft drinks, water and extra foods, including sweets and snacks. In addition to the lessons, children were also introduced to lower-calorie foods, food labeling and price reductions in school vending machines. Results showed that students' knowledge on energy intake and portion sizes was significantly affected after implementing the lessons ($p<0.01$), however, there was so significant relationship between nutritional knowledge and influence on eating behavior.

b. Environmental Factors

Currently, many children live in environments that promote inactivity and the consumption of foods high in fat and sugar [3]. Studies have reported the importance of environmental factors on influencing children's dietary habits [7, 16-18]. Environmental factors can include school and community settings and/or parental and peer influence. However, research varies in identifying if environmental factors prove successful at improving children's self-reported healthy behaviors and decreasing risk of overweight or childhood obesity [3, 12, 15, 22].

A cross-sectional study by Perez-Lizaur et al. [7] examined the correlation between personal and environmental factors and their relationship to children's fruit and vegetable consumption through use of a validated questionnaire (n=327). Researchers found that the environmental factors that influenced fruit and vegetable intake included the mother being responsible for cooking at home ($p<0.02$) and accessibility to fruit and vegetables ($p<0.01$). It's important to note however, that this study only observed correlations between factors; overall, this population still showed below recommended fruit and vegetable intake. Studies also have shown that interactive parent-student homework assignments and school policy offering more fruit and vegetable increased fruit and vegetable consumption in children [23, 24].

Peer and parental influence serves as a potential factor in determining children's behaviors related to nutrition and health. A randomized control trial conducted by Taylor et al. [13] sought to evaluate a community-based intensive nutrition education project and its effect on improving nutrition related behaviors for Hispanic mothers of pre-school aged children through use of peer educators. Hispanic grandmother figures (abuelas), who have respected positions within the Hispanic family and community were chosen as peer educators to deliver nutrition education lessons (n=36). The study consisted of an evaluation group (n=337) and a control group (n=*52*). The program used pre- and post-tests to evaluate knowledge, skills and behaviors related to healthy lifestyles. Results confirmed that program participants significantly improved their nutrition-related knowledge and behavior by improving overall total knowledge/skill score from baseline, to post-intervention and 6-month follow-up ($p<0.001$) and being able to select and prepare healthier meals from baseline, to post-intervention and 6-month follow-up ($p<0.001$).

The school environment provides an ideal setting to promote healthy eating behaviors and discourage a sedentary lifestyle [3]. In particular, research suggests that the school cafeteria proves influential in determining children's diet behavior, ultimately influencing children's' risk for obesity [18]. A cross-sectional study by Cusatis & Shannon [18] guided by Bandura's Social Cognitive Theory, examined the relationship between adolescent eating behavior and environmental factors. After surveying 342 high school students, results showed that students who reported eating food from the cafeteria had significantly greater intake of fat and sugar with male students' fat intake ($p<0.01$) and sugar intake ($p<0.02$) and female students' fat intake ($p<0.001$) and sugar intake ($p<0.01$). Peer discussion at school about which foods are healthy improves self-efficacy for healthy eating of lower fat consumption ($p<0.01$) and more consumption of fruits and vegetables ($p<0.001$) [25].

As previously mentioned, BMI is used to identify risk for childhood obesity. Researchers seek to find if certain environmental factors increase children's risk for excessive weight gain, leading to overweight or obesity. Coleman et al. [22] conducted a randomized control study in order to examine the effect of a community-based, national health program, CATCH (Child and Adolescent Trial for Cardiovascular Health) on children's health. Participants included 474 control schools (224 girls, n=224 and boys, n=249) and 434 CATCH schools (girls, n=199 and boys, n=224). Primary health outcomes (overweight, BMI and waist-to-hip ratio) were measured at the third, fourth and fifth grade levels. Results concluded that girls in control schools had a significantly greater increase of overweight status from third to fifth grade (13%) compared to girls in CATCH

schools (2%). In addition, boys from control schools also had higher increase in overweight (9%) compared to boys from CATCH schools (1%) from third to fifth grade.

A few years later, the same researchers, Coleman et al. [15] decided to test the effectiveness of a different health program delivered within the elementary school setting, except this time, with a focus on diabetes prevention along with parental involvement; primary outcomes included measuring parent's (*n*=38) and children's (*n*=44) BMI along with parent's self-reported eating behavior. Classes were composed of ten sessions, starting with 30 minutes of physical activity, followed by 1 hour providing lessons on healthy lifestyle and prevention of Type II diabetes. The child class lectures included educational materials and activities appropriate for each age group (0-5 years and 6-13 years); parents also participated in separate lectures with similar class topics. Then, BMI was measured at the beginning and end of the 10-week intervention for all children and parents by measuring weight in kilograms and height in centimeters. Results showed that there was no significant change in BMI for either parents or children from baseline to the end of the program. However, parents did report eating more servings of vegetables after participating in the program ($p<0.01$).

c. Behavioral Factors

Another component of Bandura's Social Cognitive Theory, behavioral factors including the cornerstone to Bandura's theory, self-efficacy [17]. Self-efficacy includes one's belief in themselves to accomplish certain tasks [17]. According to Bandura, self-efficacy is a central construct that is integral to the interrelationship between personal, environmental and behavioral factors [6]. Of importance, research shows that self-efficacy is correlated with dietary habits within children including improvement in self confidence in choosing more healthful foods and increasing fruit and vegetable consumption [7, 9, 18, 26].

Rinderknecht et al. [9] conducted a 7-month intervention study in order to improve dietary self-efficacy of children ages 5-18 years old. Researchers hypothesized that the nutrition intervention would improve children's dietary self-efficacy and decrease their fat and sugar intake compared to children who had no improvement in self-efficacy. 154 participants completed a pre- and post-intervention questionnaire and were measured for height, weight and BMI. Results showed that children exhibited moderate levels of dietary self-efficacy at baseline, with no variation in BMI; the nutrition intervention significantly improved the self-efficacy of children ages 5-10 years old ($p<0.003$) – especially for those children who were already obese (BMI > 95th percentile for age, $p<0.02$). However, the intervention was not successful among children ages 11-18 years old and did not decrease fat/sugar intake. Researchers propose that this population may be constrained by peer influence on food choices and use of food as a reward [9].

On the other hand, Cusatis & Shannon [18] examined the relationship between children's diet behavior and reported self-efficacy. 242 high school students completed a questionnaire regarding fat and sugar intake and personal factors including subject's body image, self-esteem and self-efficacy for healthy eating behavior. Results showed that for males, were was a significant relationship between fat and sugar intake and student's self-efficacy ($p<0.0001$). For females, only sugar intake was significantly associated with perceived self-efficacy ($p<0.008$).

A randomized control study by Najimi & Ghaffari [14], surveyed the effect of SCT-based nutrition education on fruit and vegetable consumption among 4th grade students during a 12-week period. Student were randomized into intervention (*n*=68) and control groups (*n*=70), with data collected at the beginning and end of the 3-month intervention. Results revealed that the intervention group had significantly improved scores regarding self-efficacy in difficult situations ($p=0.04$) and self-efficacy in selecting fruits and vegetables ($p=0.01$). More importantly, they also found that the intervention group consumed significantly more fruits and vegetables compared to control, post-intervention ($p<0.001$). These results support Bandura's theory that self-efficacy plays a role in influencing behavior, especially self-efficacy specific for healthy eating as a significant predictor of actual eating behavior.

Discussion

The prevalence of childhood obesity is continuing to rise over years and it has become a global issue [27]. Causes of childhood obesity can be categorized into behavioral, environmental and personal factors, which coincide to components found in Bandura's Social Cognitive Theory (SCT). This theory not only seeks to define variables leading to behavior change but also seeks to explain the relationship that exist among them. The purpose of this review was to examine the effectiveness of nutrition interventions based on individual SCT components (environmental and personal variables) in improving dietary behavior and health outcomes to prevent obesity within children (18 years old).

a. Cognitive Factors

Bandura defines knowledge as the basis for behavior change. Although the studies done by Gracey et al. [12] and Cortes et al. [11] noted a correlation between food choice and nutritional knowledge, study by Kocken et al. [13] found nutrition knowledge increased after being exposed to nutrition education, however there was no significant relationship with nutrition knowledge and actual dietary behavior. These varying results, suggest that knowledge alone may not be responsible for changing children's eating behavior. This could be due to confounding variables, including social environment and self-esteem along with the risk self-reporting error.

b. Environmental Factors

When examining the effect of environmental factors on behavior change, results revealed that environmental factors such as schools and family may provide as an ideal setting to promote healthy eating behaviors, but might not be effective in preventing excessive weight gain. Studies found that children's

fat and sugar intake was significantly correlated to reporting eating food from the school cafeteria; meanwhile, nutrition interventions that used peer nutrition education proved to be successful in modifying food purchases and preparations by children's families [16]. On the other hand, other school-based interventions showed no improvement in children's BMI, one of the main determinants of overweight, obesity and risk for obesity [15].

c. Behavioral Factors

While looking at behavioral factors such as self-efficacy in determining nutrition-related behavior change, there appeared to be a positive correlation between one's perceived self-efficacy and one's ability to choose healthy foods and participate in healthy activities. However, there does seem to be slight differences between males and females regarding self reported self-efficacy. Study by Cusatis & Shannon [18] showed significant relationship for self-efficacy and sugar intake among male and female high school students, but only a significant correlation between self-efficacy and fat intake among males. This suggest that future research should consider gender differences when determining nutrition interventions.

In conclusion studies from this paper appear to suggest that environmental, cognitive and behavioral factors act together to influence children's dietary conduct in regards to food choices and healthy lifestyle choices. Further research should be done to better control for confounding variables in order to determine if any of these individual factors alone can change nutrition behavior. Once better understood, factors from Bandura's social cognitive theory could prove as useful when developing nutrition programs for children in order to improve food choices and decrease children's risk of obesity.

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