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## Dietary Education in School-Based Childhood Obesity Prevention Programs

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## Dietary Education in School-Based Childhood Obesity Prevention Programs<sup>1,2</sup>

### Manoj Sharma\*

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### **ABSTRACT**

The purpose of this article was to review school based interventions designed to prevent childhood and adolescent obesity that focused on modifying dietary behavior and were published between 2000 and May 2009. A total of 25 interventions met the criteria. The grade range of these interventions was from K to 12; 13 studies exclusively targeted elementary school, 2 targeted both elementary and middle school, 9 exclusively targeted middle school, and 1 targeted high school. The majority of the interventions focused on both dietary and physical activity behaviors, whereas 8 interventions focused exclusively on dietary behaviors. Approximately one-half of the interventions were based on a behavioral theory. In terms of duration, 13 were longer than 6 mo, 4 were less than 1 mo, and 8 had a duration between 1 and 6 mo. The majority of the interventions were implemented by teachers. In terms of activities, almost all interventions had a curricular component except 2 that distributed free fruit or vegetables. Besides curricular instructions, parental and family involvement was also utilized by several interventions. Environmental and policy changes were used in 7 interventions. For evaluation, the 2 most popular designs were experimental design with random assignment at group level and quasi experimental design, both of which were used by 9 interventions each. In terms of impact on adiposity indices, only 14 interventions measured it and only 6 of those were able to demonstrate significant changes. Recommendations for enhancing the effectiveness of school based dietary education interventions for childhood obesity prevention are presented. *Adv. Nutr. 2: 2075–216S, 2011.* 

### Introduction

All over the world, obesity has reached epidemic proportions with over 1 billion overweight people and at least 30% of those as obese (1). The prevalence of overweight and obesity in children and adolescents in both

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Childhood overweight and obesity are also associated with a number of long term negative consequences. Some of these include increased risk of developing hypertension, type 2 diabetes mellitus, hypercholesterolemia, stroke, hepatic steatosis (fatty liver), arthritis, sleep apnea, gall bladder disease, and bronchial asthma (9). Childhood overweight and obesity are also linked to a variety of psychological issues. Some of these include depression, discrimination, low self-esteem, peer rejection, and stigmatization (10,11).

There are a number of factors that contribute to the epidemic of childhood overweight and obesity. Body weight is

<sup>&</sup>lt;sup>2</sup> Author disclosures: M. Sharma, no conflicts of interest.

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shaped by a combination of genetic, metabolic, behavioral, environmental, socio-cultural, and socioeconomic factors. For a large majority of individuals, overweight and obesity result from excess energy consumption and/or inadequate physical activity (12). Unhealthy eating habits and physical inactivity are early to become established and contribute in a major way toward development of childhood overweight and obesity. Commonly suggested modifiable public health strategies to combat childhood obesity are promotion of breast-feeding, limiting television viewing, encouraging physical activity, increasing fruit and vegetable intake, controlling portion sizes, and limiting sweetened drink consumption (13). Dietary modification is a very important part of all strategies aimed at combating childhood overweight and obesity. For addressing childhood obesity, school based interventions are a major channel. Children spend many hours in school and schools serve as important channels through which important behavior changes to reduce childhood obesity can be addressed.

It was within this backdrop that the aims of this study were to review existing school based interventions designed to prevent childhood and adolescent obesity that focused on modifying dietary behavior and suggesting ways of enhancing these interventions. It was decided to focus on interventions that were published between 2000 and May 2009. The choice was also made to focus on interventions conducted in the general population of children and adolescents as opposed to programs that focused solely on overweight and obese children.

### **Materials and Methods**

To collect the materials for the study, a search of the CINAHL, ERIC, and MEDLINE databases was done for the time period 2000 to May 2009. The criteria for inclusion of the studies were: 1) publication in the English language; 2) publication between 2000 and 2009 (however, also included were any studies conducted prior to 2000 but published in the specified time period); 3) focus on general population as opposed to overweight or obese children; and 4) having an explicit dietary component in the school based program for prevention of obesity. Exclusion criteria were publications in languages other than English, publications prior to 1999, studies that did not have a school component (such as those that focused only on after school programs), and studies that focused solely on overweight/ obese children or adolescents. Only 1 researcher retrieved the articles. The search words used were "dietary" or "nutrition" and "interventions" or "programs" and "childhood obesity." A total of 189 articles were located and abstracts read.

### Results

A total of 25 studies met the criteria. The 25 interventions starting from lower grades to higher grades and summarizing age range of children, country of the study, use of theory, dietary components of the intervention, duration, and salient findings are presented in **Table 1**. **Table 2** summarizes the types of evaluation designs used in the chosen intervention studies.

### **Discussion**

The purpose of this article was to review school based interventions for preventing childhood and adolescent obesity that had a dietary component and were published between

2000 and May 2009. Based on a review of these interventions, it is evident that there is a need for more school based prevention programs, because there was a total of only 25 interventions that were found and the problem of obesity in childhood is quite enormous. The majority (15) of the interventions have been from the United States (14,28–36,38–42), followed by 4 from the United Kingdom (17,18,25,27), 2 from Germany (15,19), and 1 each from China (20), Greece (21), Chile (24), and Norway (37). The grade range of these interventions has been from K to 12, with a majority (13) exclusively targeting elementary school (15,17-21,25,27-32), 2 targeting elementary and middle school (14,24), 9 exclusively targeting middle school (33-41), and 1 targeting high school (42). The emphasis on elementary school of most interventions seems to be justified, because the dietary behaviors are forming in this age group and are more malleable, and changing behaviors to healthy ones can go a long way in addressing the problem of childhood overweight and obesity. There has been only 1 intervention conducted in high school. This could be due to the emphasis on academics in higher grades. Healthy dietary behaviors are more important in high school, because adolescents often adopt unhealthy practices such as eating junk food, skipping breakfast, not eating fruits and vegetables, drinking sweetened beverages, and eating unhealthy snacks. Future interventions should aim at targeting high school kids as well. Ideally, there should be sequential K-12 dietary education that would target all children.

Most of the interventions (17) focused on both dietary and physical activity behaviors, whereas 8 interventions focused on only dietary behaviors. From those 8 interventions (17,18,27,30,34,37,40,41), only 3 (17,27,30) measured adiposity indicators such as BMI, and of these, only 2 (27,30) demonstrated a decrease in adiposity measures. Hence, it can be concluded that although interventions that focus only on dietary behaviors can be successful, it would be better to focus on both physical activity and dietary behaviors to reduce childhood overweight and obesity.

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Approximately one-half (13) of the interventions were based on a behavioral theory and approximately one-half were atheoretical. Using a theory helps in discerning measurable program outcomes, specifies methods for behavior change, helps in identifying the timing for interventions, helps in choosing right mix of strategies, enhances communication between professionals, improves replication, and improves program efficiency and effectiveness (44). Hence, in the future, more interventions should use behavioral theories. Among the theories that have been used, social cognitive theory is the most popular theory, which was used by 6 interventions (3,7,11,14,15,25). Social cognitive theory has been evaluated with a number of behaviors and a variety of target populations (45). It is especially useful in school based settings with children and adolescents. Future interventions might reify it and improve this theory further. A major weakness noted in the interventions that used this and other theories is that very few of those have measured changes in behavioral constructs of the theory they have

# A Manages in Nutrition An International Review Journal

Table 1. Summary of school-based childhood obesity prevention interventions with a dietary component

A Service Secretary   A Notice of Particle of Partic					
Fin for Lith (HARH) gaded United States  Fig. (15.16)/15t gaded=5.77 y  Mokrown theory  Mo			Dietary components of the Intervention	Duration	Sallent findings
United States United States United States United States  Very olds/1997–2003/ United States  Very olds/1996–2003/Cermany  Very olds/2003–	1. Fit for Life (14)/K-8th grade/	No known theory	AHA's Heart Power kits.	4 y	Outcome measures did not show significant
United States  United States  Involvement of parents and grandparents.  Community activity through lists and festivits.  (15,16)/1st grade/5-7 y  (15,16)/1st grade/5-1 y  (15,16)/1st grade/6-1 y  (16,16)/1st grade/6-1 y	5-14 y olds/1997-2003/		Work booklets to track physical activity and		improvement in knowledge or BMI
No known theory Conveniency and social support for returning and restrains.  (15)(6)/15t grade/5-7 y Conveniency education and social support for education of (15)(6)/15t grade/5-7 y Conveniency education and social support for education of (15)(6)/15t grade/5-7 y Conveniency education and social support for education of (15)(6)/15t grade/5-7 y Conveniency education of (15)(6) grade/5	United States		nutrition choices.		
Kel Obesity Prevention Study  (15,16)/1st grade/5-7 y  (16,17)/1st grade/5-7 y  (16,17)/1st grade/5-1 y  (17,17)/1st grade/5-1 y  (18,17)/1st grade/1st			Involvement of parents and grandparents.		
No known theory Courseling, education and to Bodist support for a finition nutrition and physical activity.  It is felly transpect and a consist support for the support for suppo		-	Community activity through fairs and festivals.		
(15)(b)/1st grade/5-7 y nutrition and physical activity.  (15)(b)/1st grade/5-7 y nutrition and physical activity.  (15)(b)/1st grade/5-7 y  (16)(b)/1st grade/5-7 y  (17)(b)/1st grade/5-7 y  (18)(b)/1st grade/5-7 y  (18)(b)/1st grade/5-1 y  (18)(b)/1st grade/5-1 y  (18)(b)/1st grade/6-1 y  (18)(		No known theory	Counseling, education, and social support for	8 h nutrition	Increase in nutrition
olds/1996–2005/Germany Emphasize or knowkledge self monitoring. 4-5 home visits building self esteemt and autonomy family intervention composing of home visits theory family intervention composing of home visits from theory theory family intervention composing of home visits grade/2000—  2001/United Kingdom Cognitive Emphasized short-team benefits of healthy foods 2001/United Kingdom Provided opportunity to taste healthy foods (14 mo) Provided opportunity to taste healthy foods (18)/1st-3rd grade/5-11 y and modeling on and 2 girls aged 12-13 who are fruits and olds/Published in 2004 and coding perfectly and codes who were 2 boxs and 2 girls aged 12-13 who are fruits and olds/Published in 2004 and coding and encouraged others to also do united Kingdom Curried Kingdom Curried Kingdom Curried Kingdom Curried Kingdom Curried Kingdom Visit and vegetables and encouraged others to also do united Kingdom Visit and vegetables and encouraged others to also do united Kingdom Visit and vegetables and encouraged others to also do united Kingdom Visit and vegetables and encouraged others to also do united Kingdom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to also do united Missardom Visit and vegetables and encouraged others to accordance of the provision of conference of the provision of conference of the provision of the provision activity and nutrition and encouraged of the provision of perents in united Sates.  Application of the provision of perents involved parents.  Application of the provision of th	(15,16)/1st grade/5–7 y		nutrition and physical activity.	education	knowledge ( $P < 0.05$ ).
Be Smart (17/1st-2nd Social cognitive Emphasized short-term benefits of healthy (14 mo) activitied Kingdom Lebony Emphasized short-term benefits of healthy (14 mo) (1	olds/1996–2005/Germany		Emphasis on knowledge, self monitoring,	4–5 home visits	Less increase in
Re-Smart (17/1st-2nd social cognitive Emphasized shorterem benefits of healthy grade/5-7 y olds/2000— theory restrict shorterem benefits of healthy grade/5-7 y olds/2000— theory restrict shorterem benefits of healthy foads 2001/United Kingdom theory restrict shorterem benefits of healthy foads 2001/United Kingdom behavior shortered papertical skills involved parents.  Deer Modeling and Rewards Rewarding behavior Six 6-min videos Food Dudes, who were 2 boys olds/Published in 2004/ A more and modeling shortered shortered shortered for an an old 2 girls aged 12-13 y who are fruits and vegetables. StEP TWO program No known theory shortered parents. Home pads to involve pads to creation of the parents. Home pads to involve pads to creation and physical activity by the parents. Home pads conformed parents. Home pads conformed parents. Howeverling to overweight and obee children. Howeverling the parents. Howeverling parents. Howeverling to overweight and obee children. Howeverling parents. However			building self esteem, and autonomy		triceps skinfold thickness ( $P < 0.01$ ).
Re Smart (17/1s-2nd Social cognitive Emphasized short-term benefits of healthy (aschool terms grades/5-7) y dist/2000— theory theory (18/1s) and modeling and Rewards (18/1s)—3rd grades/5-11 y and modeling and Rewards (18/1s)—3rd grades/5-11 y and modeling and Provided opportunity to taste healthy foods.  Step TWO program (19/1st-3rd grades/5-11) y and modeling who were Cood Dude's who were 2 boys (18/1st-3rd grades/5-11) y and modeling who were Cood Dude's who were 2 boys and 2 girls aged 12–13 y who ate fruits and olds/hubished in 2004  The same Customized Food Dude items. Home packs to involve parents.  Step TWO program (19/1st-4rlt grades/5-11) y oknown theory (19/1st-4rlt grades/5-11) who known theory (19/1st-4rlt grades/5-11) how known theor			Family intervention comprising of home visits		Less increase in % fat mass ( $P < 0.05$ ).
Re Smart (17/1st-2nd theory theory beating grade/5-7 y olds/2000— theory theory broaded opportunity to taste healthy foods.  2001/United Kingdom theory broaded opportunity to taste healthy foods.  2001/United Kingdom theory broaded opportunity to taste healthy foods.  1. Each incentives such as verbal praise and small prizes.  2. Developed practical skills brinkly broaded practical skills brinkly broaded opportunity to taste healthy foods.  2. Each food practical skills brinkly broaded in 2004/  2. It is and modeling and Rewarding behavior six of min vildeos. Food Dude's who were 2 boys of the same.  2. SEP TWO program and 2 girls aged 12-13 y who are fruits and old-yells and encouraged others to also do united Kingdom.  2. SEP TWO program and 2 girls aged 12-13 y who are fruits and vegetables.  2. Each of Activity broaded or same fruits and vegetables.  2. Each of Activity with overweight and obese kids.  2. Each of Activity with overweight and obese kids.  2. Each of Activity with overweight and obese kids.  2. Each of Activity with overweight and obese kids.  3. A parental involvement for 6 evenings.  Cetaran Health and Social cognitive Based on Know Vindion Intervention in United States.  2. 2003/Greece  Associal cognitive Based on Know Vindion adverbed at increasing physical activity.  4. Foods of Murition Education in United States.  2. 2003/Greece  1. Involved parents.			for those overweight and obese		
gade/5-7 y olds/2000—  2001/United Kingdom  Leed memory  Leed incentives such as verbal praise and small prizes.  Leed incentives such as verbal praise and small prizes.  Leed medity foods.  Developed partical skills  Involved parents.  Six 6-min videos; Food Dudes, who were 2 boys  and a modeling and Rewards partical skills  Involved parents.  Six 6-min videos; Food Dudes, who were 2 boys  and 2 giffs aged 12-13 v Who are fruits and olds/Published in 2004/  United Kingdom  No known theory  Rewards to children for eating fruits and vegetables.  Step 1: Health education and physical activity by  Rewards to children for eating fruits and vegetables.  Step 2: Special cooked meals and 60- to 90-min  physical activity with overweight and obese kids.  Parental involvement for children through 10 themes  Beijing 201/1st-5th  No known theory  Rewards in 2020/China  No known theory  Rewards in 2020/China  No known theory  Remester meeting for overweight and obese kids.  Des semester meeting for overweight and obese kids.  Aso almed at increasing physical activity.  Aso almed at increasing physical activity and nutrition.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese children.  Aso almed a semester meeting for overweight and obese kids.  As a semester meeting for overweight and obese kids.  As a semester meeting for overw		Social cognitive	Emphasized short-term benefits of healthy	4 school terms	Improvement in nutrition knowledge ( $P < 0.01$ ).
2001/United Kingdom  Used incentives such as verbal praise and small prizes.  Peer Modeling and Rewards  (18/11st-3rd grade/S-11 y and modeling and stronglabilities.)  Step 7WO program  (19/11st-4rth grade/S-11 y olds/2003- S-12 y olds/2003- S-12 y olds/2003- Seeing 200/11st-5rth  No known theory  Obesity intervention in No known theory  Reward to children for eating fruits and obese kds. S-12 y olds/2003- Siep 2. Special cooked meals and 60- to 90-min physical activity with ocherwight and obese kds. Perental involvement for 6 evenings.  Obesity intervention in No known theory  Wurtinon education for children through 10 themes parters the didner of a semester meeting for overweight and obese kds. Published in 2007/China  Social cognitive  Program / 10-23/11s-6th  Roward (10-23/11s-6th)  No known theory  Nutrition education for praints through 1 lecture persented in volvement of 6 evenings.  As a immed at increasing physical activity.  As a immed a semester meeting for overweight and obese kds. Program (12-23/11s-6th)  Roward (10-23/11s-6th)  As in 10 lessons, 1 per formight.  As in miner at increasing physical activity.  As in miner at increasing physical activity.  As in miner at increasing physical activity and nutrition.  Rooz/Greece  Program (12-23/11s-6th)  Rooz/Greece	grade/5-7 y olds/2000-	theory	eating	(14 mo)	Improvement in fruit ( $P < 0.01$ ) and vegetable
Used incentives such as verbal praise and small pictaes.  Peer Modeling and Rewards  (18)/1st-act grade/5-11 y and modeling olds yellished in 2004/ United Kingdom  (19)/1st-dth grade/ 5-12 y olds/2003- 5-12 y olds/2003- Certain Health and Winthin Education in No known theory Rejing CDO/1st-5th grade/ Nutrition Education in Health and Nutrition Education and physical activity.  Certain Health and Social cognitive Research Research Received a semester meeting for overweight and obese kids. Per Program Nutrition Education for children through 10 themes Rejing CDO/1st-5th Nutrition education for children through 10 themes Program 10 Dissons, 1 per forthight.  Certain Health and Social cognitive Based on Mnow Your Body curriculum developed Wilson in United States.  Proceeding Dissons and Dissons and Dissons and Dissons and Social activity. Once a semester meeting for overweight and Once a semester meeting for overweight and Once a semester and educational materials.  Proceeding Dissons and Di	2001/United Kingdom		Provided opportunity to taste healthy foods.		intake ( $P < 0.05$ ).
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Peer Modeling and Rewards Rewarding behavior six 6-min Modess. Food Dudes, who were 2 boys (18)/1st-3rd grade/5-11 y and modeling and 2 girls aged 12-13 y who are fruits and olds/Published in 2004/ United Kingdom and modeling and 2 girls aged 12-13 y who are fruits and olds/Published in 2004/ United Kingdom Lustomized Food Dude items.  SEP TWO program No known theory Step 1: Health education and physical activity by Sept. 2 special cooked meals and 60- to 90-min aphysical activity with overweight and obese kids. Parantal involvement for 6 evenings Physical activity with overweight and obese kids. Parantal involvement for 6 evenings Nutrition education for parents through 1 lecture per semester and educational materials. Once a semester and educational materials. Once a semester meeting for overweight and obese children. As aimed a tincreasing physical activity.  Cetan Health and Social cognitive Based on Know Your Body curriculum developed Noveleace.  Published in 2007/China Social cognitive Reason on the physical activity and nutrition. In United States.  Proceeding 2004/Greece Triangle Processed Processes and Process			small prizes.		
Involved parents.   Involved parents.   Involved parents.   Peer Modeling and Rewards   Six 6-min videos; Food Dudes, who were 2 boys   Six 6-min videos; Food Dudes, who were 2 boys   Six 6-min videos; Food Dudes, who were 2 boys   Six 6-min videos; Food Dude items and 2 girls aged   20.3 y who ate fruits and vegetables and and 2 girls aged   20.3 y who ate fruits and vegetables.   House parents.   House age 84 y.   No known theory   Nutrition education for parents through 1 lecture   Published in 2007/China   Social cognitive   Based on Know Your Body curriculum developed   Now study   House   H			Developed practical skills		
Peer Modeling and Rewards (18)/1st-3rd grade/5-11 y and modeling and 2 girls aged 12–13 y who are fruits and olds/Published in 2004/ United Kingdom  StEP TWO program (19)/1st-4th grade/ 5-12 y olds/2003- 2004/Germany Beijing (20)/1st-5th Grade Modeling and Application of parents: Peer Modeling and Rewards to children for eating fruits and vegetables. S-12 y olds/2003- 2004/Germany Beijing (20)/1st-5th Grade Mean age 84 y/ Published in 2007/China  Social cognitive Murtition education for parents through 1 lecture Published in 2007/China Social cognitive Ray and education for parents through 1 lecture Published in 2007/China Social cognitive Ray and education for parents through 1 lecture Published in 2007/China Social cognitive Ray are semester meeting for overweight and obese children. Also aimed at increasing physical activity and nutrition. In United States. 2002/Greece			Involved parents.		
(18)/1st-3rd grade/5-11 y and modeling and 2 girls aged 12–13 y who ate fruits and olds/Published in 2004 United Kingdom  Customized Food Dude items.  Home packs to involve parents.  Home packs to involve parents.  Home packs to involve parents.  Rewards to children for eating fruits and vegetables.  Step TWO program  No known theory (19)/1st-4th grade/ Seling (20)/1st-3th  Great Health and (21–23)/1st-6th  Published in 2007/China  Cretan Health and Social cognitive (21–23)/1st-6th  grade/6-15 y olds/1992-  In United States.  and 2 girls aged 12–13 y who ate fruits and wegetables to also do the state on the same and encuraged or both physical activity by  No known theory (19)/1st-3th  Great Health and (21–23)/1st-6th  grade/6-15 y olds/1992-  In United States.  As and 2 girls aged 12–13 y who ate fruits and encuraged or both physical activity.  In United States.  And 2 girls aged 12–13 y who ate fruits and encuraged or both physical activity.  In United States.  As and 2 girls aged 12–13 y who ate fruits and encuraged or both physical activity.  In United States.  As and 2 girls aged 12–13 y who ate fruits and encuraged or both physical activity.  Involved parents.	Pe	Rewarding behavior	Six 6-min videos: Food Dudes, who were 2 boys	5 mo	Compared to control group, lunch time ( $P < 0.001$ ),
olds/Published in 2004/ United Kingdom  Step 1: Health education and physical activity by (19)/1st-4th grade/ 5-12 y olds/1903- 5-12 y olds/1902- 6-12 y old	(18)/1st-3rd grade/5-11 y	and modeling	and 2 girls aged 12–13 y who ate fruits and		snack time ( $P < 0.001$ ), and at home ( $P < 0.05$ )
United Kingdom  United Kingdom  Customized Food Dude items.  Home packs to involve parents.  Home packs to involve parents.  Rewards to children for eating fruits and vegetables.  5–12 y olds/2003-  2004/Germany  Desity intervention in No known theory Step 1: Special cooked meals and 60- to 90-min physical activity with overweight and obese kids. Parental involvement for 6 evenings  Beging (20/1 st-5th grade/Wean age 84 y/ in 10 lessons, 1 per fortnight.  Cretan Health and Social cognitive Based on Know Your Body curriculum developed Nutrition.  Nutrition Education theory in United States.  Also aimed at increasing physical activity and nutrition.  Involved parents.	olds/Published in 2004/		vegetables and encouraged others to also do		fruit and vegetable intake increased.
Customized Food Dude items.  Home packs to involve parents.  Pewards to children for eating fruits and vegetables.  Step 1: Health education and physical activity by regular school teachers.  Step 2: Special cooked meals and 60- to 90-min physical activity with overweight and obese kids.  Parental involvement for 6 evenings  Obesity intervention in No known theory Parental involvement for 6 evenings  Obesity intervention in No known theory In 10 lessons, 1 per forthight.  Published in 2007/China Published in 2007/China Ocea semester and educational materials.  Cretan Health and Ocea semester meeting for overweight and obese children.  Also aimed at increasing physical activity.  Also aimed at increasing physical activity and nutrition.  Involved parents.  Involved parents.	United Kingdom		the same.		Adiposity indices not measured.
Step 1: Home packs to involve parents.  Rewards to children for eating fruits and vegetables. Step 1: Health education and physical activity by requires from the control teachers. 5–12 y olds/2003– Step 2: Special cooked meals and 60- to 90-min physical activity with overweight and obese kids. Parental involvement for 6 evenings Obesity intervention in No known theory Nutrition education for children through 10 themes in 10 lessons, 1 per fortnight. Nutrition education in no lessons, 1 per fortnight. Published in 2007/China per semester and educational materials. Once a semester meeting for overweight and obese children. Also aimed at increasing physical activity. Cretan Health and Social cognitive Based on Know Your Body curriculum developed in United States. Program (21–23)/1st–6th Involved parents. Involved parents.			Customized Food Dude items.		
Rewards to children for eating fruits and vegetables.  Step 1: Health education and physical activity by 19/1st—4th grade/ 5-12 y olds/2003— 5-12 y olds/2004 5-12 y olds/2003— 5-12 y olds/2003			Home packs to involve parents.		
SteP TWO program  No known theory Step 1: Health education and physical activity by One academic year (19)/1st-4th grade/ 5-12 y olds/2003- 5-12 y olds/2003			Rewards to children for eating fruits and vegetables.		
regular school teachers.  Step 2: Special cooked meals and 60- to 90-min physical activity with overweight and obese kids.  Parental involvement for 6 evenings  Obesity intervention in No known theory in 10 lessons, 1 per fortnight.  Beijing (20/1 st–5th and 2007/China age 8.4 y/ per semester meeting for overweight and obese children.  Published in 2007/China Once a semester meeting for overweight and obese children.  Also aimed at increasing physical activity.  Cretan Health and Social cognitive Based on Know Your Body curriculum developed in United States.  Program (21–23)/1st–6th proving		No known theory	Step 1: Health education and physical activity by	One academic year	Changes in dietary behavior not observed.
Step 2: Special cooked meals and 60- to 90-min physical activity with overweight and obese kids.  2004/Germany  Obesity intervention in No known theory  Beijing (20)/1 st-5th  grade/Mean age 8.4 y/ Published in 2007/China  Published in 2007/China	(19)/1st-4th grade/		regular school teachers.		No changes in prevalence of overweight or obese
2004/Germany  2004/Germany  Parental involvement for 6 evenings  Obesity intervention in  Reijing (20)/1 st–5th  grade/Mean age 8.4 y/ Published in 2007/China  Pores emester meeting for overweight and obese children.  Also aimed at increasing physical activity.  Also aimed at increasing physical activity.  Program (21–23)/1st–6th	5-12 y olds/2003-		Step 2: Special cooked meals and 60- to 90-min		children in intervention or control
Obesity intervention in No known theory Beijing (20)/1 st—5th Nutrition education for children through 10 themes 3 y in 10 lessons, 1 per fortnight.  Grade/Mean age 8.4 y/ Published in 2007/China Pu	2004/Germany		physical activity with overweight and obese kids.		groups ( $P > 0.05$ ).
Obesity intervention in No known theory Nutrition education for children through 10 themes 3 y Beljing (20)/1 st–5th grade/Mean age 8.4 y/ Published in 2007/China per semester and educational materials. Once a semester meeting for overweight and obese children. Also aimed at increasing physical activity.  Cretan Health and Social cognitive Based on Know Your Body curriculum developed in United States.  Program (21–23)/1st–6th Focused on both physical activity and nutrition. Involved parents.			Parental involvement for 6 evenings		
Beijing (20)/1st–5th grade/Mean age 8.4 y/ Published in 2007/China Pose semester and educational materials. Once a semester meeting for overweight and obese children. Also aimed at increasing physical activity. Also aimed at increasing physical activity. Program (21–23)/1st–6th grade/6–15 y olds/1992– Involved parents.	Õ	No known theory	Nutrition education for children through 10 themes	3 у	Nutrition behaviors not measured.
grade/Mean age 8.4 y/ Published in 2007/China Once a semester and educational materials. Once a semester meeting for overweight and obese children. Also aimed at increasing physical activity. Also aimed at increasing physical activity. Program (21–23)/1st-6th in United States. Program (21–23)/1st-6th Focused on both physical activity and nutrition. Hivolved parents.	<i>Beijing</i> (20)/1 st–5th		in 10 lessons, 1 per fortnight.		Prevalence of overweight (9.8 vs. 14.4%, $P < 0.01$ ) and
Published in 2007/China per semester and educational materials.  Once a semester meeting for overweight and obese children.  Also aimed at increasing physical activity.  Also aimed at increasing physical activity.  Nutrition Education theory in United States.  Program (21–23)/1st-6th Focused on both physical activity and nutrition.  Program (21–23)/1st-6th Focused on both physical activity and nutrition.  High and Theory High and Theory Focused on both physical activity and nutrition.	grade/Mean age 8.4 y/		Nutrition education for parents through 1 lecture		obesity (7.9 vs. 13.3%, $P < 0.01$ ) were lower in
Once a semester meeting for overweight and obese children.  Also aimed at increasing physical activity.  Also aimed at increasing physical activity.  Nutrition Education theory in United States.  Program (21–23)/1st–6th Focused on both physical activity and nutrition.  2002/Greece	Published in 2007/China		per semester and educational materials.		intervention schools than in control schools.
Cretan Health and Social cognitive Based on Know Your Body curriculum developed 10-y study  Nutrition Education theory in United States.  Program (21–23)/1st–6th Focused on both physical activity and nutrition.  2002/Greece			Once a semester meeting for overweight and		
Cretan Health and Social cognitive Based on Know Your Body curriculum developed 10-y study  Nutrition Education theory in United States.  Program (21–23)/1st-6th Focused on both physical activity and nutrition.  grade/6–15 y olds/1992– Involved parents.  2002/Greece			Obese children. Also aimed at increasing physical activity.		
theory in United States. Focused on both physical activity and nutrition. Involved parents.		Social cognitive	Based on Know Your Body curriculum developed	10-y study	Lower BMI increase in intervention group
Focused on both physical activity and nutrition. Involved parents.	Nutrition Education	theory	in United States.		(P < 0.05).
Involved parents.	Program (21–23)/1st–6th		Focused on both physical activity and nutrition.		Higher intake of potassium ( $P=0.018$ ) and
	grade/6-15 y olds/1992-		Involved parents.		magnesium ( $P = 0.011$ ) in intervention
	2002/Greece				compared to control.

(Continued)

# ANAdvances in Nutrition An International Review Journal

# Table 1. (Continued)

u	Study/grade/age/year/country	Theory	Dietary components of the Intervention	Duration	Salient findings
∞i	Diet and Nutrition Intervention (24)/1st-8th grade/5-15 y olds/2002-2003/Chile	No known theory	Nutrition education for children through curricula. Selling of healthier food items at school kiosks. Involvement of parents. Contest in which stickers were given to kids for eating healthy snacks. Physical activity was also targeted.	One academic year	Improvement in BMI and waist circumference for boys ( $P < 0.001$ ) but no change for girls.
9.	Active Program Promoting Lifestyle Education in School (APPLES) (25,26)/ 2nd-4th grade/7–11 y olds/1996–1997/ United Kindom	No known theory	Targeted students, parents, teachers, catering staff, and school environment. Schools developed individual action plans. Modification of school meals.	One academic year	No change in BMI or dieting behavior. Vegetable consumption higher in the intervention group (0.3 portions/d)
10.	S	No known theory	Decrease consumption of carbonated drinks by a simple message.	One hour session for each class each term for 1 y	Carbonated drinks decreased in the intervention group (by 0.6 glasses).  The percentage of overweight and obese children decreased in the intervention group (by 0.2%).
Ξ.	Pathways (28)/3rd–5th grade (American Indians)/8–11 y olds/1997–1998/United States	Social cognitive theory	Classroom curricula modified to promote healthy nutrition and physical activity.  Modifications in food service to reduce fat. Family involvement to support healthy behaviors.	Two 45-min lessons for 12 wk	Knowledge (P < 0.001), attitudes (P < 0.05), and behaviors (P < 0.001) positively changed.  No significant reduction in body fat.
7.	<i>SWITCH</i> (29)/3rd–5th grade/ 8–11 y olds/2005–2006/ United States	Social ecological model	Community, school, and family based intervention for nutrition, physical activity, and screen time. First phase: Child and parents identify behaviors to change.  Second phase: Plan changes based on self rewards. Third phase: Plan meals, plan healthy snacks, increase shopping of fruits and vegetables. Fourth phase: Maintenance of healthy behaviors.	Academic year (9 mo)	Results not yet published
<del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> .	Policy-based School Intervention (30)/ 4th-6th grade/Mean age 11.3 y/2005–2006/ United States	Social marketing and other theories	Five components: self-assessment; 50 h nutrition education per student per school year using Planet Health and Know Your Body curricula; nutrition policy; social marketing; family outreach	2 ×	A 50% reduction in the incidence of overweight. After 2 y only 7.5% children in the intervention group were overweight compared to 14.9% in the control group.
<del>7</del>	70	Social cognitive theory	Primary prevention program that focuses on modification of environmental cues, improving social support, and building self-efficacy for healthy eating and physical activity.  Secondary prevention program that focuses on behavior modification, uses synchronous internet counseling, and e-mails.	30 mo	Results awaited
15.	Social Cognitive Theory based Intervention (32)/5th grade/11 y olds/2006–2007/ United States	Social cognitive theory	Four modules: 3 sessions of physical activity, 3 sessions of increasing fruit and vegetable consumption, 3 sessions of limiting TV usage, and 3 sessions of replacing sweetened beverages with water.	12 wk	Increase in expectations for drinking water $(P=0.049)$ . Increase in number of glasses of water consumed $(P=0.022)$ .

(Continued)

# A Maurees in Nutrition An International Review Journal

Table 1. (Continued)

Plact Community Prevention The Stage State	2	vaturios/acev/enc/ehean/vbirts	Theory	Distance of the Intervention	Duration	Caliant finding
Plate Community Prevention   Transheretrical   Instruction in fundion finess, self-efficacy, goal setting, program (3) bilds (1-12 y olds/2004-2005)   Another States   Three States   T		study/glade/age/year/coultily	lileol y	Dietaly components of the intervention	Caladion	Janeth Infamilys
Program (33)/6th gradek   model   and stages of change,   model   mo	16.		Transtheoretical	Instruction in nutrition, fitness, self-efficacy, goal setting,	Five 40-min sessions	No significant changes from pre- test to post-test
11-12 y olds/2004-2005/   Family fun injit was organized.   10-12 y olds/2004-2005/   Family fun injit was organized.   12-wk curriculum that combined nutrition education   12 wk with that combined nutrition education   12 wk curriculum that combined nutrition education   12 wk with that combined nutrition   12 wk   12 wk curriculum that combined nutrition   12 wk		Program (33)/6th grade/	model	and stages of change.	over the course	in students' individual health attitudes and
United States  Murtition in the Garden (34)  Mush known theory  United States  Un		11–12 y olds/2004–2005/		Families were involved.	of 6 wk	behaviors.
Murition in the Garden (34)/ 6 grade/10-13 y olds/ 6 bill streed in 2007/ 1 United States Carge-based hereurinon 6 grade/10-13 y olds/ 1 Innstrheoretical model 6 pilysical activity. 6 Graduate nusing struction datases. 6 Graduate nusing struction datases. 6 Graduate nusing struction datases. 7 Innstrheoretical model 8 physical activity. 8 Graduate nusing struction datases. 8 Graduate nusing struction datases. 8 Graduate nusing structurinon datases. 9 Graduates nusing		United States		Family fun night was organized.		Mean family ratings improved in importance of
forthindron five Garden (34)  (by grade/10–13 yolds/  bublished in 2007/  bublished in 2008/  bublished in	!		-	-	-	goal setting for eating ( $P < 0.05$ ).
Ong gades (10-13 y olds)  Published in 2013 / olds)  United States  Stage-board Internation  Stage-board Internation  Stage-board Internation  Olds/2000-2001/United States  Stage-board Internation  Olds/2000-2001/United States  Program (69/kHth-8th  Row region School Fruit Program  No known theory  School/Near age 14.5 y/  Present and Prevent (39)/Widdle  School/Mean age 14.5 y/  Action No known theory  School/Mean age 14.5 y/  School/Mean age 12.5 y/  Construction and Configuration  No known theory  States  Destance  Theory of planned  Carriculum in Science classes. Units  Theory of reasoned  Carriculum (40)/Middle  School/Mean age 12.5 y/  Conditional States  USDA Fresh Fruit and Vegetable  No known theory  Theory of reasoned  Carriculum (40)/Middle  Carriculum			No known theory	12-wk curriculum that combined nutrition education	12 wk	Students in garden based nutrition education
Published in 2007/ United States Stage-based Intervention Positive consolution of the seasons and provision model of seasons and the seasons and provision model of seasons and the seasons an		oth grade/10-13 y olds/		with horticulture.		increased their intake of fruits and vegetables
Stage-bosed Intervention (33/64t-8th grade/12-17 y promotion model of provided intervention of provided intervention of provided intervention of provided in 2009/United States (33/74th grade/11-13 y olds/ 2009/United States control and provided in 2008/United States control and provided in 2008/United States (38/74th grade/11-13 y olds/ 2009/United States control and provided in 2008/United States control and characteristic control, and characteristic control and characteristic control and characteristic control and characteristic control and characteristic control, and characteristic control and control		Published in 200// United States		Hands-on garden based activities.		compared to control ( $P < 0.001$ ).
35/6th-8th grade/12-17 y promotion model and self-reevaluation for fat control and olds/2000-2001/United States   Transtheoretical model   and self-reevaluation for fat control and olds/2000-2001/United States   Transtheoretical model   and self-reevaluation discourance   and olds/2000-2001/United States   Transtheoretical model   and self-reevaluation for fat control and folds/2000-2001/United States   Transtheoretical model   and self-reevaluation for fat control and folds/2000-2001/United States   Transtheoretical model   and self-reevaluation for fat control and fatore   and fa	∞	Stage-based Intervention	Pender's health	Four 45-min sessions using consciousness raising	4 classroom sessions	Post-test % fat in food was less ( $t = 2.06$ . $P = 0.04$ ).
olds/2000-2001/United States  School-based Obesity Prevention  No known theory Prevent of States  20-30 min discussion on food labels, pondion size, food pyramid, and food in 2008/United States  2001-2002/Nerway  No known theory Prevent (39)/Middle Evaluation based on Two Strool Mean age 14.5 y/ action  No known theory Prevent (39)/Middle Evaluation based on Two Strool Mean age 14.5 y/ action  No known theory Prevent (39)/Middle Evaluation based on Two Strool Mean age 12.5 y/ body mage, benefits of healthy body weight, healthy but stroop of mage included causes and health problems of obesity. Benefit of the action prevent and Prevent (39)/Middle Evaluation based on Two Strool Mean age 12.5 y/ body mage, benefit of healthy body weight, healthy food choices, food base leading, controlling pontion size, chool/Mean age 12.5 y/ body mage, benefit of healthy body weight, healthy food choices, food base leading, controlling pontion size, chool/Mean age 12.5 y/ body mage, benefit of healthy basis, increasing physical action without health with the son plans: nutrition knowledge about food of I mo operation of fest fruit and vegetable snacks every day. I wo academic years provided states  LISDA Fresh Full with Vegetable  Provision of fresh fruit and vegetable snacks every day. I wo academic years program (1)/4th-9th  gade/9-14 y olds/2005-2007/		(35)/6th-8th grade/12-17 v	promotion model	and self-reevaluation for fat control and		Duration of exercise was higher (t = $2.925$ ,
School-based Obesity Prevention  No known theory Program (36)/6th-8th grade/12-15 y olds/Published in 2008/United States  No known theory Present and Prevent (39)/Middle school/Mean age 145 y/ Action Model Nutrition No known theory School/Mean age 125 y/ School/Mean age 125 y/ School-based Obesity Prevention No known theory School/Mean age 125 y/ School-based Obesity Prevention No known theory School/Mean age 125 y/ School-based Obesity Prevention No known theory School/Mean age 125 y/ School-based Obesity Prevention No known theory School/Mean age 125 y/ School-based Obesity Prevention School/Mean age 125 y/ School-Weal Age		olds/2000–2001/United States	Transtheoretical model	physical activity.		P = 0.004).
School-based Obesity Prevention No known theory Program (36)/6th-Buth grade/12–15 y olds/Published in 2008/United States Norwegian School Fruit Program No known theory (37)/7th grade/11–12 y olds/ 2001–2002/Norway Chiec Control, and Change (38)/7th grade/11–13 y olds/ 2006/United States Achool Fruit (39)/Middle School/Mean age 145 y/ action No known theory Chiec control and Change School/Mean age 145 y/ action No known theory No known theory No known theory Chiec control and Change School/Media States Acholited States Achool/Mean age 145 y/ action No known theory School/Media States Acholited S				Graduate nursing students implemented.		
Program (36)/6th-8th Program (36)/6th-9th Program (36)/6th	19	School-based Obesity Prevention	No known theory	Delivered in physical education classes.	16 classroom sessions	Only formative evaluation done
grade/12-15 y olds/Published in 2008/United States  Norwegian School Fruit Program (37)/7th grade/11-12 y olds/ 200-30 min physical activity session. (37)/7th grade/11-12 y olds/ 200-2002/Norway (200-2002/Norway (200-2002/Norway (200-2002/Norway (2006/United States		Program (36)/6th–8th		First 20–30 min discussion on food labels,		
in 2008/United States  Norwegian School Fruit Program No known theory (37)/7th grade/11–12 y olds/ 2001–2002/Norway (37)/7th grade/11–12 y olds/ 2001–2002/Norway (38)/7th grade/11–13 y olds/ 2006/United States  Theory of planned (38)/7th grade/11–13 y olds/ 2006/United States  Present and Prevent (39)/Middle Evaluation based on theory of reasoned commercially. 2008/United States  Michigan Model Nutrition No known theory Commonition School/Mean age 12.5 y/ 2005/United States  Michigan Model Nutrition No known theory Commonition School/Mean age 12.5 y/ Consumption, healthy edited shares  No known theory Present and Vegetable snacks every day.  Topics included causes and health problems of obesity, and overcoming barriers.  School/Mean age 12.5 y/ Cond choices, food able reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  School/Mean age 12.5 y/ Consumption, healthy edited shares  Program (41)/4th-9th grade/2005-2007/ United States  Divinited States  Divinity States  Divinited S		grade/12–15 y olds/Published		portion size, food pyramid, and food		
Nowvegian School Fult Program (37)/The grade/11–12 y olds/ 2001–2002/Noway Choice, Control, and Change (38)/Thi grade/11–13 y olds/ Choice, Control (38)/Middle School/Mean age 145 y/ action Curriculum (40)/Middle Change (125 y/ Condumid Midrigan Model Nutrition Curriculum (40)/Middle Choice, control (38)/Middle Choice, control (39)/Middle Choice, control (39)/Middle Choice, control (39)/Middle Choice, control (30)/Middle Choice (30)/Middle Choice, control (30)/Middle Choice, control (30)/Middle Choice, control (30)/Middle Choice, control (30)/Middle		in 2008/United States		decision making.		
No known theory (1974)  No known theory (1982/Middle States)  No fruit in 9 schools.  1037/7th grade/11–12 y olds/ 2006/United States  1087/7th grade/11–13 y olds/ 2006/United States  1088/7th grade/11–14 y olds/2005-2007/ 2007/United States  1089/7th grade/11/4th-9th				20–30 min physical activity session.		
(37)/7th grade/11–12 y olds/ 2001–2002/Norway Choicz Control, and Change Theory of planned Classroom curriculum in science classes. Units Choicz Control, and Change Theory of planned Classroom curriculum is science classes. Units Classroom curriculum is cleared classes. Units Choicz Chortao, and Change Classroom curriculum is cleared classes. Units Choicz Chortao, and Change Classroom curriculum is cleared classes. Units Choicz Chortao, and Change Choices, role of food and activity endory of period of 7–8 wk of personal data, importance of healthy food choices, role of food and activity endory of reasoned choices, role of food and activity endory of reasoned choices, role of food and activity endory of reasoned choices, role of food and activity endory of reasoned choices, role of food and activity endory entering skills as a competent eater. Two 30-min Power Point presentations available school/Mean age 14.5 y/ action Topics included causes and healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Program (41)/4th-9th grade/9-14 y olds/2005-2007/ United States  Disconting the states  No known theory Program (41)/4th-9th grade/9-14 y olds/2005-2007/ United States  Two academic years	20.		No known theory	Free fruit in 9 schools.	One academic year	Free fruit school had higher intake of fruits and
2001–2002/Norway  Choice, Control, and Change (38)/7th grade/11–13 y olds/ Dehavior and Prevent (39)/Middle Evaluation based on school/Mean age 14.5 y/ action  No known theory  LODA Fresh Fruit and Vegetable Program (41)/4th—9th  grade/9–14 y olds/2005–2007/ United States  Control and Change  Control in 20 schools  Classroom curriculum in science classes. Units and vegetable snacks every day.  Labely of planned classes included causes and health problems of obesity, action  No known theory  Consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable Program (41)/4th—9th  grade/9–14 y olds/2005–2007/ United States  Lond in a choice in the control in the		(37)/7th grade/11–12 y olds/		Paid fruit in 9 schools.		vegetables ( $P < 0.001$ ).
Choice, Control, and Change Theory of planned Classroom curriculum in science classes. Units (38)/7th grade/711–73 y olds/ behavior per included: getting right amount of energy, use period of 7–8 wk 2006/United States competent and Prevent (39)/Middle school/Mean age 14.5 y/ action theory of reasoned commercially.  2008/United States action based on the commercially. Two 30-min Power Point presentations available theory of reasoned commercially. Topics included causes and health problems of obesity, body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  2008/United States brown theory Eight Jesson plans: nutrition knowledge about food concers, food planels, advertising, school/Mean age 12.5 y/ consumption, healthy eating at fast food places.  2006/United States brown theory Proxision of fresh fruit and vegetable snacks every day. Two academic years USDA Fresh Fruit and Vegetable snacks every day. Two academic years Using States brown theory Proxision of fresh fruit and vegetable snacks every day. Two academic years Using States		2001-2002/Norway		No fruit in. 20 schools		Adiposity indices not measured.
(38)/7th grade/11–13 y olds/ behavior included: getting right amount of energy, use period of 7–8 wk 2006/United States chock/Mean age 14.5 y/ action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on theory of reasoned commercially.  2008/United States action based on the following action below the properties and based to the problems of obesity, body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: untition knowledge about food activity, and overcoming barriers.  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years period States.  United States Program (41)/4th—9th	21.	S	Theory of planned	Classroom curriculum in science classes. Units	24 sessions over a	Improvement in eating ( $P < 0.05$ ) and physical
of personal data, importance of healthy food choices, role of food and activity environment, and maintaining skills as a competent eater.  Present and Prevent (39)/Middle Evaluation based on school/Mean age 14.5 y/ theory of reasoned commercially.  2008/United States action commercially.  2008/United States action based on reasoned commercially.  Michigan Model Nutrition No known theory conditions and vegetable snacks every day.  1 wk  2008/United States action based on reasoned commercially.  2008/United States  2005/United States		(38)/7th grade/11–13 y olds/	behavior	included: getting right amount of energy, use	period of 7–8 wk	activity ( $P < 0.05$ ) behaviors.
choices, role of food and activity environment, and maintaining skills as a competent eater.  Present and Prevent (39)/Middle Evaluation based on school/Mean age 14.5 y/ action theory of reasoned commercially.  2008/United States action pook weight, healthy body weight, healthy body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food activity, and overcoming barriers.  Wichigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food activity, and overcoming barriers.  USDA Fresh Fruit and Vegetable No known theory Program (41)/4th-9th grades)  Program (41)/4th-9th grades)  Program (41)/4th-9th grades)  No known theory Provision of fresh fruit and vegetable snacks every day.  Interest, and overcoming partiers.  Two academic years the maintenance of the provision of fresh fruit and vegetable snacks every day.  Interest, and overcoming barriers.  Two academic years the maintenance of the provision of fresh fruit and vegetable snacks every day.  Interest and overcoming partiers.  Two academic years the maintenance of the provision of fresh fruit and vegetable snacks every day.		2006/United States		of personal data, importance of healthy food		
Present and Prevent (39)/Middle schoution based on school/Mean age 14.5 y/ action theory of reasoned school/Mean age 14.5 y/ action based on Two 30-min Power Point presentations available theory of reasoned action action action body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory school/Mean age 12.5 y/ solos/United States  USDA Fresh Fruit and Vegetable No known theory provision of fresh fruit and vegetable snacks every day.  Program (41)/4th—9th grade/9-14 y olds/2005-2007/United States  Using made/9-14 y olds/2005-2007/United States				choices, role of food and activity environment,		
Present and Prevent (39)/Middle Evaluation based on Two 30-min Power Point presentations available 14.5 y/ action 2008/United States action 2008/United States action action body image, benefits of healthy body weight, healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food activity, and overcoming barriers.  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day.  Program (41)/4th–9th grade/9–14 y olds/2005–2007/United States  Using the states of the state of				and maintaining skills as a competent eater.		
school/Mean age 14.5 y/ theory of reasoned commercially.  2008/United States action Projecs included causes and health problems of obesity, body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food groups, food pyramid, food labels, advertising, period of 1 mo groups, food pyramid, food labels, advertising, period of 1 mo body image, increasing fruit and vegetable states  USDA Fresh Fruit and Vegetable No known theory Proxision of fresh fruit and vegetable snacks every day. Two academic years Integrated States  Using the States Integrated States Proxision of fresh fruit and vegetable snacks every day. Two academic years Integrated States	22.		Evaluation based on	Two 30-min Power Point presentations available	1 wk	Changes in dietary knowledge ( $P < 0.001$ ) and
2008/United States action Topics included causes and health problems of obesity, body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food activity, and overcoming barriers.  School/Mean age 12.5 y/ groups, food pyramid, food labels, advertising, period of 1 mo body image, increasing fruit and vegetable consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Integrated States  United States		school/Mean age 14.5 y/	theory of reasoned	commercially.		dietary intentions to eat fewer fried foods,
body image, benefits of healthy body weight, healthy food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food serving activity, and overcoming barriers.  School/Mean age 12.5 y/ school/Mean age 12.5 y/ school/Mean age 12.5 y/ consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable No known theory Proxision of fresh fruit and vegetable snacks every day. Two academic years Integrated States  United States		2008/United States	action	Topics included causes and health problems of obesity,		fewer sweets, and examine food labels
food choices, food label reading, controlling portion size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food serior of 1 mo groups, food pyramid, food labels, advertising, period of 1 mo body image, increasing fruit and vegetable consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Integrade/9-14 y olds/2005-2007/ United States				body image, benefits of healthy body weight, healthy		(P < 0.001).
size, changing unhealthy habits, increasing physical activity, and overcoming barriers.  Michigan Model Nutrition  Curriculum (40)/Middle School/Mean age 12.5 y/ School/Mean				food choices, food label reading, controlling portion		Program satisfaction significantly linked with
activity, and overcoming barriers.  Michigan Model Nutrition  No known theory Eight lesson plans: nutrition knowledge about food 8 lessons over a Image of 1. The period of 1 mo groups, food pyramid, food labels, advertising, period of 1 mo school/Mean age 1.25 y/ body image, increasing fruit and vegetable consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable  No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Int grade/9–14 y olds/2005–2007/ United States				size, changing unhealthy habits, increasing physical		behavioral intentions.
Michigan Model Nutrition No known theory Eight lesson plans: nutrition knowledge about food 8 lessons over a Im Curriculum (40)/Middle groups, food pyramid, food labels, advertising, period of 1 mo school/Mean age 12.5 y/ body image, increasing fruit and vegetable consumption, healthy eating at fast food places.  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Int grade/9-14 y olds/2005-2007/ United States				activity, and overcoming barriers.		
Curriculum (40)/Middle groups, food pyramid, food labels, advertising, period of 1 mo school/Mean age 1.25 y/ body image, increasing fruit and vegetable 2005/United States  USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Int grade/9-14 y olds/2005-2007/ United States	23.		No known theory	Eight lesson plans: nutrition knowledge about food	8 lessons over a	Improvements in nutrition knowledge, eating
school/Mean age 12.5 y/ 2005/United States 2005/United States 2005/United States USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Int grade/9-14 y olds/2005-2007/ United States		Curriculum (40)/Middle		groups, food pyramid, food labels, advertising,	period of 1 mo	behaviors, and efficacy expectations
2005/United States  LOSDA Fresh Fruit and Vegetable  No known theory  Provision of fresh fruit and vegetable snacks every day.  Program (41)/4th-9th  grade/9-14 y olds/2005-2007/  United States		school/Mean age 12.5 y/		body image, increasing fruit and vegetable		regarding healthy eating.
USDA Fresh Fruit and Vegetable No known theory Provision of fresh fruit and vegetable snacks every day. Two academic years Int Program (41)/4th–9th grade/9–14 y olds/2005–2007/ United States				consumption, healthy eating at fast food places.		
	24.		No known theory	Provision of fresh fruit and vegetable snacks every day.	Two academic years	Intervention group showed an increased
		Program (41)/4th–9th				willingness to try new fruits compared to
		grade/9-14 y olds/2005-2007/				control group (24.8 vs. 12.8%, $P < 0.01$ ) and
		United States				new vegetables (25.1 vs. 18.4%, $P = 0.01$ ).

(Continued)

**Table 1**. (Continued)

~	Study/grade/age/year/country	Theory	Dietary components of the Intervention	Duration	Salient findings
١.		Social cognitive	Girls-only alternative PE program that focused on	16 wk	Majority of outcomes were not significant.
	grade/14-17 y olds/2000-2001/ theory	theory	environmental, personal, and behavioral factors		
	United States		for nutrition and physical activity.		
			Nutrition sessions focused on building skills and		
			self-efficacy for eating behaviors.		

reified and followed those over time. To improve any theory, it is important to find out which components or constructs of that theory are working and to what extent. Hence, it becomes very important to operationalize the constructs of a theory and document changes in these constructs as a result of the intervention. Future researchers and intervention evaluators could develop psychometrically robust instruments that measure the changes in constructs of the theory that is being used in the intervention and track those over time.

In terms of the impact of the program, most programs have measured changes in antecedents of childhood obesity such as dietary knowledge, dietary attitudes, dietary behavior, etc. Six interventions (20,24,29-31,36) did not measure these antecedents. From the 19 interventions that measured antecedents of childhood obesity, 15 interventions (15,17,18,21,26-28,32,34,35,37-41) showed significant changes in the favorable direction for these antecedents, whereas 4 (14,19,33,42) could not demonstrate any significant change. It is important that all interventions measure changes in antecedents of childhood obesity. Psychometrically valid and reliable instruments must be developed to measure these antecedents and reported by all interventions. When it comes to measuring changes in adiposity indices such as BMI, waist circumference, skinfold thickness, etc., slightly more than one-half, only 14 interventions, measured these. From these 14 interventions, only 6 (15,20,21,24,27,30) were able to demonstrate significant changes in adiposity indices or could be considered successful in affecting childhood obesity. The characteristics of the successful programs are not straightforward. From these 6 interventions, 4 (15,20,21,24) focused on both physical activity and dietary behaviors and 2 (27,30) focused on only dietary behaviors. From these 6 interventions, only 2 (21,30) used behavioral theories and 4 (15,20,24,27) did not explicitly focus on any behavioral theory.

In terms of duration, approximately one-half of the interventions (13) were longer than 6 mo. Four interventions (15,35,39,40) were <1 mo long and 8 interventions (18,28,32–34,36,38,42) were between 1 and 6 mo. Of the 6 interventions that measured adiposity indices and were successful in altering them, the study durations were 8 h [nutrition education (15)], 3 y (20), 10 y (21), 1 academic year (24), 1 y (27), and 2 y (30). From this it is evident that, although short duration interventions can be successful, it is usually the interventions that are longer than 6 mo that tend to be more successful. For behavior change to take place, usually 6 mo is considered a minimum time (44). Future research must aim at designing interventions that are at least 6 mo in duration.

In terms of activities, all interventions except 2 (37,41) focused on a curricular component related to dietary education. The 2 interventions that did not use a curricular component distributed free fruit (37) or provided fruit and vegetable snacks (41). Although neither of these interventions measured changes in adiposity, they did demonstrate significant changes in antecedents of behavior, particularly consumption of fruits and vegetables. Hence, it can be said that there is some merit to providing fruits and

Table 2. Summary of designs used in evaluation of school based childhood obesity prevention interventions

n	Study	Design
1.	Fit for Life (14)	Quasi experimental
2.	Kiel Obesity Prevention Study (KOPS) (15,16)	Quasi experimental
3.	Be Smart (17)	Experimental with random assignment at individual level
4.	Peer Modeling and Rewards (18)	Quasi experimental
5.	StEP TWO program (19)	Quasi experimental
6.	Obesity intervention in Beijing (20)	Experimental with random assignment at group level
7.	Cretan Health and Nutrition Education Program (21–23)	Experimental with random assignment at group level
8.	Diet and Nutrition Intervention (24)	Quasi experimental
9.	Active Program Promoting Lifestyle Education in School (APPLES) (25,26)	Experimental with random assignment at group level
10.	Carbonated Drink Reduction (27)	Experimental with random assignment at group level
11.	Pathways (28)	Experimental with random assignment at group level
12.	SWITCH (29)	Not yet evaluated
13.	Policy-based School Intervention (30)	Experimental with random assignment at group level
14.	Louisiana Health (31)	Experimental with random assignment at group level
15.	Social Cognitive Theory based Intervention (32)	Pre-test post-test design
16.	Pilot Community Prevention Program (33)	Pre-test post-test design
17.	Nutrition in the Garden (34)	Quasi experimental
18.	Stage-based Intervention (35)	Quasi experimental
19.	School-based Obesity Prevention Program (36)	Only formative evaluation done
20	Norwegian School Fruit Program (37)	Experimental with random assignment at individual level
21.	Choice, Control, & Change (38)	Pre-test post-test design
22.	Present and Prevent (39)	Experimental with random assignment at group level
23.	Michigan Model Nutrition Curriculum (40)	Quasi experimental
24.	USDA Fresh Fruit and Vegetable Program(41)	Quasi experimental
25.	New Moves (42,43)	Experimental with random assignment at group level

vegetables for initiation of behavior. Most of the interventions that used curricula developed their own, but some of the interventions used existing curricula such as the AHA's Heart Power kits (14), Know Your Body (21,30), and Planet Health curriculum (30). The topics in dietary education curricula have included: nutrition knowledge about food groups, information about the Food Pyramid, food label reading, advertising, body image, ways to increase fruit and vegetable consumption, healthy eating at fast food restaurants, self-monitoring of food consumption, building self-esteem, modification of environmental cues, building self-efficacy for healthy eating, controlling portion size, consuming an appropriate amount of energy, healthy food choices, causes and health problems of obesity, and benefits of healthy body weight. Future curricula can focus on some or all of these areas for building a dietary component in childhood obesity prevention programs. Besides providing dietary education in the classroom, other activities used by interventions included involvement of parents and grandparents (14,18–21,24,28–30,33), organizing fairs and festivals (14), counseling (15,31), home visits (15), food tasting (17), giving incentives (17,18), customized videos (18), selling healthier food at school kiosks (24), modification of school meals (25,28), contests (24), developing nutrition policy (30), social marketing of healthy foods (30), improving social support (31), and garden based activities (34). This is quite an exhaustive list of potential activities that future intervention planners can consider incorporating. Of particular importance is parental and family involvement, which many interventions have used and has a greater potential to influence dietary behaviors.

Most of the interventions (18) focused on individual level behavior change strategies and only 7 (15,25,28-31,42) focused on environmental and policy level changes. Only 2 (15,30) of the 7 interventions that focused on environmental approaches were effective in significantly influencing adiposity indices. Some of the environmental and policy strategies included development of social support (15), changes in school environment (25), modification of school meals (25,28,29), changes in nutrition policy (30), and modification of environmental cues (31,42). Future interventions need to develop stronger strategies to influence environmental and policy level constructs and also measure changes in these constructs.

In terms of the design used in the evaluation of these interventions, the predominant designs were an experimental design with random assignment at the group (class, school, or cluster) level, which was used by 9 studies (20,21,25,27,28,30,31,39,42), and a quasi experimental design, which was also used by 9 interventions (14,15,18,19,24,34,35,40,41) (Table 2). Three studies used a pre-test post-test design (32,33,38) and 2 studies (17,37) used an experimental design with random assignment at individual level. The pre-test post-test design is a rather weak design and does not provide much evidence toward causality. The experimental design with random assignment at the individual level is a pretty robust design, but, unfortunately, in school settings it is often not possible to randomly assign students to 2 groups. The students are already divided into classes and breaking them into separate groups is often too disruptive. The experimental design with random assignment at the group level has been a popular design and is also useful in establishing causality. Of the 6

interventions that demonstrated significant changes in adiposity indices, 4 (20,21,27,30) used an experimental design with random assignment at the group level. This design could be used by future evaluators. However, in this design the unit of randomization is group and unit of analysis is individual data and therefore adjustment must be made during analysis.

In terms of the person implementing the intervention, the majority of the interventions (18) were implemented by teachers. In addition to teachers, some interventions were implemented by guest teachers comprising education majors from a local university (14), a team of nutritionists and school teachers (15,24), researchers (17,27,33), graduate nursing students (35), and school lunch personnel (37,41). Teachers seem to be the most logical choice, because they are certified to teach, know the students, are present in the school, and can be easily trained in the curriculum and other aspects of the intervention. Using trained nutritionists or dietitians is also a good idea. Both the interventions that used a team of nutritionists and teachers were successful in changing adiposity indices. Interventions could at least use the nutritionists or dietitians in planning the intervention. None of the interventions used trained health educators in implementing the intervention and these functionaries that are available in countries like United States can also be used by future interventions, because they have systematic training in planning, implementing, and evaluating health education programs.

Only 8 interventions conducted process evaluation or measured aspects of quality of intervention implementation (17,25,28,30,36,37,39,42). The majority of the interventions (17) did not conduct process evaluation, which is an important precursor to impact and outcome evaluation (46). If the process is not good, then there will be no impact. Of the interventions that did conduct process evaluation, most focused on satisfaction or attendance in the program. Very few interventions documented the degree of fidelity in implementation of the planned curriculum. Developing instruments that measure degree of fidelity and implementing those instruments help in reassuring that the curriculum was indeed implemented the way it was designed.

### Limitations

There are some limitations in this review. First, only interventions published in the English language were included and many interventions, especially in international settings, are published in other languages. Second, only interventions published in 3 databases (MEDLINE, CINAHL, and ERIC) were included. Although these databases are quite extensive, they do not tap into all the health literature from every country. Third, many of the interventions, especially those conducted in international settings, often did not meet the rigors of being published in peer-reviewed journals and were thus excluded. Fourth, only 1 researcher retrieved and examined the studies and this could cause some bias. Ideally, 2 or more researchers should have independently worked on this review. This is not a systematic review and

no quality assessment was conducted. Fifth, this review focused on nutrition education alone and it seems, nutrition education in combination with physical activity is more effective than nutrition education only, but we cannot draw any conclusions regarding physical activity components alone. Finally, differing evaluation methodologies and outcome indices were used in the chosen studies. In the selection criteria, attempts were not made to filter studies based on methodology or outcome indicators, but effort was made to be more inclusive of various interventions. As a result, conclusive meta-analysis type of work cannot be done with these studies and comments cannot be made regarding the effect size of the interventions.

### Implications for practice

A summary of recommendations for future school based childhood obesity prevention dietary interventions is presented in Table 3. Sequential K-12 school based interventions that focus on dietary education could be planned to address the issue of childhood overweight and obesity. If K-12 programming is not feasible, then upper elementary and lower middle school grades would be most appropriate targets for changing dietary behaviors and could be focused. Childhood obesity interventions can focus solely on changing dietary behaviors, but in order to enhance their impact these must be coupled with changing physical activity behaviors also. If the intervention is based on a behavioral theory, then it has several advantages. Social cognitive theory is a popular theory that works well with children and could be used in planning and evaluating interventions. Most interventions use a behavioral theory but do not measure the changes in constructs of that theory. Absence of such data prevents advancement of our understanding about what works and what does not. There is need to develop psychometrically robust instruments that can discern the changes in the constructs of various behavioral theories being used by intervention researchers.

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**Table 3.** Summary of recommendations for future school based childhood obesity prevention dietary interventions

### Summary of recommendations

Focus on upper elementary and lower middle school grades Coupling dietary behaviors with physical activity behaviors Use of behavioral theory (such as social cognitive theory) in planning and evaluation

Measurement of impact at 3 levels: 1) constructs of behavioral theory; 2) dietary behavior; 3) adiposity indices

Duration of at least 6 mo

Use of curriculum coupled with parental/family involvement Inclusion of environmental and policy approaches such as building social support, modification of school meals, and changes in nutrition policies

Use of teachers for implementation coupled with nutritionists/ dietitians or health educators

Utilization of experimental design with random assignment at group level

Utilization of process evaluation to assess degree of fidelity of implementation and satisfaction

To assess the impact of the dietary component of childhood obesity prevention programs, efforts must be made to measure changes at 3 levels. First, as discussed in the previous paragraph, assessment of the changes in constructs of the behavioral theory must be made. Second, changes in dietary behavior such as fruit and vegetable consumption, portion size, consumption of sweetened beverages, etc. could be measured. Finally, changes in adiposity indices such as BMI, skinfold thickness, waist circumference, etc. could be measured and reported. It is very important that all interventions could systematically measure and document changes at all 3 levels. Such practice would help in estimating effect sizes of interventions and improving efforts at addressing the issue of childhood obesity.

It can be recommended that interventions be at least 6 mo long, and introduction of education through a curriculum seems to be the best approach. This should be complemented by other approaches such as parental and family involvement. Further individual approaches to behavior change should be complemented with environmental and policy approaches such as building social support, modification of school meals, and changes in nutrition policies. In terms of the person implementing the intervention, teachers are most appropriate. They can be complemented by employing nutritionists/dietitians or health educators.

For evaluation of interventions, the most useful design is experimental with random assignment at the group level. If this is not possible, then quasi experimental designs can also be instituted. Finally, all interventions must utilize process evaluation and assess degree of fidelity of implementation and satisfaction.

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### **Literature Cited**

- 1. Obesity and overweight [Internet]. Geneva: WHO [updated 2009; cited 2009 Jun 26]. Available from: http://www.who.int/dietphysicalactivity/ publications/facts/obesity/en/print.html.
- 2. Jolliffe D. Extent of overweight among US children and adolescents from 1971 to 2000. Int J Obes Relat Metab Disord. 2004;28:4-9.
- 3. Lobstein T, Frelut ML. Prevalence of overweight among children in Europe. Obes Rev. 2003;4:195-200.
- 4. Wang Y, Monteiro C, Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. Am J Clin Nutr. 2002;75:971-7.
- 5. Lobstein T, Baur L. Uauy R. Obesity in children and young people: a crisis in public health. Obes Rev. 2004;5 Suppl 1:4-104.
- 6. Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. Prev Med. 1993;22:167-77.
- 7. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med. 1997;337:869-73.
- 8. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. Pediatrics. 1999;103:1175-82.
- 9. Childhood overweight and obesity. Consequences [Internet]. Atlanta: CDC [updated 2009 May 28; cited 2009 Jun 26]. Available from: http://www.cdc.gov/obesity/childhood/consequences.html.

- 10. Erickson SJ, Robinson TN, Haydel KF, Killen JD. Are overweight children unhappy. Arch Pediatr Adolesc Med. 2000;154:931-4.
- 11. Schwartz MB, Puhl R. Childhood obesity: a societal problem to solve. Obes Rev. 2003;4:57-71.
- 12. Office of the Surgeon General. The Surgeon General's call to action to prevent and decrease overweight and obesity. Rockville (MD): Office of the Surgeon General; 2001.
- 13. Gerberding JL, Marks JS. Making America fit and trim-steps big and small. Am J Public Health. 2004;94:1478-9.
- 14. Gombosi R, Olasin R, Bittle J. Tioga county fit for life: a primary obesity prevention project. Clin Pediatr (Phila). 2007;46:592-600.
- 15. Müller MJ, Asbeck I, Mast M, Langnase K, Grund A. Prevention of obesity: more than an intention. Concept and first results of Kiel Obesity Prevention Study (KOPS). Int J Obes Relat Metab Disord. 2001;25 Suppl 1:S66-74.
- 16. Danielzik S, Pust S, Landsberg B, Müller MJ. First lessons from the Kiel Obesity Prevention Study (KOPS). Int J Obes (Lond). 2005;29 Suppl 2: S78-83.
- 17. Warren JM, Henry CJK, Lighttowler HJ, Bradshaw SM, Perwaiz S. Evaluation of a pilot school programme aimed at the prevention of obesity in children. Health Promot Int. 2003;18:287-96.
- 18. Horne PJ, Tapper K, Lowe CF, Hardman CA, Jackson MC, Woolner J. Increasing children's fruit and vegetable consumption: a peer modeling and rewards-based intervention. Eur J Clin Nutr. 2004;58: 1649-60.
- 19. Graf C, Rost SV, Koch B, Heinen S, Falkowski G, Dordel S, Bjarnason-Wehrens B, Sreeram N, Brockmeier K, et al. Data from the StEP TWO programme showing the effect on blood pressure and different parameters for obesity in overweight and obese primary school children. Cardiol Young. 2005;15:291-8.
- 20. Jiang J, Xia X, Greiner T, Wu G, Lian G, Rosenqvist U. The effects of a 3-year obesity intervention in schoolchildren in Beijing. Child Care Health Dev. 2007;33:641-6.
- 21. Manios Y, Moschandreas J, Hatzis C, Kafatos A. Health and nutrition education in primary schools of Crete: changes in chronic disease risk factors following a 6-year intervention programme. Br J Nutr. 2002;88:315-24.
- 22. Kafatos A, Manios Y, Moschandreas J, Preventive Medicine and Nutrition Clinic University of Crete Research Team. Health and nutrition education in primary schools of Crete: follow-up changes in body mass index and overweight status. Eur J Clin Nutr. 2005;59:1090-2.
- 23. Kafatos I, Manios Y, Moschandreas J, Kafatos A, Preventive Medicine and Nutrition Clinic University of Crete Research Team. Health and nutrition education program in primary schools of Crete: changes in blood pressure over 10 years. Eur J Clin Nutr. 2007;61:837-45.
- 24. Kain J, Uauy R, Albala VF, Cerda R, Leyton B. School based obesity prevention in Chilean primary school children: methodology and evaluation of a controlled study. Int J Obes Relat Metab Disord. 2004;28: 483-93
- 25. Sahota P, Rudolf MCJ, Dixey R, Hill AJ, Barth JH, Cade J. Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. BMJ. 2001;323:1027-9.
- 26. Sahota P, Rudolf MCJ, Dixey R, Hill AJ, Barth JH, Cade J. Randomised controlled trial of primary school based intervention to reduce risk factors for obesity. BMJ. 2001;323:1029-32.
- 27. James J, Thomas P, Cavan D, Kerr D. Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomized controlled trial. BMJ. 2004;328:1237-9.
- 28. Caballero B, Clay T, Davis S, Ethelbah B, Rock B, Lohman T, Norman J, Story M, Stone EJ, et al. Pathways: a school-based randomized controlled trial for the prevention of obesity in American Indian school children. Am J Clin Nutr. 2003;78:1030-8.
- 29. Eisenmann JC, Gentile DA, Welk GJ, Callahan R, Strickland S, Walsh M, Walsh DA. SWITCH: rationale, design, and implementation of a community, school, and family-based intervention to modify behaviors related to childhood obesity. BMC Public Health. 2008;8:223.
- Foster GD, Sherman S, Borradalie K, Grudny K, Vander Veur S, Nahcmani J, Karpyn A, Kumanyika S, Shults J. A policy-based school

- intervention to prevent overweight and obesity. Pediatrics. 2008;121:
- 31. Williamson DA, Champagne CM, Harsha D, Han H, Martin CK, Newton R, Stewart TM, Ryan DH. Louisiana (LA) health: design and methods for a childhood obesity prevention program in rural schools. Contemp Clin Trials. 2008;29:783-95.
- 32. Canavera M, Sharma M, Murnan J. Development and pilot-testing a social cognitive theory-based intervention to prevent childhood obesity in Kentucky. Int Q Community Health Educ. 2008-2009;29:57-70.
- 33. Hawley SR, Beckman H, Bishop T. Development of an obesity prevention and management program for children and adolescents in a rural setting. J Community Health Nurs. 2006;23:69-80.
- 34. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. J Am Diet Assoc. 2007;107:662-5.
- 35. Frenn M, Malin S, Bansal N. Stage-based intervention for low-fat diet with middle school students. J Pediatr Nurs. 2003;18:36-45.
- 36. Ward-Begnoche W, Gance-Cleveland B, Harris M, Dean J. Description of the design and implementation of a school-based obesity prevention program addressing needs of middle school students. J Appl Sch Psychol. 2008;24:247-63.
- 37. Bere E, Veierod MB, Klepp K. The Norweigian school fruit programme: evaluating paid vs. no-cost subscriptions. Prev Med. 2005;

- 38. Contento I, Koch P, Lee H, Sauberli W, Calabrese-Barton A. Enhancing personal agency and competence in eating and moving: formative evaluations of a middle school curriculum: choice, control, and change. J Nutr Educ Behav. 2007;39:S179-86.
- 39. Abood DA, Black DR, Coster DC. Evaluation of a school-based teen obesity prevention minimal intervention. J Nutr Educ Behav. 2008;40:168-74.
- 40. Fahlman MM, Dake JA, McCaughtry N, Martin J. A pilot study to examine the effects of a nutrition intervention on nutrition knowledge, behaviors, and efficacy expectations in middle school children. J Sch Health. 2008;78:216-22.
- 41. Jamelske E, Bica L, McCarty D, Meinen A. Preliminary findings from an evaluation of the USDA fresh fruit and vegetable program in Wisconsin schools. WMJ. 2008;107:225-30.
- 42. Neumark-Sztainer D, Story M, Martin S. New moves: a school-based obesity prevention program for adolescent girls. Prev Med. 2003;37:41-51.
- 43. Flattum C, Friend S, Neumark-Sztainer D, Story M. Motivational interviewing as a component of a school-based obesity prevention program for adolescent girls. J Am Diet Assoc. 2009;109:91-4.
- 44. Sharma M, Romas JA. Theoretical foundations of health education and health promotion. Sudbury (MA): Jones and Bartlett Publishers; 2008.
- 45. Bandura A. Health promotion by social cognitive means. Health Educ Behav. 2004;31:143-64.
- 46. Green LW, Kreuter M. Health promotion planning: an educational and ecological approach. 4th ed. Boston: McGraw Hill; 2005.