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The Effects of a Physical Activity Intervention on the way Elementary School Girls Play

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Abstract

The rates of childhood and adolescent obesity in the United States have been increasing steadily. American youth continue to eat more (increase energy intake) and reduce physical activity (decrease energy expenditure) resulting in increased body weight and body fatness. One way to help reduce body weight in children is to increase physical activity. The purpose of this study was to determine if an age appropriate before-school physical activity intervention would be successful in increasing energy expenditure, intensity of activity, and behavioral approaches in overweight girls. The subjects were recruited from Parker Memorial School in Tolland, Connecticut, and two testing periods occurred over an eight week period. Video recordings of each physical activity session were analyzed to determine energy expenditure, exercise intensity, and behaviors during exercise. Data was evaluated for normal distribution, and paired t-tests were used to determine statistical significance. This study showed that the age appropriate before school physical activity intervention was able to increase energy expenditure and exercise intensity and have a positive effect on behavioral approaches in overweight girls.

Introduction

Background

Childhood obesity is a growing problem in the United States that has continued to increase over the years. The prevalence of obesity in children has tripled since 1980 (5, 11, 12, 15, 17). It is believed that children that are already overweight are just going to continue to get heavier (16). There are many complications that children can have due to being overweight. Children can develop medical problems such as fatty liver disease, hypertension, and impaired glucose regulation (5). These complications aren't medical problems that are seen in the average child. Medical problems aren't the only effects seen in overweight children. Overweight children are also prone to low self-esteem, depression, and social alienation (7). Additionally, it is believed that if a child is overweight then they have an increased likelihood to be overweight as an adult (15).

One possible explanation for the rise in childhood obesity could be due to lack of physical activity. Physical activity is an important component of energy balance, and obesity is likely a cause of energy imbalance (12). Energy imbalance can occur when energy consumed (intake) is greater than energy expended by the body (12, 14). It has been reported that overweight children typically participate in less physical activity than normal weight children (6, 19). Overweight children also participate in physical activity for a shorter amount of time and at less intensity than other children (6, 19). Due to the fact that overweight children aren't as active as normal weight children, means that physical activity could play an essential role in getting them to lose weight.

There are a variety of barriers that overweight children cite as the reasons that they don't participate in physical activity. The most common barrier is body-related concerns (22). Other barriers include social and resource barriers. Resource barriers include: lack of place, lack of time, lack of interest, and lack of knowledge (22). Social barriers include: not having anyone to play with, no one at their skill level, or friends that don't like physical activity (22). Overweight girls are more likely to report these barriers than overweight boys (22). Additionally, overweight girls report low levels of support to participate in physical activity (22).

Girls and boys are similar to normal and overweight children because they show different patterns of physical activity participation. Boys tend to be more active and participate in higher intensity activities (2, 8, 13, 18, 20). Girls generally participate in passive games, and one study showed that during recess girls preferred to swing, walk, or talk with friends (20). Boys also report higher participation in team sports (13). Since girls generally tend to be less active, it could be suggested that overweight girls are the least active group of children.

Physical activity is an important factor to focus on in regards to promoting health and decreasing obesity (21). One way to promote physical activity is through interventions. Schools have been identified as the best place to start an intervention because they offer access to a larger group of children, and if everyone is participating no one feels stigmatized (8). Physical activity interventions have already shown to be successful in changing children's physical activity patterns (21). One intervention was able to reduce obesity prevalence among females that participated (9). It has also been found that girls tend to respond better to interventions since they are more likely to be interested in issues regarding diet and activity (9). School interventions have shown to be successful in changing physical activity habits and reducing the prevalence of obesity (9, 21).

Purpose of Study

The research shows that girls and overweight children are typically less active than boys and normal weight children (2, 6, 8, 13, 18, 19, 20). Therefore, it is important to encourage physical activity in both of these groups. The current study was completed to determine if a behaviorally age appropriate before-school physical activity intervention would be successful in changing the physical activity habits of overweight girls. The parameters evaluated in this study were: (a) energy expenditure of activity during the intervention, (b) intensity of activities (low, moderate, and vigorous) and (c) behavioral approaches during activity (parallel, social, and solitary).

Hypothesis

The current research study had three hypotheses. The first was that the age appropriate before-school physical activity intervention would increase the energy expenditure of activity during the intervention. The second hypothesis was that the amount of time spent in moderate to vigorous intensity activities would increase over the intervention period, and time spent in low intensity activity would decrease. The final hypothesis is that the intervention would have a positive effect on the girls' behaviors during physical activity.

Limitations

One limitation to this study was a small sample size. A larger sample size would have allowed us to collect data on more than eight girls, which would have given us a better representation of the overweight girl population. Another limitation of this study was the inability to assess a greater amount than 8 weeks of video collection. Due to staffing constraints

and time involved in analysis we were only able to do six days of activity measurement for each girl during the two data collection periods.

Review of the Literature

Childhood Obesity

Childhood obesity is described in the 2000 Centers for Disease Control and Prevention Growth Charts for the United States (11, 17). For children aged 2 to 19 years, excess weight is defined by body mass index (BMI) in relation to the CDC sex specific BMI-for-age growth charts (16). Body mass index is the weight of the child in kilograms divided by their height in meters squared (16). Previously these charts were used to define the terms overweight or at risk for being overweight (11, 17). However, recently the experts have suggested changing the nomenclature to obese and overweight (16). Children who are defined as at risk for overweight have a sex-specific BMI for age at or above the 85th percentile but less than the 95th (11, 16, 17). A child that is considered overweight has a sex-specific BMI that is over the 95th percentile for their age and sex (11, 16, 17). The most recent analysis of obese and overweight children determined that 17% of children were at or above the 95th percentile and 32% of children were between the 85th and 95th percentile (16).

The rates of childhood and adolescent obesity in the United States have been increasing steadily. The prevalence of obesity has tripled in children between 1980 and 2002 (5, 11, 12, 15, 17). It is also believed that overweight children are becoming even heavier (16). Childhood obesity is a major concern because it has been shown to continue into adulthood and many of the metabolic and cardiovascular complications associated with obesity have become present in childhood (5, 12, 15). Some metabolic complications that obese children can develop are fatty liver disease, hypertension, and impaired glucose regulation (5). Children also experience other consequences such as depression, low self-esteem, and social alienation (7). Some studies have

also shown that if a child has an obese parent that increases their risk for developing adult obesity (15).

Childhood obesity is most likely a consequence of an imbalance in energy (12). Energy balance occurs when energy intake is equal to energy expenditure. Weight gain occurs when energy intake is greater than energy expenditure (12, 14). Energy expenditure may be reduced due to the increase in sedentary behaviors that reduces an individual's energy requirements (15). Physical activity is one way to increase energy expenditure and to have positive effects on energy balance (4).

Physical Activity in Overweight Children

Currently, children should engage in at least 60 minutes of activity, five days per week (8). Additionally, children should have at least three sessions a week of moderate to vigorous levels of activity (8). Despite these guidelines, fewer than 50% of children are active enough to produce health benefits (8).

Physical activity is an important component in maintaining energy balance and preventing weight gain. Increases in physical activity have proven to be an important factor in decreasing BMI in children (4). Although physical activity is important, overweight children typically participate in less physical activity than normal weight children (6, 19). Overweight children are also recorded as engaging in less moderate and vigorous intense activities that burn more calories than lower intensity activities (6, 19). Increases in intensity of exercise are also shown to decrease BMI, which is why it is important to get overweight children to participate in intense activities (4). In addition to participating in less intense activity, overweight children also have shown lower amounts of continuous time spent being active compared to normal weight

children (19). Increased physical health has been shown to occur with longer duration of activity, so it is essential that overweight children begin to engage in physical activity for longer periods of time (8).

Children that are overweight typically perceive more barriers to physical activity and show a less positive attitude towards being active (6, 19). The common barriers reported contributing to reduced physical activity are body-related concerns. These concerns were especially prominent in overweight girls (6, 22). It is important that children are taught the importance of what their body can do instead of how their body looks so that physical appearance doesn't remain a barrier for physical activity.

There are resource barriers that children cite as the reason that they don't participate in physical activity. Resource barriers include: lack of convenient place, lack of time, lack of interest, and lack of knowledge (22). Zabinski et al. (2003) associate high levels of resource barrier reporting to the fact that most of these barriers are more socially acceptable so overweight children may report them at higher levels than other barriers. There are also social barriers that children report as reasons for not participating in physical activity. Social barriers include: not having anyone to participate in physical activity with, no one at their skill level to play with, or friends don't like physical activity (22). Overweight children show less confidence in being able to overcome these barriers (19).

Although most overweight children reported these barriers to physical activity, overweight girls report higher barriers than overweight boys (22). Overweight girls also report lower levels of support for physical activity that contributes to a reduced participation in physical activity (22). Since overweight girls report higher barriers and less support in relation to physical

activity, interventions need to focus on reducing barriers resulting in greater activity levels in young girls (22).

Gender Differences Regarding Play

Similar to overweight and normal weight children, girls and boys have different play styles. Girls and boys differ on both the amount of time they spend in activities and the type of activities that they participate in. First, boys tend to be more active than girls (2, 8, 13, 18, 20). Boys also reported being more active during their leisure time than girls did (13). Additionally, as girls get older their participation in physical activity decreases. Boys don't show this decline in activity that girls do (13).

The other difference that is apparent among girls and boys is the choice of activity that they participate in. Boys tend to participate in activities that are more aggressive and competitive, and girls typically engage in more passive games (20). A study that focused on gender differences during recess showed that boys chose to play soccer, basketball, and kickball while girls preferred swinging, walking, and talking with friends (20). The boys chose to participate in activities that were more intense than girls. These intense activities also have greater energy expenditure than the activities the girls chose to participate in (20). This suggests that girls typically engage in less intense activities than boys.

Another difference in the activities among boys and girls is that boys belong to more team sports than girls do (13). Kirchengast et al. (2008) showed that out of all of their participants 63.2% of boys belonged to a sports team while only 14.4% of girls participated in sports. Girls tend to show a preference for more independent sports such as swimming (13).

It is important to understand these gender differences because studies have proven that girls generally are less active than boys (2, 13, 18, 20). Additionally, overweight children are typically less active than normal children (6, 19, 22). This suggests that overweight girls are one of the least active populations. We must focus on ways to promote physical activity and get overweight girls excited about being active. Additionally, we must also focus on getting overweight girls involved in more intense activities since these have shown to lower BMI (4).

Physical Activity Interventions

Programs focusing on increasing physical activity in children have become a key factor in promoting health (21). Physical activity interventions can be effective for the development of a healthy lifestyle because it has been shown that activity patterns track from childhood to adulthood (8). One of the best places to start an intervention are schools because they offer access to a large population of students (9). Recently, the World Health Organization (WHO) specifically identified schools as the target setting for promoting physical activity (8). One important aspect of running an intervention at a school is that it includes all students and helps decrease children being stigmatized (8). Promoting physical activity in schools is important because often times physical education classes don't occur often enough or children aren't active enough in them to develop the strategies that children need for lifelong activity patterns (8).

Interventions have shown to successfully change children's physical activity patterns. A review of school based interventions showed that interventions proved to have a 13% increase in play time spent in moderate or vigorous physical activity (21). Additionally, interventions have shown to increase the number of participants who are regularly active (21). Duration of activity

has also been increased due to interventions along with increasing fitness levels of participants (8).

Changing physical activity patterns can be beneficial to decreasing obesity. Interventions have shown to have significant positive effects on BMI (8). One school based intervention significantly reduced obesity prevalence among females that participated in the intervention (9). Females participating in the program also showed greater tendency to not return to being obese which was not true for girls that were in the control group (9). It is believed that girls benefit from interventions because they are more attuned to issues regarding diet and activity (9).

Methods

Sample

Eight girls who were enrolled in the PawPALS program at Parker Memorial School in Tolland, Connecticut participated in this study. The eight participants were either in the third or fourth grade. All of the participants met the Center for Disease Control (CDC) BMI-for-age criteria for at risk for overweight or overweight (11, 16, 17). Parental consent and child assent was obtained for all subjects that participated in the study.

Research Design

This project was an analysis of how overweight girls played and if their play was changed by the before school intervention. The two factors around play that were looked at in this study were activity intensity and social behaviors while playing. Energy expenditure of physical activity (EEact) was also calculated for the two test sessions. All participants play activities were studied via video analysis. Data collection occurred for six days in both the pre and post testing periods. The pre data collection occurred at the start of the program. Height and weight were taken during the pre data collection. The post data collection occurred eight weeks after the initial data collection. At both data collection periods energy expenditure of physical activity (EEact) was measured as well as the activity intensity and social behaviors of the participant.

Physical Activity Coding

Each PawPALS session was video taped so as not to rely on the children to recall their activity during PawPALS. A single video camera was placed in one corner of the gymnasium to

allow for the largest angle to record the students. Only one camera was used so as not to interfere with the student's activities while at the program. Single subject observations were recorded to determine two primary characteristics of activity: duration and type of activity. Three stages of video analysis then occurred. First, video for each child was observed and coded for duration of activity. Duration of each movement was done in seconds for each sixty-minute session that the subjects participated in. Next, the metabolic equivalent (MET) for each activity was determined from the Compendium of Physical Activities (1). METS for each activity were multiplied by the duration of time (in seconds) spent in that activity for the period (METS/hr). The final stage of video analysis was calculating the EEact for each session. EEact was calculated using the age adjusted resting metabolic equivalents ($1.71 \text{ Kcal} \cdot \text{Kg}^{-1} \cdot \text{min}^{-1}$) (10). The age adjusted correction was used to account for the greater energy cost associated with certain activities for children compared to adults (10).

Activity Intensity Classification

The intensity of the activities each subject participated in were classified as either low, moderate, or vigorous intensity. Intensity levels were determined from the Compendium of Physical Activities. The intensity level of every activity is based on the rate of energy expenditure expressed as METS (1). Intensity levels appear on the compendium as multiples of 1 MET (1). Low intensity activities are less than 3 METS, moderate intensity activities are 3-5 METS, and vigorous activities are greater than 5 METS (18).

Behavior Classification

Social behaviors of the subjects were analyzed based on the methods developed by Blatchford et- al (2003). The three categories that children were coded for were solitary, social,

and parallel. Solitary behavior is defined as the child not interacting or in a parallel activity with other children (3). Parallel behavior is when the target child is situated in close proximity to another child and they are both doing the same activity but are not interacting (3). The final category is social. Social behavior is when the target child is engaged in physical and/or social interaction or involved in a socially organized game (3).

Statistical Analysis

Data were evaluated for normal distribution. Demographic data were analyzed using standard descriptive statistics. Paired t-tests were used to determine statistical significance over time (pre versus post measures). A one-way (time) analysis of variance was used to determine significance in the intensity of activity variables. Statistical significance was held at $p \leq 0.05$ for all measures and data are represented as mean \pm standard error of the mean.

Results

Quantitative Assessment

Systemic observations through video analysis provided information regarding the activity intensity of the girls during the before school activity program. Video analysis also provided information for calculating the EEact during the program.

Demographics

Descriptive results for age, height, weight, and BMI for the eight participants is shown in Table 1. Table 1 shows the averages for all four of these parameters for the eight girls in this study. All of these parameters were only measured during the pre-testing data collection because it was determined that eight weeks wouldn't be a significant amount of time to change any of these parameters in the girls that participated. The average age of the group was 9.8 ± 0.3 years. The average height was 149.6 ± 2.7 cm, average weight was 49.3 ± 1.7 kg, and the calculated average BMI was 23.4 ± 0.8 .

Table 1. Subject Demographic Characteristics

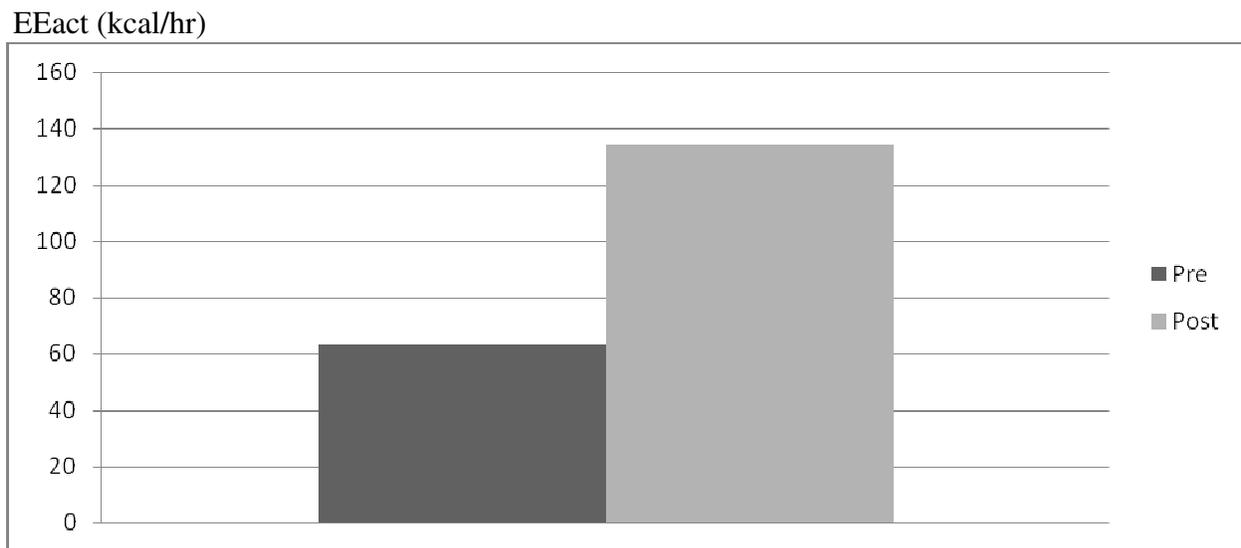
Age	9.8 ± 0.5
Height (cm)	149.6 ± 2.7
Weight (kg)	49.3 ± 1.7
BMI	23.4 ± 0.8

Energy Expenditure of Physical Activity

Energy expenditure of physical activity (EEact) was calculated using second by second video analysis for each of the six days. Averages for all six days were taken for each girl. The EEact is represented as the average of all eight participants six day averages for the pre and post

testing period. EEact for the pre and post testing period can be seen in Figure 1. The pre EEact was 63.4 ± 4.2 for all eight participants. The post testing average EEact was 134.4 ± 5.2 . EEact was significantly different ($p < 0.001$) between these two test periods. This data shows that EEact increased over the eight-week period for the group as a whole.

Figure 1. Energy Expenditure of Physical Activity for Pre and Post testing

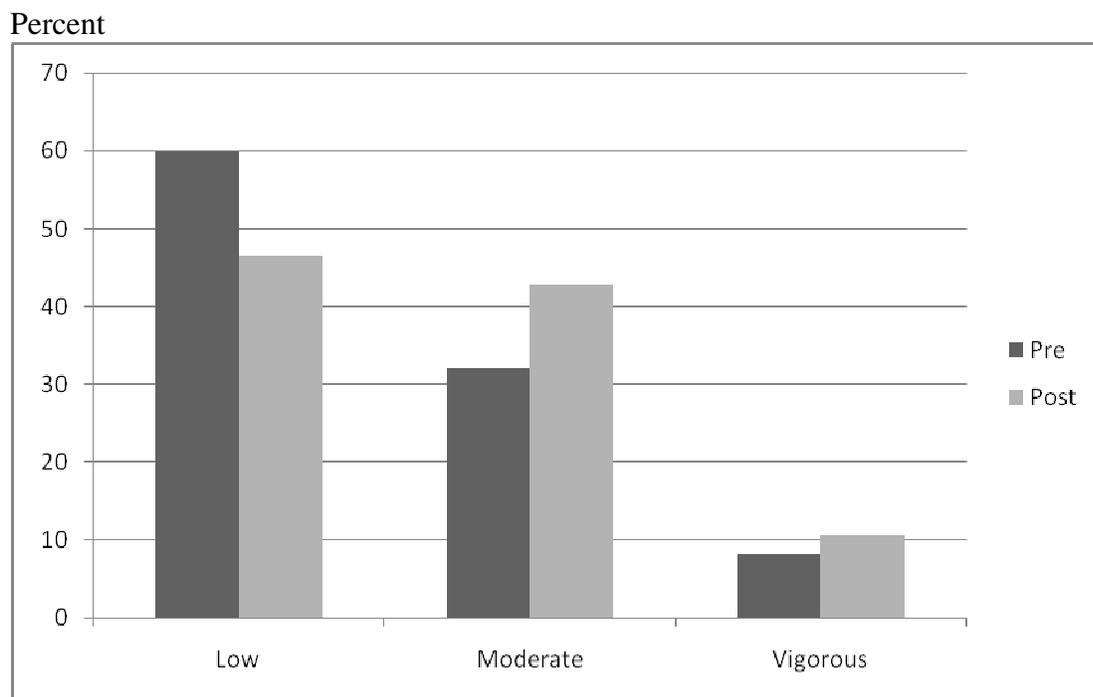


Intensity of Activity

Activity data was also analyzed to determine the intensity levels of the activities each subject participated in based on MET values (low: < 3 METS, moderate: 3-5 METS; vigorous > 5 METS) (18). Intensity levels were split into the percent of time that participants spent at each of the three levels. The averages for the pre and post period can be seen in Figure 2. The percent of time spent in low intensity activities during the intervention was 59.8 ± 7.7 for pre testing and 46.4 ± 5.0 for post testing. Moderate intensity activities were done for 32.1 ± 4.5 percent of the time in pre testing and 42.9 ± 4.2 in post testing. The percent of time spent in vigorous intensity

activities was 8.2 ± 0.9 for pre testing and 10.7 ± 0.9 for post testing. The time spent in low intensity activities decreased over the intervention period, while the percent of time spent doing moderate and vigorous activities increased. There was no significant difference between the percent of time in each level of intensity over the intervention period, but the data shows that there was trend for the girls to be moving from low intensity activities to moderate or vigorous.

Figure 2. Percentage of Time Spent in Intensity of Physical Activity Category



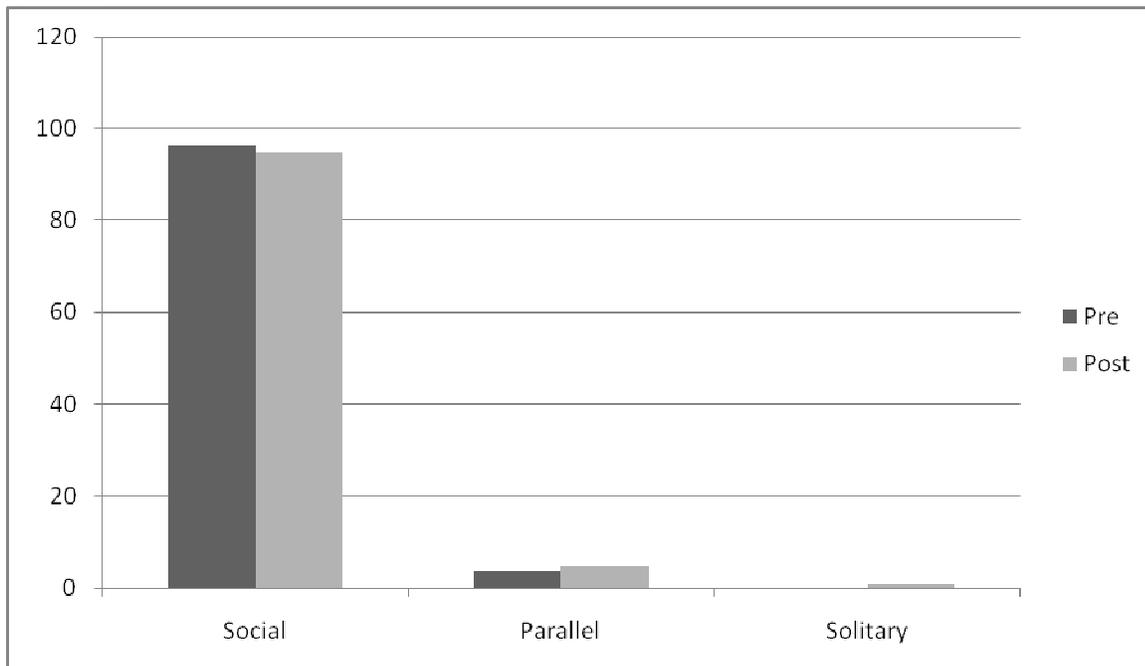
Qualitative Assessment

PawPALS videos were analyzed to provide information about the eight girls' social interactions. Video data was analyzed using coding for the three states of social interaction described by Blatchford et al. (2003). The girls were coded for being in one of the three social interaction categories (3).

Social Interaction

The three categories of social interaction are solitary, parallel, and social. Figure 3 shows the percent of time that the girls spent in each category for the pre and post testing periods. The majority of the time spent at PawPALS consisted of social behaviors for the girls. Social behavior is when the girls participated in activities together while talking to each other as well. The girls spent 96.3 ± 0.9 percent of the time being social in the pre testing period and 94.5 ± 0.4 percent in post testing. Parallel play consisted of the girls participating in activities next to each other but not doing them together such as jumping roping alone. The percent of time spent in parallel play was 3.7 ± 0.3 during pre testing and 4.7 ± 0.6 post testing. The final category is solitary play. Solitary play is when the child isn't interacting or in a parallel activity with another child. The amount of time spent in solitary play was 0.0 ± 0 for pre testing and 0.8 ± 0.3 for post testing.

Figure 3. Social Interaction Behaviors
Percent



Discussion

The purpose of this study was to examine the effects of an age appropriate before-school physical activity intervention on energy expenditure, intensity of activity, and behavioral approaches during play in overweight girls. Video analysis was used to systematically assess activity and play characteristics for each child. Qualitative analysis was employed to evaluate behavioral approaches according to Blatchford et al. (2003).

Activity Intensity

It was hypothesized that the intervention would increase the intensity of the girls' activities. There was no significant difference between the three intensities of activity over the intervention period, but the data did show that there was a trend toward more vigorous activity. The percent of time spent doing low intensity activities decreased during the intervention period from 59.8 ± 7.7 to 46.4 ± 5.0 , while the percent of time spent in moderate and vigorous activities increased. Time spent doing moderate activities increased from 32.1 ± 4.5 to 42.9 ± 4.2 , and time spent in vigorous activities increased from 8.2 ± 0.9 to 10.7 ± 0.9 . Our results show that the intervention was able to engage overweight girls in more moderate and vigorous activities throughout the intervention.

Van Sluijs et al (2007) found that school based interventions have proven to increase the intensity of activities 13% of the time, and our findings show that we were able to replicate this. Overweight children typically don't participate in moderate to vigorous physical activity, so the findings suggest that physical activity interventions can successfully promote higher intensity activities in overweight children (6, 19). The current physical activity guidelines stipulate that children get at least three sessions a week of moderate to vigorous activity and our intervention

was able to provide the opportunity for the girls to meet this guideline (8). Higher intensity activities are also associated with greater energy expenditure which could have positive effects on BMI (4, 20).

Another important aspect of our findings is that the intervention was successful in getting the girls involved in higher intensity activities, which is normally more typical of boys (20). Girls normally participate in passive games that aren't intense, but with this intervention we were able to get the girls to participate in more high intensity activities (20). The findings show that girls will become involved in higher intensity activities when the chance arises.

Energy Expenditure

Video analysis showed that energy expenditure of activity (EEact) increased from 63.5 ± 4.2 kcal/hr to 134.4 ± 5.2 kcal/hr during the intervention period. This was a significant difference of $p=0.001$. The increase in energy expenditure could be attributed to the fact that the girls' began to participate in greater intensity activities during the intervention period. Higher intensity activities have greater energy expenditure, which is why it is important to have overweight children participate in them (20).

Increasing energy expenditure is important for maintaining energy balance. One of the best ways to increase energy expenditure is through physical activity, and our intervention was able to successfully increase the energy expenditure during activity of the girls involved which could promote better energy balance (4). Although BMI changes during this intervention were not measured, other intervention studies of longer duration have shown that increased energy expenditure can lead to decreased BMI (4).

Behavioral Approaches to Activity

It was hypothesized that the intervention would have a positive effect on the girls' behavior related to physical activity. The results indicate that there was a significant difference between social ($p=0.05$) and parallel ($p=0.04$) play during the intervention, but no significant difference was seen in the amount of solitary play that the girls' participated. At both testing periods the girls showed to participate mostly in social play, but they also increased their parallel play by the end of the intervention. Overall, the girls exhibited mostly social behaviors as they relate to physical activity.

The outcomes indicate that the girls participated mostly in social behaviors, which is consistent with other studies that looked at the behavior of children during physical activity (3). This could be due to the fact that girls are more likely to participate in conversational play (3). Blatchford et-al (2003) also found that social behaviors didn't increase overtime in their study, but parallel activities did show a slight increase. This is similar to the results in the present work. In both this study and Blatchford et al. (2003) even though parallel activities showed a slight increase, the dominating behavior was social. The lack of social play in this study could be due to the fact that the environment of PawPals encourages social and parallel play.

Conclusion

Previous studies have shown that overweight children typically don't engage in as much physical activity as their normal weight counterparts (6, 19). When overweight children participate in physical activity, it is normally predominantly low intensity activities that have lower energy cost than moderate or vigorous activities (6, 19, 20). Similarly, girls tend to be less

active than boys and participate in less intense activities than boys do (2, 8, 13, 18, 20). These findings suggest that overweight girls could be one of the least active groups of children.

Results from the current study indicated that a before school age appropriate intervention was able to get overweight girls participating in physical activity. The girls that participated in the program had an increase in energy expenditure and intensity of activities over the intervention period. This suggests that overweight girls participated in high intensity activities, which other studies have shown is atypical for this group of girls (2, 6, 8, 13, 18, 19, 20). One reason for this finding, could be that the PawPals environment is an environment that encourages physically activity. Zabinski et-al (2003) showed that overweight girls report having less support in relation to physical activity, but they were able to get this support at PawPals. PawPals was able to give the girls the support they needed to engage in physical activity and successfully improve their physical activity behaviors.

Other barriers that overweight children report regarding physical activity are lack of time, lave of convenient place, and not having others to participate in physical activity with (22). PawPals was able to eliminate all of these barriers for overweight children. Since overweight children are normally less confident about overcoming barriers, it is important that interventions be able to eliminate these barriers for them (22). Once the barriers were eliminated the girls were able to participate in physical activity. The findings show that given the opportunity to play the girls did and at high intensities which isn't a normal characteristic of this demographic (2, 6, 8, 13, 18, 19, 20). Additionally, other research has shown that girls normally respond well to interventions because they tend to be more attuned to issues regarding diet and activity (9).

Findings from this study suggest that PawPals was successful at increasing energy expenditure and activity intensity throughout the intervention period. The environment created at

PawPals is one that is conducive to exercise and breaks barriers that overweight girls normally perceive regarding physical activity. It is important that future interventions eliminate the barriers common to overweight children and provide an environment that gets them active.

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