

PARENTS ROLE IN SCHOOL INTERVENTION PROGRAMS TO TREAT OBESITY IN
CHILDREN: A SYSTEMATIC REVIEW

Project

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Jesse Cyle Gavin

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We the undersigned, certify that we have read this project and approve it as adequate in scope and quality for the Master's Degree in Fitness and Human Performance.



Terry Dupler, Ph.D.
Project Director



William Amonette, M.A.
Committee Member



Howard Eisner, Ph.D.
Associate Dean for Academic Affairs



Bruce Palmer, Ph. D.
Dean

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Abstract

Objective: To determine whether school based interventions that include parents, as well as the child(ren), provide greater results than interventions involving the child(ren) alone.

Data Sources: A search was performed using Google Scholar, PubMed, Academic Search Complete, PsycArticles, JSTOR Arts, MEDLINE, SAGE Premier 2007, Cochrane Database, and Wiley InterScience Journals from August 2008 through January 2009.

Review Methods: A systematic review was performed to answer the question: Does parental involvement in intervention programs designed to treat childhood obesity have a direct effect on the outcome. To be included in the review the selected random controlled trial (RCT) had to have children that had $\geq 85\%$ body mass index (BMI) for their age, children had to be 6-18 years of age, the study had to perform body fat percentage (BF%) measurements rather than just BMI, and interventions had to include both a nutrition education and physical activity portion. Studies were not included in the review if the subjects took medication for weight issues or if the study was performed before 1990. The Physiotherapy Evidence Database (PEDro) scale was also used to determine the quality of the articles. BF% was the conclusive factor to determine whether parents' involvement in interventions had a direct affect on childhood obesity interventions.

Results: Five articles met the inclusion criteria. Four of the articles scored a 6 on the PEDro scale and one study scored a 5 because it did not have more than 85% of the initial subjects complete at least one outcome measure. Decrease in body fat percentage (BF%) was the determining factor in deciding whether parents had a significant effect on the outcome of the intervention.

Conclusion: From the current research it cannot be concluded that parental involvement has a direct effect on the results of interventions that are designed to treat childhood obesity. There are

too many dependant variables that could change the outcome; and future research, where parents are the sole dependant variable, needs to be done.

Keywords: Childhood obesity, Systematic reviews, Parents, Childhood interventions

Introduction

Childhood obesity is a pandemic that has swept through our society for the past three decades (1). According to the 2007 Youth Risk Behavior Survey (YRBS) (2), the percentage of students that were found to be obese rose 2.3% between 1999 and 2007. The Center for Disease Control reported between 1976 and 2006 that childhood obesity rose from 5% to 12.4% in children aged 2-5. It rose from 6.5% to 17% in children aged 6-11, and rose from 5% to 17.6% in adolescents aged 12-19 (3). Overweight is defined as having a body mass index (BMI) percentile that is $\geq 85\%$ for a person's age and obese is defined as $\geq 95\%$ (3). There are many causes for this chain reaction.

Causes of Obesity

The following have been shown to contribute to this epidemic:

The number of children who participate in physical education has decreased.

Overall physical activity has decreased from 65.8% to 62.7% between 1993 and 2003 (4).

Physical education programs in schools are being cut because the money can be used elsewhere (5, 6).

The YRBS reported the number of students that participate in school physical education decreased from 41.6% to 25.4% between 1991 and 1995 (2). Since the Bush administration's No Child Left Behind Act, schools and the nation have been looking directly at the education programs and making sure children are capable of advancing through the school system. This hinders physical fitness programs because all of the school's budget is being used to provide tutors and other resources that will help children (7). In 2001 only 3 states, Illinois, New Jersey and Iowa, required students to participate in 2.5 to 4 years of physical education. Eleven states

did not mandate any physical education requirements for students to get their high school diploma (8). In a 2004 year-end report on physical education, 11 states reported either not having physical education requirements or only statutorily mandated physical education instruction. These states, however, did not have any graduation requirements regarding physical education (9). Texas requires that a student must participate in 1.5 semesters of physical education in order to graduate. Those semesters could be substituted for other physical activity-related classes such as athletics or other activities including band, ROTC, dance, cheerleading, or drill (9).

Parents' attitude toward their children being overweight, lack of parental education, and knowledge about childhood obesity (10).

Eckstein et al. (11) studied parental views of their children's weight and found that thirty-six percent of the parents viewed their overweight children as overweight. Only 26% of the parents worried about their children being overweight and 18% remembered a doctor being concerned about the child being overweight. In another study (12), parents were reluctant to seek help from a professional with their child being overweight. Earlier understanding and education of the effects of childhood obesity could help parents realize their child(ren) need help.

Straus and Knight found that many different factors related to the parents themselves increased the likelihood of their children becoming overweight. The factors are things such as not having graduated high school, being a single parent, and being unemployed (13). If parents have a better understanding about proper nutrition and how important physical activity is, they would be able to instill this healthy lifestyle methodology into their children.

School lunches are not healthy and unhealthy snacks are readily available to children throughout the school day (14, 15).

From age 6 or 7 until graduation from high school, children spend around 7 hours a day Monday through Friday at school, not including any extracurricular activities. If you exclude the 6 -10 hours of sleep children should be getting, they spend around 50% of their day at school and school-related activities. Programs in schools allow children to purchase unhealthy items at lunch and purchase items from vending machines (16). Vending machines allow schools to make extra money to fund certain programs but also allow children to purchase unhealthy snacks throughout the day (17). Kubik et al. found that 93% of the items sold in the schools were unhealthy items, fattening items or sweetened drinks (16).

Some school based programs have made great strides in the effort to reduce childhood obesity, but most schools are just starting to adopt these programs. Heart Smart and the Coordinated Approach to Child Health (CATCH) (18, 19) are two programs that attempted to educate cafeteria workers and encourage schools to meet the US Department of Agriculture's (USDA) Dietary Guidelines for Americans. These guidelines include incorporating at least 5 servings of fruits and vegetables and limiting the daily intake of fat to less than 30% (16). A study performed by Hoelscher et al. found that around 82% of the schools participating in the CATCH program completed all guidelines according to the USDA (15).

Children are getting less sleep and leading busier lives (20).

From 1996 to 1998, girls aged 15-17 worked an average of 16 hours per week during the school year (21). This same study found that girls who worked were more likely not to participate in extracurricular activities such as sports programs after school, but in this study, girls that worked were more likely to be active than girls that did not. This could be due to the fact that working is activity and some activity is better than sitting at home.

As children get older and start socializing, late night activities could prevent them from getting sleep. Chen et al. found that adequate sleep is positively associated with healthy behaviors, reducing the rate of obesity, and reducing the number of visits to the doctor (20). In the same study, 54% of the students that participated reported getting less than the recommended amount of sleep, 6-8 hours, on a school night (20).

Meal frequency and eating patterns are also a cause for concern in today's busy society. Two habits that have been positively associated with obesity are skipping breakfast and increased frequency of eating in restaurants. In the review written by Nicklas et al., the researchers concluded that the energy intake over time has remained the same but the macronutrient density of the food children are eating has changed (22), meaning that the number of calories children are consuming has not varied but the types of foods children are eating do not have as many vitamins and nutrients. The researchers cite many possible causes for obesity including an increase in eating restaurant meals, food availability, portion sizes, snacking, and meal-skipping. Results found from a study performed by Ma et al. (23) indicated a greater meal frequency in children resulted in a reduced risk of being overweight or obese. On the contrary, skipping breakfast was positively correlated with being overweight. Also, eating dinner away from home was an indicator of children being overweight or obese. Mota et al. performed a study using a questionnaire and found that children who were already obese were more likely to skip breakfast than their normal weight counterparts, 13% versus 5.6% (24). The researchers did not find any differences in girls, but in boys an additional meal in the day decreased the risk of becoming overweight or obese. In contrast to the Ma et al. (23), the results found in the Mota et al. study determined that breakfast skipping was not a predictor of being overweight/obese.

Children are spending more time watching television or playing computer games (25-27).

Television (TV) and computers contributed to children skipping meals. A study done by Bulk and Eggermont (28) found that 10% of children aged 13 and 16 skipped at least one meal a week in order to watch television or play computer games. In the same study, it was found that 25% of participants rushed through a meal in order to watch a certain television show or play a computer game.

The current recommendation for total media time, television and computers, made by the American Academy of Pediatrics, is 2 hours or less per day. In 2007, the percentage of children who reported spending 3 or more hours a day playing video games was 24.9 % and the procedure that reported watching at least 3 hours of TV per day was 35.4% (2). This is significantly higher than in 2009 when the percentage of children who reported watching TV for at least 4 hours a day during the school week was 25% (25). Furthermore, in the same review of the 2009 YRBS, Eiseman et al. also found students who reported watching less than an hour of TV per day were 40% less likely to be overweight or obese compared to the students who reported watching at least 4 hours per day (25). Laurson et al. supported these findings by examining the risk factor of children being overweight based on the amount of media time they participated in or the lack of physical activity. The researchers found that children who did not adhere to the recommendations of limited media time and inclusion of physical activity, (11,000 to 13,000 steps per day was used in this study) were 35% to 40% more likely to be overweight. A study done by Gable et al. introduced a new factor while enhancing earlier findings. He and his colleagues found that students who watched more television, ate fewer meals with their families, and lived in neighborhoods that were deemed unsafe by their parents were more likely to have

persistent weight problems (27). This conclusion leads to the point that today's society is not as safe as it was just 10 years ago.

Interventions

Being an overweight child can lead to many social and physical complications such as obesity, stereotyping, bullying, Type 2 diabetes, heart disease later in life, higher health insurance costs and economic spending, amputations, renal failure, kidney problems, joint problems, and many other side effects (1, 3, 29-37) Dr. Risa Lavizzo-Mourey, president and CEO of the Robert Wood Johnson Foundation, stated, "If America is not careful the next generation will be the first to bury their children" (38). Morrill and Chinn (1) reported the average spending on health care by individuals who were overweight or obese ranged from 50 to 80 million dollars between 1996 and 1998.

Since the mid 70's, schools and researchers have been trying interventions to make school lunches healthier (19, 30) and make children more active through the day. Childhood obesity interventions have been shown to significantly reduce the risk of heart disease and obesity. They can also help subjects decrease body fat percentage(BF%), decrease bodyweight, increase endurance, decrease television watching time, and improve insulin sensitivity in children that already have type 2 diabetes (39-44).

Parents have an important role in whether their child(ren) become obese adults. (10, 13, 45). When they are young, children mimic their parents' behavior when deciding what actions to take (46). If their parents eat unhealthy foods, then their child(ren) will as well. Also, parents decide what the child will eat for the first part of their life. In one study researchers found that having one or two obese parent(s) significantly increases a child's risk of becoming an obese adult (47). This is especially true if their mother was obese (47). Some have investigated the role

of parents in childhood obesity (48-51) but few have quantified the effect of parental influence on outcomes of a school intervention dealing with obese children. The purpose of this review is to determine whether parental involvement in school intervention programs designed to treat childhood obesity has a direct affect out the results.

Methods

A systematic review is defined as “a review of the evidence on a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant primary research, and to extract and analyze data from the studies that are included in the review”(52). Writing a systematic review allows a researcher to answer a specific question on a given subject in an outlined and systematic manner. Theoretically, a narrative literature review just explains the current research and is often subject to researcher bias. The authors of a narrative literature review sometimes have a preconceived notion about the subject they are writing about and they look for research that supports their claim(52). Systematic reviews start off with a question and the researcher uses certain specific criteria to separate relevant and valid research. The evidence based question for this review was: Does parental involvement have a direct affect on school interventions aimed at decreasing the rate of childhood obesity in America.

A literature search was performed using Google Scholar, PubMed, Academic Search Complete, PsycArticles, JSTOR Arts, MEDLINE, SAGE Premier 2007, Cochrane Database and Wiley InterScience Journals to find literature related to childhood obesity. Key words and phrases used were “childhood obesity interventions,” “school based childhood obesity interventions,” “family- based childhood obesity interventions,” “parents and childhood obesity,” and “obese parents and obese children.” Search parameters that were used included English and peer reviewed articles.

Abstracts specific to childhood interventions, childhood obesity, and parent-child obesity were researched for this review (Figure 1). The citations from the chosen abstracts were cross-referenced for additional articles. The primary reasons for exclusion were either a lack of school

interventions or interventions that dealt with different social problems. Also, there was a variety of literature reviews or research proposals that outlined the methods of experiments that had not

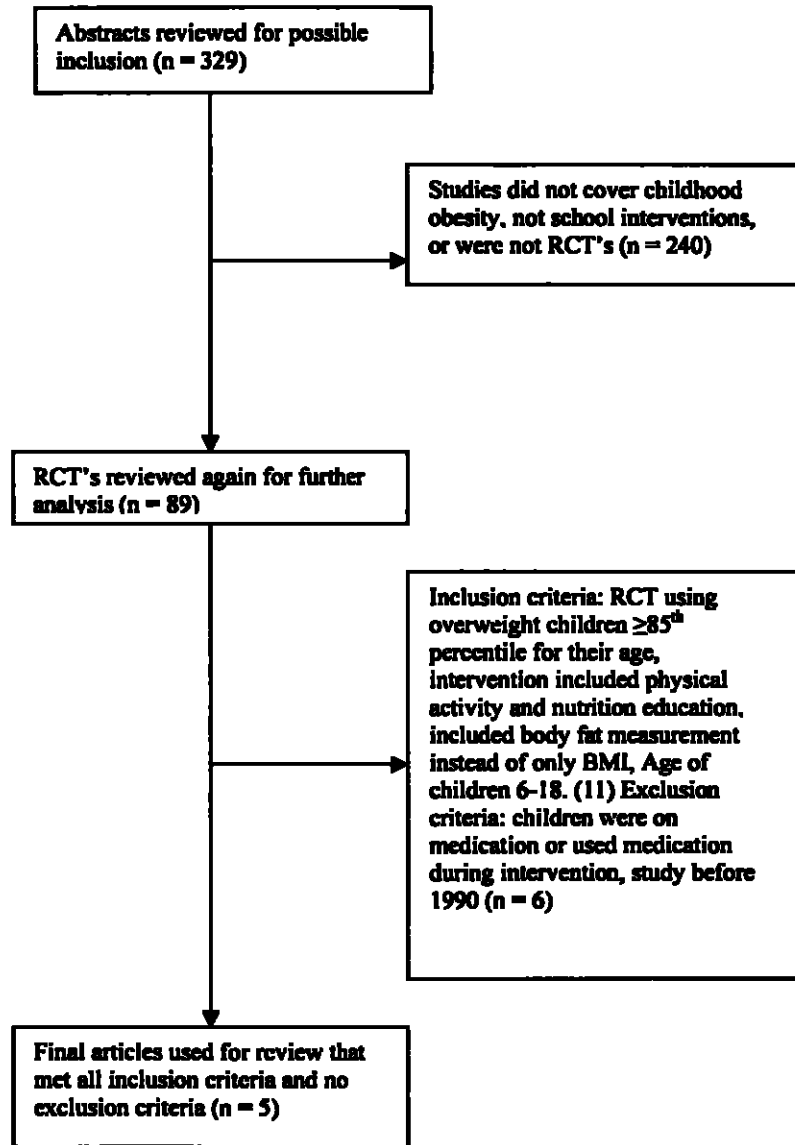


Figure 1: Criteria for Review Articles

yet taken place. Articles that were reviewed for final inclusion and exclusion criteria were randomized controlled trials (RCTs) that dealt with childhood obesity through a school intervention.

For quality purposes, inclusion and exclusion criteria were identified. To be included in the review the study had to investigate the outcome of the intervention on children that were at least $\geq 85\%$ BMI for their age. This would put them in an overweight category. Studies that included only overweight children were used to exclude children that were already active or fit that might skew the results of an intervention.

Physical activity and some form of nutrition education had to be used in each intervention since past research has also proven that when researchers combine physical activity and nutrition education the intervention yields better results than using either dependant variable by itself (37). BMI has also been shown as an inefficient way to measure obesity in children (53, 54) so studies that measured BF% rather than BMI alone were also included. This created a smaller sample size but more valid outcomes. Also, the children in the studies had to be between 6 and 18 years of age.

Exclusion criteria were that the studies could not have been done before 1990 and the children could not be taking any medication used to treat obesity before or during the intervention. The articles and interventions are described in tables 1 and 2. For this review, the subjects decrease in body fat percentage was the main factor used when determining whether parental involvement made a significant difference in the outcome of the intervention. Due to the variance in age and height throughout the 5 studies reviewed and the effect this would have on BMI, the decision to use BF% as the determining factor for improvement was based on the premise that body fat percentage is a more acceptable indicator of a change in body composition.

Body fat percentage was also chosen because at a young age the change in body composition would most likely come from changes in fat mass. Increasing muscle mass is the most effective way to decrease body fat ;however, according to the physiology of children, the increase of muscle mass does not occur until puberty due to lack of testosterone (55).

The Physiotherapy Evidence Database(PEDro) scale (56) was used to evaluate the validity and interpretability of the 5 reviewed articles. The scale measures validity by looking at different aspects of the RCT dealing with study design such as blinding, allocation of subjects, and randomization. It looks at interpretability by analyzing between group statistics and measure of variability. The scale has 11 items and can yield a max score of 10 (Table 3). The reliability of the PEDro scale was measured on RCTs related to physical therapy (57). Maher et al. found the PEDro scale to be an acceptable way of evaluating trials based on the criteria provided. Even though physical therapy trials were not used in this review, the similar research designs allow the use of the PEDro scale. Each of the 5 RCTs used in this review was individually scored and given a score based on the 11 criteria.

Maher et al. used the values ($>.75$ = "excellent," $.40 - .75$ = "fair" to "good," and $<.40$ = "poor") to determine if the final PEDro value would deem a given study valid. According to these values, the 5 studies used in this review would be fair to good.

Table 3. PEDro Scale

	Nemet et al. (61)	Huang et al. (63)	Nemet et al. (62)	Johnston et al. (64)	Savoie et al. (60)
Eligibility criteria were specified (no points awarded)	yes	yes	yes	yes	yes
Subjects were randomly allocated to groups.	1	1	1	1	1
Allocation was concealed.	0	0	0	0	0
The groups were similar at baseline regarding the most important prognostic indicators.	1	1	1	1	1
There was blinding of all subjects.	0	0	0	0	0
There was blinding of all therapists who administered the therapy.	0	0	0	0	0
There was blinding of all assessors who measured at least one key outcome.	0	0	0	0	0
Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	1	1	1	1	0
All subjects for whom outcome measures were available received the treatment or control condition as allocated, or, where this was not the case, data for at least one key outcome were analyzed by "intention to treat."	1	1	1	1	1
The result of between-group statistical comparisons is reported for at least one key outcome.	1	1	1	1	1
The study provided both point measures and measures of variability For at least one key outcome.	1	1	1	1	1
Total points awarded	6	6	6	6	5

Results

The articles included in this review had a PEDro scores ranging from 5 - 6. All articles had random assignment to the control and treatment groups. Both groups had similar characteristics at baseline, and both groups received either the treatment or control. There is analysis for at least one key outcome, and each study had both point measurements and a measurement of variability of at least one key outcome. Four of the articles had at least 85% of the subjects that started the study tested for a key measurement at the end of the study. Savoye et al. (58) had an overall score of 5 on the PEDro scale because they had only 68% of the initial subjects who started the study complete at least one key measurement.

Two studies by Nemet et al. (59, 60) were included in this review. Both studies had similar study designs, meaning they met all inclusion criteria and interventions. One trial (60) included children with at least one overweight parent. In both studies the parents attended some nutrition education classes. Huang et al. (61) did not include any parental involvement in their intervention but they did meet all criteria which warrants the articles inclusion in this review. In Johnston et al.s' study (62), parents attended monthly meetings with their child(ren) so that healthy habits could be adopted in the family environment. Savoye et al. (58) had the most parent intervention/involvement. Parents attended all nutrition classes covering basic nutrition with their children and then attended separate meetings dealing with modeling healthy behaviors. Parents were also encouraged to "weigh in" with their child(ren), although not all of them did.

Even though some of the articles reviewed included parents in the intervention, the parents did not attend all intervention classes they were instructed to. In two articles (58, 59, 61) the percentage of attendance of parents or children were not specified. The Savoye et al. (58) article stated parents attended all classes. In Nemet et al. (59), out of the 8 meetings parents were

asked to go to every month, around 52% attended. Johnston et al. (62) reported only 16.5% of parents instructed to attend monthly meetings with their children went to the meetings, but 82.4% that did not attend signed that the information covered was discussed between the parent and child.

The intervention design did not vary greatly between the 5 studies. All of the studies had nutrition education that focused on basic nutrition. In addition to basic nutrition, Johnston et al. (62) also gave the children nutrition quizzes and the children that did not do well on the quizzes received extra attention to make sure they were grasping the concepts. Johnston et al. also used a token system as an incentive for displaying healthy behaviors. The children received points for certain activities and changed the points for money; each point received counted as one cent (62).

The physical activity in the intervention did not vary significantly between studies while three interventions (59, 60, 62) encouraged children to be physically active outside the intervention. The length of time spent during the training portion of the intervention was probably the most variety seen throughout the 5 articles. Two interventions (59, 60) spent 60 minutes per session keeping participants active while one had the children spending 50 minutes per session (58), another 40 minutes (61), and the last intervention used 30-35 minutes per session in their intervention (62). Johnston et al. used a progressive training program the combined circuit training and sports specific training.

Three of the studies performed interventions that lasted 3 months (59-61). Johnston et al.'s (62) intervention lasted 6 months, the intervention lasting 3 months and taking measurements at 3 months and 6 months while Savoye et al. (58) developed an intervention that lasted 12 months. Savoye et al. took measurements at 6 months and 12 months. Due to the

amount of time it takes for the body to react and make changes to a given stimulus, the length of the intervention would make a difference in interpreting the results in this review.

Discussion

From the reviewed articles, it can not be concluded that parental involvement has a direct affect on the outcome of intervention programs. There are many factors that could lead to this change such as the length of intervention, participation of the children and parents, content of intervention, and frequency. Intervention design and content seem to be the biggest factors in determining the success of an intervention.

Childhood obesity is a disease that has plagued our nation and the world for many years. Interventions in a school setting are essential in the treatment of obesity. The 5 articles chosen for this review all displayed significant positive results in helping overweight children, with or without parental involvement. Despite the numerous studies that use interventions to combat childhood obesity, only a few actively use parents.

As mentioned earlier, participation of children and parents along with the length, content and frequency of the intervention are all important factors when considering the outcome of an intervention.

Participation of children and parents

In the studies that recorded the participants' participation, none of them had the participants or their parents attend all of their scheduled meetings. In an intervention study if the subjects do not attend the program, the results and the intervention itself will not have reliability. Nemet et al. reported that only 58% of the parents involved in their study actually attended all classes (59) and Johnston et al., only 16.5 % attended all meetings (62). Also, in the Johnston et al. intervention only 13% of the children went to all nutrition meetings while 52% went to at least one. It is hard to conclude that parent involvement has an effect when parents did not actually participate. In today's busy society it is hard for parents and children to communicate,

but in order to decrease the rate of childhood obesity in the United States parents need to take an active role in helping their children. They need to be able to recognize when there is a problem and either seek help or be able to intervene themselves.

It is also up to the parents' to make sure that their children attend all meetings as well. This is extremely hard for children not old enough to drive who have to rely on their parents to make sure they attend required nutritional meeting and physical portions of the interventions. Children who are overweight or obese need the education and activity in order to help them change their lifestyle. In addition, researchers need to be aware of this and offer new ways to make sure at least children have every opportunity able to attend all meetings.

Length of intervention

Four of the articles in this review lasted 3 months, and the other 12 months. A longer intervention has both advantages and disadvantages. During a longer intervention the participants have a longer time to grasp the concepts and incorporate them into their lifestyles. Children's bodies also have more time to adapt to the training they are receiving. Another advantage of a longer intervention is researchers getting to know their participants on a personal level. This allows them to better understand what an individual child needs and they can better help them in the intervention.

Two major disadvantages of having a long intervention are budget and participants dropping out of the intervention. The longest intervention used in this review is also the only review in which 85% of the original participants did not complete both the initial and final testing. The main factor that caused so many subjects to drop out was loss of interest in the study. Children have short attention spans so having an intervention that lasts a year is going to require components that help keep the children involved. Because of the dropout rate in the

Savoie et al. study, they had to use an estimation method to obtain what the results would have been if all participants would have completed the study. If the study did not meet all the inclusion criteria, it would have not been put in this review. It would not have been used because the final results were not actual data collected from the original participants. This means the study is not reliable. For instance, it could be the case that the students who finished the intervention had amazing results and would have had those same results even if all of the children finished the intervention and none of them dropped out. However, the final results are then skewed because Savoie and his colleagues used those results to make conclusions about all of the children as if all children had completed the intervention. The results actually might not have been as substantial. The other disadvantage of having a longer intervention is the budget. It costs money to hire staff, researchers and equipment for a whole year. If the right funding is acquired this disadvantage is not as significant as complete participation throughout the study. It is still present.

Content of intervention

Johnston and colleagues employed an intervention that used quizzes, a nutrition program that used information that incorporated a game into the program, positive reinforcement and a demanding physical fitness program (62). All of these components are significant factors when determining what causes the changes in dependant variables. Children may respond better to certain objectives such as games. Also, studies that provide children with extra help are going to be more successful than other interventions such as in Johnston et al's study. In terms of content of an intervention, Johnston's intervention had more detailed education then the other 4 studies. The other 4 articles taught the information but they did not use any form of measurement or test to see if the information was retained.

A progressive training program has been shown to provide the best results when exercising to change body composition or increase conditioning (55). Johnston et al's use of circuit training during the first phase of the intervention and then moving on to more sports specific training could be why their intervention had the high decrease of BF%. The change in the program also helped keep the children's attention throughout the study and helped to keep the intervention interesting. After the intervention, Johnson preformed a 3 month follow up and found that BF% for the subjects had actually gone back up. After the intervention is over children must be able to maintain the results and activity level they had while in the intervention.

Frequency of intervention

The frequency of activities performed in a given week and the amount of classes the researchers' had the students attend in the allowed intervention time is going to have a dramatic affect on the outcome of the intervention. All 5 studies in this articles all varied in the frequency of nutrition and physical activity given, ranging from bi-weekly to semiweekly nutrition classes and physical activity ranging from semiweekly to 4 times per week. Johnston's intervention was one that included exercise 4 times per week and also asked the participants to exercise on their own for 30 minutes per week. The more children have access to the categories included and taught in the intervention, the more they will retain the information (62).

Outcome

Although not seen in this review, Epstein et al. showed that interventions incorporating parents and children had better results than ones that just targeted children by themselves but this study did not meet the inclusion criteria to be included in this review (33, 63, 64). Two of the articles, (33, 63), were review articles on childhood obesity and the other, (64), was a follow-up

article on four intervention trials and suggested that interventions that combine parents and children could have significant long term affects, but Epstein's article was not a RCT.

Savoie et al. (58) had the most parental involvement and it would seem the decrease in BF% is higher than the rest. This study had a 3% decrease in BF% at 6 months and a 4% decrease at 12 months. As previously stated, the researchers only had 68% of the participants who had their beginning measurements taken finish the study. Most of these participants lost interest in the intervention. To account for this loss of participation, Savoie and his colleagues used multiple imputation, a formula that uses the average results of the participants left in a study to account for the participants that dropped out. Even though it would seem they had the most decrease, it can't be decided because most of the final results were estimated and then calculated. The 5 reviewed studies can't be directly compared to each other because the Savoie et al. article did not take measurements at 3 months. Out of the other 4 studies that had measurements at 3 months, Johnston et al. (62) had more parental involvement than the rest and they showed a greater decline of BF%, ~2.8% compared to ~1.2%. This change could be from the parental involvement or it could also be from the researchers using a progressive physical activity program in their intervention including circuit training and sports specific circuits. This intervention was also better designed and focused on individual children.

Future Recommendations

Parents should be more involved in interventions aimed at decreasing obesity and their children's health. Parents and children should realize that obesity is a disease and it can have detrimental effects if it is not corrected. Future studies should make parents' the sole dependant variable to determine whether parental involvement is the reason for the outcome. Also, more studies should provide follow up information on their participants so that, as a nation, we can

conclude that interventions provide long term results. This will also help determine if having a parent involved in the intervention will have lasting affects because of their support and knowledge.

The government and society are taking action to prevent childhood obesity. Some schools eliminated junk food from their vending machines. The NFL has started the “NFL Play 60” program which helps keep children active (65). This and many other programs can help lower obesity for the future. Also, new advances in technology such as the Nintendo Wii, a game consol designed for increased player activity and realism, are using past knowledge and applying it to children. Now, instead of children sitting in front of a television set and holding a controller, children can move around while playing their favorite game. In recent months, the Wii fit has become more popular. Wii fit tests certain areas of fitness such as balance and strength while still keeping players active doing yoga or running in place.

In summary, school intervention programs provide an innovative and productive way to combat the obesity epidemic. Researchers have used the help of parents to instill lasting behaviors that will prove to be beneficial to their child(ren) into adulthood. At this time, whether parental involvement has a direct affect on the outcomes on intervention programs in school can not be decided but future research will be done.

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Table 1. Reviewed Articles.

Author	Subject description	Age (y)	Intervention type and duration	Description of treatment and control groups	Data collected	Results
Nemet et al. (61)	24 children BMI ≥95 th % 15 females 9 males	8-16	Nutrition modification and physical activity, 12 weeks	Nutrition education bi-weekly (6 total meetings), exercise 3x per week (2x at school, one at home)	BMI, BF%, endurance test, bone strength	TG decreased BF%, improvement in BMI% and endurance time in both groups but greater change in TG.
Hunag et al. (63)	120 5th graders BMI ≥95 th % 55 females 65 males	10-13	Nutrition education and physical activity, 12 weeks	Nutrition education 2x per week, physical activity 3x per week	BMI, BF%, BP, 800- meter run, 50 item test over healthy topics, blood test	TG decrease BMI, BF%, run time; increase in knowledge
Nemet et al. (62)	22 children BMI >95 th % and had overweight parents (BMI ≥27kg/m ²) 14 females 8 males	8-11	Nutrition modification and physical activity, 12 weeks	Nutrition education weekly (14 total), physical activity 4x per week (2-home, 2-school)	BMI, BF%, endurance, screen time	TG decreased BMI, BF%, screen time; increased endurance
Johnston et al. (64)	71 Mexican American students BMI ≥85 th % 39 females 32 males	10-14	Nutrition education and physical activity, 3 months with follow up at 6 months	Nutrition education once per week, physical activity 4x per week, plus 30 min other activity elsewhere	BMI, BF%, blood tests, BP	TG decreased BMI and BF%
Savoie et al. (60)	174 children BMI >95 th % 106 female 68 males	8-16	Nutrition modification and physical activity, 12 months	Nutrition education once and physical activity 2x per week for 6 months then biweekly for 6 months (also asked to exercise 3x per week at home)	BMI, BF%, BP, blood tests	No weight change but BMI went down in TG due to changes in height, decrease in BF%

TG = treatment group, BMI = Body mass Index kg/m², BP = blood pressure, BF% = body fat percentage

Table 2. Description of treatment and control interventions.

Author	Nemat et al. (61)	Huang et al. (63)	Nemat et al. (62)	Johnston et al. (64)	Savoie et al. (60)
TG					
Randomization	TG = 12 CG = 12	TG = 60 CG = 60	TG = 11 CG = 11	TG = 46 CG = 25	TG = 105 CG = 69
Nutrition	First meeting brought 48hr recall of food, 45-60 min; others 30-45 min topics included eating habits, food labels, food pyramid, etc. Reduced calorie diet 1200- 200 kcal	Used "Guideline handbook for a nutrition education curriculum aimed at reducing fat intake," selecting healthy foods and changing behavior 30 min	Children met w/ dietician weekly (14 meetings), basic nutrition; 1st apt 60-90 min, others 60 min	Focused on food choices and a "safety", "caution", "danger" to teach healthy foods; took quizzes 35-40 min	Used "Smart moves" workbook, taught self awareness, goal setting, behavior, contingency management, 40 min
Physical activity	Same activities school children perform, (50% team, 50% running games.) 1 hr	Various noncompetitive aerobic activities designed to work major muscles; 40 min	Same activities school children perform, (50% team, 50% running games.) 1hr	Weeks 1-6 basic circuit training, weeks 7-12 sports specific circuits, 30-35 min	Aerobic exercise, HR between 65-85% max used HR monitors 50 min
Other	Asked to decrease sedentary behaviors		Asked to decrease sedentary behaviors; 45 min movement therapy weekly (all)	Children with low quiz grades or absences got individual attention; used money system to help adopt habits Asked to be active outside intervention goal being 60 min/day	
Parent involvement	Children 6-8 yo parents invited to first 2 nutrition meetings only w/o children then children joined; >8 yo parents came with children to all meetings; pubertal children 1st meeting with parents then alternated meeting with dietician	None	Met with dietician separately (8 meetings total) which had 52 ± 8% attendance. Info in meetings similar to children except parents learned about modeling behavior and reasons for childhood obesity.	Monthly meetings to discuss adoption of healthy habits. 16.5% attended, those that did not had material sent home and 82.4% signed that they discussed it with their children.	Attended all nutrition related classes and went to behavior modification separate; topics included modeling healthy behaviors and other concerns parents had. Some parents weighed w/ their children.

Attendance (children)	Not given	Not given	Children attendance 77 ± 17% in both nutrition and physical activity classes	13% went to all nutrition meetings; 52% attended at least one.	Not given			
Detailed results					3 months	6 months	6 months	12 months
BMI		24.2± 3.5 to 23.1± 2.3	26.6± 1.8 to 25.9± 1.9		-.34± .77	-.18± 1.07	-2.1± .6	-1.7± .6
BF%	29.6± 1.0 to 28.6± 1.0	28.1± 5.7 to 28.5± 5.5	32.3± 2.7 to 31.7± 3.3		-2.85± 4.27	-2.45± 3.21	-3.2± 1.1	-4.0± 1.2
BMI%	96.7± .8 to 93.9± 1.9		97.2± .5 to 95.8± 1.0		-1.10± 2.48	-1.62± 3.64		
CG	Referred to ambulatory nutritional consultation at least once , asked to perform physical activity 3x per week on their own.	None	Referred to ambulatory nutrition consultation at least once , asked to perform physical activity 3x per week on their own	Given instructions to follow parent - guided manual, "Trim Kids," for weight loss and maintenance	Seen twice for diet and exercise counseling, parents help set goals			
Detailed results					3 months	6 months	6 months	12 months
BMI		25.1± 2.8 to 25.5± 3.1	26.5± 1.3 to 26.4± 1.4		.17± .83	.70± .92	1.1± .7	1.6± .8
BF%	31.8± 1.0 to 32.7± .8	29.4± 6.5 to 30.6± 6.8	37.8± 1.6 to 38.5± 1.6		-.93± 2.18	-.45± 2.72	2.0± 1.5	2.0± 1.5
BMI%	96.2± 1.0 to 95.9± .9		97.3± .5 to 97.3± .5		-.35± 1.83	.65± 2.20		

TG = treatment group, CG = control group, yo = years old, BF% = body fat percentage, BMI = body mass index kg/m², HR = heart rate