The relationship between affective response to exercise and activity level in children

By

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Abstract

Childhood obesity is a health epidemic in the United States. There have been many interventions designed to prevent and treat childhood obesity, but these programs have seen only moderate success. Exercise enjoyment influences children's physical activity, but little is known about obese children's enjoyment of exercise. The present study evaluated exercise enjoyment and subsequent physical activity among an ethnically diverse sample of children (n=25) participating in an 11-week obesity intervention. It was hypothesized that children would engage in progressively more physical activity over the course of the intervention and that their enjoyment of exercise would predict improvements in physical activity. Additional hypotheses were that 1) ethnicity, age, and BMI would influence both enjoyment and physical activity levels, and 2) reported hope would increase. Results showed the children engaged in less physical activity and reported lower exercise enjoyment over the 11-week intervention. African-American children were most active and Hispanic children were least active. Older children enjoyed exercise less and were less active than their younger counterparts. Reported hope showed a non-significant trend toward increasing. Pathways beliefs increased significantly but agency beliefs showed no change. Replicating the present study to better understand exercise enjoyment and hope among children who are obese could lead to more effective, targeted interventions.

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Introduction

The efficacy of various interventions to combat pediatric overweight and obesity has been extensively researched. An important common thread in such studies is that physical exercise is a vital component of any intervention designed to help children achieve and maintain a healthy weight. However, many of the children involved in these interventions do not maintain exercise behavior over time (U.S. Department of Health and Human Services, 1996). The degree to which individuals experience positive affective responses to exercise is an important factor in their long-term exercise behavior, and children who enjoy participating in sports or physical education classes maintain higher levels of physical activity than children who do not enjoy physical activity (Berger & Owen, 1992; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Prochaska, Sallis, Slymen, & McKenzie, 1993; Weiss, 1993; Williams, Dunsinger, Ciccolo, Lewis, Albrecht, & Marcus, 2008). However, there has been only limited research examining the extent to which children who participate in obesity interventions experience positive affective responses to exercise. Gaining a better understating of children's affective response to exercise in the context of these interventions may aid in the development of more effective programs. If researchers can tailor future interventions to encourage enjoyment of exercise among children, it is possible that rates of exercise adherence will improve both before and after the programs have ended.

Childhood obesity

Childhood obesity is an important public health concern affecting millions of families in the United States (Lobstein & Jackson-Leach, 2007). Overweight and obesity among children is determined by calculating their body mass index (BMI). To account for their varying stages of

development, children's BMIs are calculated using their height and weight, as with adults, as well as age and gender. Rather than being given a BMI number, children's BMI values correspond to percentiles, allowing for comparisons with other children of the same age and gender. Boys and girls who are between the 85th and 94th percentile for their height and weight are considered overweight, while children at or above the 95th percentile are considered obese (Centers for Disease Control and Prevention, 2008a). For simplicity, throughout this document children who are overweight or obese and fall above the 85th BMI percentile will simply be referred to as obese.

Recent meta-analytic studies indicate that 66% of adults and 34% of children are overweight or obese (Wang & Beydoun, 2007). Results from the National Health and Nutrition Examination Survey (NHANES) suggest that childhood obesity has steadily increased during the last three decades: between 1980 and 2004, prevalence rates for children between the ages of two and five have risen from 5% to 13.5%, from 6.5% to 18.8% for children ages six to eleven, and from 5% to 17.4% for adolescents ages twelve to nineteen (Centers for Disease Control and Prevention, 2008b). Rates of obesity also tend to be higher among children of low socioeconomic status, minority group status and those who live in rural and mixed-ethnicity urban areas (Lutfiyya, Lipsky, Wisdom-Behounek, Inpanbutr-Martinkus, 2007; Tudor-Locke, Kronenfeld, Kim, Benin, & Kuby, 2007; Wang & Beydoun, 2007).

Health consequences. As with adult obesity, childhood obesity has been associated with a host of negative health consequences. Cardiovascular disease (CVD) risk factors such as high cholesterol levels, hypertension, and abnormal glucose tolerance are significantly more common among obese children (CDC, 2008b). As many as 60% of obese teens have at least one CVD risk factor (Freedman, Dietz, Srinivasan, & Berenson, 1999). In fact, these health risks are of such

concern that the American Academy of Pediatrics recently released a controversial recommendation to begin administering statin cholesterol medications to obese children as young as eight years of age in an effort to prevent future CVD complications (Daniels, Greer, & Committee on Nutrition, 2008). Other health concerns include increased risk for asthma, hepatic steatosis (fatty liver disease), sleep apnea, and type II diabetes (CDC, 2008b).

Psychosocial concerns such as low self esteem, social discrimination, and academic and behavioral problems are also associated with childhood obesity (CDC, 2008b; Shin & Shin, 2008). Interestingly, research suggests that even modest decreases in BMI can lead to meaningful improvements in health outcomes. Children who decreased their BMI by an average of only 1.7 points over a 6-month period saw significant improvements in blood pressure, total cholesterol, low-density lipoprotein cholesterol, triglycerides, insulin, and aerobic fitness (Kirk, Zeller, Claytor, Santangeko, Khoury, & Daniels, 2005).

Contributing factors. Gradual changes in children's behaviors, environments, the food market, and family structure in the United States have all contributed to the rise in childhood obesity (Anderson & Butcher, 2006). Increased marketing, availability and consumption of sweetened drinks and non-nutritive, high-calorie foods, along with the vast expansion of the internet, television, and other sedentary forms of entertainment, have played major roles. Furthermore, changes in transportation and infrastructure, such as the use of cars for transportation and the associated urban sprawl, have effectively removed much of the physical activity that was once built into daily life (Anderson and Butcher, 2006; Baur & O'Connor, 2004). The structural and environmental changes that have slowly altered the ways in which children and families live their daily lives have been largely detrimental to overall health.

Exercise and physical activity. Physical activity has long been regarded as an important tool for treating childhood obesity (Spear, Barlow, Ervin, Ludwig, Saelens, Schetzina, & Taveras, 2007) and is currently one of the chief recommendations for treating and preventing pediatric obesity (American Academy of Pediatrics, 2007). Research on adults has indicated a strong relationship between levels of physical activity and obesity (Fogelholm, Stallknecht, & Van Baak, 2006). Moreover, physical activity decreases the risk of future weight gain (Wadden, Vogt, Foster, & Anderson, 1998). Not surprisingly, patterns of physical activity and sedentary behavior are also important predictors of children's weight status. Results from a recent twelve-year longitudinal analysis suggest that one of the most important predictors is television viewing, a behavior largely incompatible with physical activity (O'Brien, Nader, Houts, Friedman, Belsky, Susman, et al., 2007). These authors found that children who were more physically active and watched less television were less likely to be overweight by age twelve. Similarly, among a group of three- to four-year old children who were followed for three years, physical activity and television viewing were the only significant predictors of BMI, and these relationships became more pronounced as the children aged (Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005).

In defining children's patterns of activity, physical exercise and physical activity may be distinguished by certain qualitative differences. Exercise refers to planned, structured activity that involves repetitive bodily movements with the goal of improving some aspect of physical fitness, while activity more broadly encompasses any bodily movement that results in energy expenditure (Caspersen, Powell, & Christienson, 1985). However, as is clear in both definitions, both structured and unstructured physical activities necessitate the use of stored energy and should be encouraged. Reestablishing patterns of play and general physical activity in

conjunction with more formal physical exercise has been recommended for children (American Academy of Pediatrics, 2000), and emphasizing to children the importance of enjoying activity rather than achieving specific weight loss goals may be most beneficial for children's physical, social, emotional, and cognitive well-being (Burdette & Whitaker, 2005).

Exercise and affect

Many factors influence exercise and physical activity. Social cognitive theory (Bandura, 1997) is often applied in understanding exercise behavior. This theory proposes that personal characteristics and environmental events concurrently influence the extent to which individuals exercise (Buckworth, 2000). Specific factors linked to exercise include demographics, cognitive and psychological variables (e.g., self-efficacy, behavioral intent, motivation, expectations, perceived barriers), social support and opportunities to exercise (Buckworth, 2000). Investigators have also proposed the existence of a biological control mechanism that influences how much an individual exercises (Rowland, 1998). Although much of the research on exercise determinants has involved adults, these findings may also apply to younger populations.

In addition to the physical health benefits described above, there is a well-established relationship between exercise and psychological health. For example, regular physical exercise has been associated with a significantly decreased prevalence of current major depression and several anxiety disorders among adults in the United States (Goodwin, 2003), and exercise therapies have been shown to have large, positive effects in the treatment of depressive disorders (Stathopoulou, Powers, Berry, Smits, & Otto, 2006). The use of exercise therapy for children with elevated anxiety and depression levels has also been associated with clinical improvements, although the effect may be smaller than with adults (Larun, Nordheim, Ekeland, Hagen, Heian, 2006). Research suggests exercise therapy may provide mental and physical health benefits for

children who are obese. Among these populations, brief, supervised exercise therapy can lead to significant improvements in physical-self worth, self-esteem, and physical activity, even when there are no meaningful changes in BMI (Daley, Copeland, Wright, Roalfe, & Wales, 2006). Other studies (Annesi, 2005; Williamson, Dewey, & Steinberg, 2001) support the potential for exercise to lead to positive changes in mood and physical self-concept among non-clinical child populations.

Positive affective response to exercise. One psychological factor that has received attention is positive affective response to exercise. Results from a large meta-analysis indicate that adults consistently experience positive affective responses to exercise that is of a low to moderate intensity lasting up to 35 minutes. Moreover, such affective improvements are greater when pre-exercise affect scores are lower than average (Reed & Ones, 2006). These findings raise several questions. Does exercise act as a preventive or protective mechanism leading to decreased negative affect and increased positive affect? Or, are individuals with higher baseline levels of positive affect simply more likely to be active and therefore reap the benefits of exercise? Which comes first, positive affect or exercise?

Mood, emotion, and affect are all closely-linked constructs, but they are not interchangeable. Mood refers to a longer-lasting state that tends to bias cognition by altering information processing, whereas emotions are briefer responses to antecedent events and may be identified by specific facial expressions (Smith & Crabbe, 2000). Affect, on the other hand, refers to an individual's subjective appraisal of an experienced emotion (Smith & Crabbe, 2000). The fact that individuals can simultaneously experience exercise as challenging and tiring while also deriving positive affect from the activity (Hall, Ekkekakis, & Petruzzello, 2002) illustrates the importance of individuals' appraisals. In studies of children's exercise behavior and activity,

"enjoyment" is commonly used as the operational term for positive affective response (McCarthy, Jones, & Clark-Carter, 2008; Scanlan & Simons, 1992), as it may be more easily understood by children and appears to effectively target their subjective appraisal of activities.

Individuals' decisions about their actions and behaviors, including decisions to engage in exercise, are governed by many factors, one of which is the expected affective response to the action or behavior. People engage in behaviors they know lead to positive affective experiences, and they may be motivated to develop goals according to these positive affective experiences (Cofer, 1981; Emmons & Diener, 1986). Positive affect felt during engagement in various situations strongly predicts time spent in those situations, and the importance of affect in making these decisions appears to be even stronger for recreational activities, such as exercise, than for work-related activities (Emmons & Diener, 1986). Children are similarly inclined to engage in the activities they find most enjoyable, including physical exercise activities (Epstein, Kilanowski, Consalvi, & Paluch, 1999; Epstein, Roemmich, Saad, & Handley, 2004).

Enjoyment and maintenance of exercise behavior. One hypothesis regarding children's failure to maintain exercise behavior is that they do not enjoy it. Understandably enough, those who do enjoy exercise are more likely to maintain it than those who do not (Berger & Owen, 1992; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Weiss, 1993; Williams, Dunsinger, Ciccolo, Lewis, Albrecht, & Marcus, 2008). However, there is limited information regarding how obese children respond to exercise and whether the relationship between enjoyment and physical activity changes over time.

Enjoyment of exercise has consistently been linked to children's physical activity. Cross-sectional and longitudinal survey data indicate that among a range of variables including social support, parental modeling, and perceived barriers to exercise, enjoyment of physical activity is

the strongest predictor of children's current physical activity (Stucky-Ropp & DiLorenzo, 1993). In addition, 6-year follow-up data suggest that enjoyment continues to be the strongest predictor of children's activity levels (DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998). National, population-based studies also have led researchers to conclude that enjoyment of physical education is among the most important correlates of children's physical activity (Sallis, Prochaska, Taylor, Hill, & Geraci, 1999).

Variability of exercise enjoyment. Children experience various affective responses to exercise. Differences in exercise enjoyment may be associated with demographic factors, including ethnicity and gender. For instance, among a large, ethnically-diverse sample of adolescent girls, African-American and Hispanic girls reported significantly lower enjoyment of and social support for physical activity than White girls (Grieser, Neumark-Sztainer, Saksvig Lee, Felton, & Kubik, 2008). National data concur that preferences for physical activity vary by ethnicity and gender (Eyler, Nanney, Brownson, Lohman, & Haire-Joshu, 2006), suggesting children may be less likely to participate in physical activity if engaging activities are not available or not encouraged. There are additional data suggesting BMI plays an important role in enjoyment of physical activity among adults (Ekkekakis & Lind, 2006), but it is unclear whether a similar relationship between BMI and enjoyment exists among children.

Children's enjoyment of physical activity also appears to be positively associated with fitness level, motor skill development, and perceived activity-related competence. For instance, children who have difficulty engaging in physical activity tend not to enjoy physical activity. Perceived inadequacy in activities also is associated with less enjoyment (Cairney, Hay, Mandigo, Wade, Faught, & Flouris, 2007). Qualitative interview data indicate that enjoyment is the strongest motive for participating in favored sports, and lack of skill at any particular activity

is a primary reason for avoiding it (Woods, Bolton, Graber, & Crull, 2007). In addition, among children participating in a summer activity program, physical fitness and perceived motor competence were correlated and strong predictors of physical activity throughout the program (Castelli & Valley, 2007). Although these data may not seem surprising, they are important in their potential application to pediatric obesity interventions. Many children who participate in these interventions have had minimal experience engaging in physical activity and organized sports. As a consequence, they often have had fewer opportunities to develop the specialized motor skills necessary to gain mastery experiences and to develop a pattern of enjoying physical activity.

Children may also experience more or less enjoyment of physical activity as a result of being obese, but few studies have examined this issue. One small, qualitative study of children participating in a pediatric obesity intervention reported that enjoyment of the physical activity, along with improved body image and perceived competence, contributed to high adherence rates and maintenance of exercise (O'Brien & Martin, 1998).

Hope Theory and affective response to physical activity. Hope is "a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal-directed energy), and (b) pathways (planning to meet goals)" (Snyder, Irving, & Anderson, 1981; p.287). Hope is seen as reflecting individuals' goal-directed cognitive processes, and an individual's perception about one's progress toward a desired goal influences subsequent emotions (Snyder, 2002). Positive emotional responses are said to result from positive progress toward a goal, while negative emotional responses result from a perceived lack of progress (Snyder, 2002). There appears to be no prior research examining hope in children who are obese, though it seems hope theory could play an important role in children's affective and behavioral responses to exercise.

For instance, if a child perceives him or herself as using prescribed pathways (i.e. physical activity) to make progress toward achieving a goal (e.g. attaining a healthy weight), the child might be more likely to respond with positive affective response to the activity and serve to maintain the activity. Children with high hope have been shown to be more adherent to medical regimens than their lower-hope counterparts (Moon, et al, 2001).

Current findings. Perhaps not surprisingly, in view of long-recognized principles of reinforcement, existing data point to a strong relationship between enjoyment of exercise and level of physical activity. However, much of the research has consisted of correlational and cross-sectional studies; few studies have examined the nature of this relationship over time. In a rare longitudinal study, college students who participated in swimming or yoga classes reported more positive mood in response to exercise and were more likely to continue attending a multi-person class than were students assigned to a non-active control group (Berger & Owen, 1992). These findings suggest that exercise may not need to be vigorous or aerobic to produce positive mood and continued involvement. Additional support for this possibility was provided by a study of sedentary adults. Those who reacted positively to an acute bout of exercise engaged in more weekly exercise at 6- and 12-month follow-ups compared to adults who reacted less positively (Williams, Dunsinger, Ciccolo, et al, 2008).

There is evidence that children's enjoyment of exercise and physical activity can be improved via activity intervention, and that improved enjoyment can lead to increased leisure-time physical activity (Dishman, Motl, Saunders, Felton, Ward, Dowda, & Pate, 2005). However, there are limited data regarding the extent to which obese children's enjoyment of physical activity can be improved upon. Recently, findings from an intervention to prevent weight gain and promote physical activity showed that children who were randomized to a

movement skills group emphasizing fun physical activities reported greater enjoyment of and engagement in physical activity. Furthermore, these improvements were maintained up to one year post-intervention as assessed via self-report and activity monitor, respectively (Salmon, Ball, Hume, Booth, & Crawford, 2008). While these findings are promising, less than half of the children in the study were overweight, potentially limiting the extent to which the findings generalize to children who are obese. In addition, the measure used by Salmon and colleagues to assess enjoyment simply asked children to rate their enjoyment of different activities, precluding detailed examination of specific aspects of their enjoyment. For instance, how did their enjoyment vary from week to week? How did their affective response influence weekly exercise patterns, and what was the nature of this change over the course of the intervention?

Summary

Among studies that have examined factors associated with participation in and maintaining exercise over time (Berger & Owen, 1992; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Weiss, 1993; Williams, Dunsinger, Ciccolo, et al, 2008), enjoyment of exercise has been positively associated with subsequent activity levels. However, these studies have focused primarily on adults, were conducted in laboratory settings, and may have limited generalizability for children who are obese. Among studies that have assessed exercise enjoyment in children, most have focused on sport or physical education environments (e.g. Dishman, Motl, Saunders, et al, 2005; Motl, Dishman, Saunders, et al, 2001; Prochaska, Sallis, Slymen, & McKenzie, 2003). Children who are obese or participating in obesity interventions may experience qualitatively different affective responses to exercise. Existing research is also limited by the overwhelming use of cross-sectional methodologies and self-report measures of physical activity (Francis & Kentel, 2008; Grieser, Neumark-Sztainer, Saksvig Lee, et al., 2008;

Hagger, Cale, & Almond, 1997; Macfarlane & Kwong, 2003; Paxton, Nigg, Motl,Yamashita, Chung, Battista, & Chang, 2008). This precludes examining changes in enjoyment and objectively-measured activity levels over time. The few longitudinal studies that focused on children who were obese or participating in obesity interventions (O'Brien & Martin, 1998; Salmon et al, 2008), although promising, have offered minimal discussion of the affect measures used or have provided no detailed examination of the children's affective responses.

Present Study

The present study will attempt to improve our understanding of the extent to which children who are obese enjoy exercise, and whether their affective response to exercise changes over time or predicts physical activity outside of group sessions. The investigation will contribute to the existing literature by: 1) assessing children who are obese rather than children of normal weight, 2) assessing children in the context of a pediatric obesity intervention rather than in the context of physical education or sports environments, 3) using objective, "in-vivo" measures of physical activity levels, 4) examining the longitudinal relationship between enjoyment and physical activity in children, and 5) assessing enjoyment and physical activity among an ethnically- and socioeconomically-diverse population.

Hypotheses

1. Children's affective response to exercise will predict their activity level during the following week, and this pattern will be maintained throughout the course of the eleven-week intervention.

2. As children consistently engage in exercise in the context of an obesity intervention, their enjoyment of exercise will increase.

3. The relationship between affective response to exercise and activity level will remain relatively stable over the course of the intervention, such that level of physical activity will be consistently positively correlated with enjoyment.

4. Certain demographic variables, including ethnicity, gender, age, and BMI, will influence affective response to exercise and activity level.

5. Children's hope ratings will increase over the course of the intervention.

Methods

Participants

A total of 25 children (10 girls, 15 boys) from the Healthy Hawks pediatric obesity intervention program at the University of Kansas Medical Center participated in this study over the course of three 11-week interventions (group 1, n=11; group 2, n=8; group 3, n=6). Children ranged in age from 8 to 17 (M=10.92, SD=2.16). The majority of participants were Hispanic (n=12) or African-American (n=10) with the remainder being White, non-Hispanic (n=3). Children attended about 7 of 11 sessions on average. All children read and spoke English, and parents and children gave consent and assent, respectively, to wear activity monitors and complete the affect and hope measures.

The Healthy Hawks program is a family-focused pediatric obesity intervention consisting of three stages. Stage 1 is characterized by a one-on-one primary care relationship between a child and his or her family and a pediatrician. In stage 2, children and families are treated by a multidisciplinary team during visits to the Healthy Hawks medical clinic. In stage 3, families participate in a twelve-week program where they attend weekly, psychoeducational classes and exercise activities in a group setting. Stage 3 is grant-funded, and is therefore available to families at no cost. The Healthy Hawks program recruits participants from the greater Kansas

City metropolitan area and typically includes an ethnically and socioeconomically diverse group of participants.

The present study was conducted within the context of Healthy Hawks Stage 3. Psychoeducational classes were conducted separately with children and parents. Childrens' classes were divided by age group (e.g. ages 2-5, 6-8, 9-12 and 13-18) and parents' classes by English-speaking and Spanish-speaking. Topics included specific lessons about nutrition (e.g. understanding nutrition labels, increasing fruit and vegetable intake, planning ahead for parties and meals away from home) and physical activity (e.g. incidental exercise, benefits of physical activity, exercising in the home). Group exercise included all parents and participants together and consisted of activities such as relay races, kickball, soccer, obstacle courses, and other group-based activities.

Measures

Healthy Hawks Patient Demographic Form. This self-report questionnaire was completed by the parents of participating children (Appendix A). Age, gender, and ethnicity information were obtained for the children and their parents. This form has been used during previous Healthy Hawks interventions and has been found to be a reliable tool for obtaining demographic information.

Body Mass Index (BMI) percentile measurement. BMI was calculated for participating children during the first, sixth, and eleventh weeks of the study. Each week of the program, the children's weight was recorded prior to the beginning of weekly group sessions, allowing for evaluation of changes in weight and BMI (Appendix B). BMI has been found to be a simple and reliable indicator of adiposity for most children (CDC, 2008; Mei, Grummer-Strawn, Pietrobelli, Goulding, Goran, & Dietz, 2002). Children's height and weight were obtained using medical-

grade scales and stadiometers that are operated by the KUMC Pediatrics Department. These instruments were regularly evaluated for accuracy.

Physical Activity Enjoyment Scale, Short Form (S-PACES; Dishman, Motl, Sallis, et al, 2005). The S-PACES, a modified version of the 16-item PACES (Motl, Dishman, Saunders, et al, 2001), is a self-report scale containing seven negatively-worded questions regarding children's enjoyment of physical activity (Appendix C). All items begin with the stem "When I am active…" and present different questions to measure enjoyment (e.g. "It's not at all interesting." "I feel bored."). Questions are rated on five-point likert scales ranging from 1 ("Disagree a lot") to 5 ("Agree a lot"), with higher overall scores equating to less positive affect. This measure was chosen for its simplicity, brevity, and the fact that it has been validated for use with an ethnically-diverse population of children as young as eight years of age (Dishman, Motl, Sallis, et al, 2005; Paxton, Nigg, Motl, et al, 2008).

The Children's Hope Scale (Snyder et al, 1998). The Children's Hope Scale is a brief, six-item measure that assesses the cognitive processes associated with children's goal-directed behavior. It measures two distinct factors that comprise hope, agency and pathways beliefs, each of which is evaluated using three items (Appendix D). The scale has demonstrated good internal consistency (median alpha of 0.77) and test-retest validity ($r = 0.71$). This scale has been validated for use with a variety of clinical and non-clinical populations (Snyder, et al, 1994).

ActiGraph Physical Activity Monitors. The ActiGraph (ActiGraph LLC, Pensacola, FL) is a small, lightweight activity monitor worn on a belt over the non-dominant hip. It allows objective measurement of physical activity. The monitor is programmed for start time and data collection interval (60 seconds) and data are retrieved for analysis via download to a computer USB port. Motion outside normal human movements is rejected by a filter. The ActiGraph has

been shown to provide valid assessments of physical activity for adults and children during both laboratory (treadmill walking/running) (Brage, Brage, Wedderkopp, & Roberg, 2003; Freedson, Melanson, & Sirard, 1998) and daily living activities (Ainsworth, Haskell, Whitt, et al, 2000; Hendelman, Miller, Baggett, Debold, & Freedson, 2000; Sirard, Melanson, Li, & Freedson, 2000). Children were asked to wear their activity monitor every day, but had to wear it for at least three of seven days in order for an average weekly activity score to be calculated. The activity monitors provided a behavioral measure of children's average daily and weekly levels of physical activity over the course of the twelve-week program.

Procedure

The current proposal received full review from the Institutional Review Board at the University of Kansas Medical Center. Eligible children and their parents were informed about the study and its requirements and were invited to participate during attendance at regularly scheduled Healthy Hawks orientation and consent sessions. Children and parents had the opportunity to decline participation in this additional program component.

Participating children were asked to complete the affect measure and activity questions at the end of each of the 11 group exercise sessions. Measures were collected prior to their departing from KUMC. The affect measure generally took no more than 5 minutes to complete. Children answered questions independently but were allowed to ask their parents or a research assistant if they needed help understanding any of the questions. On weeks 1, 3, 5, 7, and 10 children were asked to wear their activity monitors outside of the Healthy Hawks group during their waking hours for at least three days before the next group session (Table 1). Children wore the activity monitors every other week in order to download weekly data and charge the monitor

batteries during "off" weeks, as well as to avoid putting unnecessary strain on children and their parents. Data were collected by the primary investigator and by Healthy Hawks staff.

Missing Data

Due to the nature of longitudinal research with diverse, low-socioeconomic status families, there was some missing data due to dropout (n=4) and missed sessions (% missing sessions overall). Multiple imputation using LISREL 8.8 was performed in order to properly account for the missing data and to maximize statistical power, as recommended by current best-practice statistical guidelines (Enders, 2010). Due to the relatively small sample size, I performed 5 imputations and then aggregated the 5 imputed data sets to minimize any potential bias. Where data were present, values were not affected by the imputation process.

Results

A total of 25 children (10 girls, 15 boys) participated in this study. These children completed the 11-week interventions in three groups (group 1, n=11; group 2, n=8; group 3, n=6). Forty-eight percent (n=12) of the children were Hispanic, 40% (n=10) were African-American, and 12% (n=3) were White, non-Hispanic. Children's BMI percentiles ranged from 92.5 to 99.9% (*M*=98.28, SD=1.89%), indicating all of the children were overweight, and 23 had BMIs above the 95th percentile, indicating they were obese. Parental BMI ranged from 25.1 to 47.2 (*M*=34.42, SD=5.38), indicating that all of the parents (n=25) were overweight, and 20 parents had BMIs above 30, indicating they were obese (see Table 2).

Descriptive statistics for the primary affect, physical activity and hope variables can be seen in Table 3 and correlations between the affect, activity and hope measurements can be seen in Table 4. There were few statistically significant correlations among these variables. Children's attendance was significantly correlated with average overall affect scores from the S-PACES (*r*=

-0.492, p=0.013) and post-intervention pathways (*r*= -0.493, p=0.012). Post-intervention agency scores, another subscale of the hope measure, were significantly correlated with attendance (*r*=0.464, p=0.019), child BMI (*r*=0.458, p=0.021) and parent BMI (*r*=0.507, p=0.010). Activity monitor data indicated average total physical activity was correlated with average total vigorous physical activity (*r*=0.503, p=0.010). In addition, except for week 11, all weekly affect scores from the S-PACES were statistically significantly correlated with total 11-week affect scores, and weekly affect and biweekly activity levels were only sporadically correlated.

I then used hierarchical linear modeling (HLM), also known as multilevel modeling, to explore the majority of the hypotheses. HLM models were conducted using LISREL. HLM is an extension of regression in which nested data structures (i.e. repeated measures within individuals) can be appropriately modeled (Raudenbush & Bryk, 2002). In this study, repeated measurements (level 1) were nested within individuals (level 2). A series of multilevel models, analyses of variance and linear regressions were run to evaluate the main hypotheses.

Variability

I began by examining a series of null models in order to determine the extent to which activity levels and affective response to exercise varied within individuals across the study. The null model examining overall physical activity indicated statistically significant level 1 variance (within-participant; β=10393.15, SE=1469.81, p<0.001) but not significant level 2 variance (between-participant; β=974.4, SE=912.19, p=0.28), suggesting there was greater variability in physical activity minutes within individual children than among the children. Next, the null model examining affective response to exercise indicated statistically significant level 1 variance (within-participant; β=25.108, SE=2.246, p<0.001), but not significant level 2 variance

(between-participant; β=2.454, SE=1.355, p=0.070), indicating there was greater variability in affective response to exercise within individual children than among children.

I next ran null models examining variance in low, moderate and vigorous physical activity. Both low (within-participant: β=542.23 SE=76.68, p<0.001; between-participant: β=23.93, SE=40.46, p=0.55) and vigorous (within-participant: β=7.27, SE=1.03, p<0.001; between-participant: β=0.96, SE=0.71, p=0.18) physical activity showed statistically significant level 1 but not level 2 variance. The null model for moderate physical activity indicated statistically significant level 1 (β=25.108, SE=2.246, p<0.001) and level 2 (β=25.108, SE=2.246, p<0.001) variance, indicating variability in moderate physical activity both within and among children.

Enjoyment and Physical Activity

I next ran the proposed hierarchical linear models to determine whether a predictive relationship would be found between affective response to exercise and physical activity levels. To examine whether children's affective response to exercise predicted activity levels, I modeled weekly affective response scores with bi-weekly physical activity ratings as the dependent variable. The effect was not statistically significant (β=2.218, SE=2.472, p=0.369), indicating that children's affective response to exercise did not predict their level of physical activity during the following weeks in the Healthy Hawks intervention (Figures 1 and 2).

To examine whether children's enjoyment of exercise would increase over the 11-week intervention, I modeled weekly affective response ratings. Affective response to exercise showed statistically significant change (β=0.360, SE=0.093, p=0.0001) over the course of the intervention, but opposite the predicted direction. Higher scores denote less positive affective

response to exercise, thus children reported less enjoyment of physical activity as the intervention progressed.

To examine whether children's enjoyment of exercise and activity levels showed both linear change and change in the same direction, I ran two models assessing the trajectory of changes in affective response to exercise and activity levels. Affective response to exercise showed a statistically significant linear decline over the course of the intervention (β=0.360, SE=0.093, p=0.0001) as did mean overall physical activity minutes (β= -9.724, SE=3.074, p=0.002) (Figure 1). Low physical activity also showed a statistically significant linear decrease (β= -1.455, SE=0.722, p=0.044) and vigorous physical activity showed a non-significant trend for decline over the course of the intervention. Moderate physical activity was the only activity variable that appeared to increase over the course of the intervention (baseline: *M*=30.64; Post-intervention: *M*=34.08). However, the increase was neither linear nor statistically reliable and it is therefore uncertain whether the increase could be attributed to statistical error.

Because there was not a statistically significant relationship between affective response to exercise and activity level, I decided not to assess whether this relationship was moderated by demographic variables.

Demographic Effects

Several demographic variables appeared to influence enjoyment of exercise (Table 4). Age predicted affective response to exercise (β= -0.407, SE=0.189, p=0.032), such that older children were more likely to have lower affect scores, corresponding to more positive affect. There were non-significant trends for African-American ethnicity (β= -1.585, SE=0.829, p=0.056), child BMI (β= -0.119, SE=0.062, p=0.053), and parent BMI (β= -0.146, SE=0.077, p=0.058) to predict children's affective response to activity. Over the 11-weeks, it is possible

that children who were African-American, who had higher BMI percentiles, or whose parents had higher BMIs tended to experience more positive affect (lower scores) in response to exercise.

Several demographic variables also appeared to influence activity levels. Hispanic children engaged in fewer minutes of daily physical activity (β= -50.591, SE=19.830, p=0.011) than African-American and White, non-Hispanic children. There was a non-significant trend for African-American children to be more physically active than Hispanic and White, non-Hispanic children (β=40.913, SE=21.021, p=0.052). Older age predicted lower levels of both moderate (β= -3.448, SE=0.925, p=0.0002) and vigorous physical activity (β= -0.273, SE=0.136, p=0.045), indicating that older children got less moderate and vigorous physical activity than their younger counterparts. There was also a statistically significant relationship between African-American ethnicity (β=1.393, SE=0.569, p=0.014) and vigorous physical activity indicating African-American children engaged in significantly more vigorous physical activity that the other children over the course of the 11 weeks.

Hope

To examine whether children's hope ratings would increase over the course of the intervention, I performed a series of paired-sample T-tests comparing baseline and post-intervention hope and subscale scores (see Figure 3). There was a slight increase in children's mean hope ratings from baseline (*M*=25.272, SD=1.487) to post-intervention (*M*=26.872, *SD*=1.374), though this increase was not statistically significant (t= -1.406 p=0.173). The pathways subscale showed a statistically significant increase (t= -2.106 p=0.046) from baseline (*M*=12.72, SD=4.277) to post-intervention (*M*=14.36, SD=4.182), indicating that, by the end of

the intervention, children perceived they had greater ability to determine the means to achieve their goals. There was no statistically significant change in agency beliefs.

Discussion

Physical activity is an integral component of pediatric obesity interventions (American Academy of Pediatrics, 1996). Children who get regular exercise are less likely to be obese throughout childhood, adolescence (Janz, Kwon, Letuchy, et al, 2009) and adulthood (Fogelholm, et al, 2006). Physically active children also have lower levels of abdominal fat (Kim & Lee, 2009) which is linked to metabolic syndrome, lower prevalence of cardiovascular risk factors (i.e. hypertension, high cholesterol, abnormal insulin resistance) and higher bone density (Janz, Letuchy, et al, 2009). Even brief (i.e. 8 to 12 week) exercise interventions with obese children can lead to substantial improvements in hepatic fat accumulation, insulin resistance (van der Heijden, Wang, Chu, et al, 2010), body mass, body fat and muscle strength (McGuigan, Tatasciore, Newton, & Pettigrew, 2009). Moreover, even relatively small improvements in these physical health measures can lead to important health improvements in children who are obese (Kirk, et al, 2005). In addition to physical health benefits, regular exercise has been associated with improved mental health in obese children (Daley, et al, 2006) and appears to lead to short-term improvements in self esteem (Walker, et al, 2007; Ekeland, et al, 2005).

One of the reasons pediatric obesity interventions sometimes fail to produce lasting effects is children's and families' non-adherence to health behavior changes, including physical activity, after the interventions have ended (American Academy of Child & Adolescent Psychiatry, 2008). One of the reasons for such non-adherence could be obese children's affective response to physical activity. Physical or not, if children enjoy an activity, they are more likely to

continue engaging in it on a regular basis (Emmons & Diener,1986). Conversely, if children dislike or perceive no benefit from an activity, they are not likely to regularly engage in it.

Affective response to, or enjoyment of exercise plays an important role in individuals' physical activity levels. Among studies that have examined factors associated with participation in and maintaining exercise over time (Berger & Owen, 1992; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Weiss, 1993; Williams, Dunsinger, Ciccolo, et al, 2008), enjoyment of exercise has been positively associated with subsequent activity levels. However, these studies have focused primarily on adults, were conducted in laboratory settings, and may not generalize to children who are obese. Among studies that have assessed exercise enjoyment in children, most have focused on sport or physical education environments (e.g. Dishman, Motl, Saunders, et al, 2005; Motl, Dishman, Saunders, et al, 2001; Prochaska, Sallis, Slymen, & McKenzie, 2003). Also, research has been limited by the overwhelming use of cross-sectional methodologies and self-report measures of physical activity (Francis & Kentel, 2008; Grieser, Neumark-Sztainer, Saksvig Lee, et al., 2008; Hagger, Cale, & Almond, 1997; Macfarlane & Kwong, 2003; Paxton, Nigg, Motl,Yamashita, Chung, Battista, & Chang, 2008), which has precluded examining changes in enjoyment and objectively-measured activity levels over time. The few longitudinal studies that have focused on children who were obese or participating in obesity interventions (O'Brien & Martin, 1998; Salmon et al, 2008), although promising, have offered minimal discussion of the affect measures used or have provided no detailed examination of the children's affective responses.

Adults report enjoyment of moderate-intensity exercise lasting for approximately 35 minutes (Reed & Ones, 2006). Normal-weight children report enjoyment of gender-segregated group exercise activities, as well as gym class and sports in which they feel confident

participating (Castelli & Valley, 2007; Woods, et al, 2007). However, little is known about the extent to which obese children enjoy exercise. The present study attempted to remedy this by using "in-vivo" measures of physical activity, using a longitudinal design, and assessing enjoyment and activity levels in a low-income, minority population that tends to be at greatest risk for obesity.

Physical Activity

Overall, obese children in this study were less physically active week by week over the course of the intervention. Contrary to prediction, some of the obese children actually exercised less after beginning the family-focused health behavior change program. Physical activity ratings over the course of a pediatric obesity intervention do not appear to have previously been evaluated among a similarly high-risk population, but most data suggest no change or an increase in physical activity during the intervention period (i.e. Kalarchian, Levine, Arslanian, Ewing, Houck, Cheng, et al, 2009).

There are multiple potential reasons why children may have engaged in progressively less physical activity during the intervention. The decrease could have been due to a higher-than-usual amount of exercise upon beginning the program and children simply reverted back to their baseline level of activity. It is also possible that these children were an anomaly and do not represent the normal activity patterns of children in obesity interventions, although we do not expect this. There were no statistically significant differences in wear-time per day (valid days were only included for analysis if activity monitors were worn for at least 10 hours) nor in the number of valid days per week; thus, it is unlikely that an error in data-processing led to the drop in physical activity.

If the linear decline in children's activity levels was not anomalous, this presents a troubling challenge for pediatric obesity interventionists. First, most overweight and obese children fail to participate in an adequate amount of physical activity. Second, these findings suggest that, at best, there is an initial spike in activity that reverts to baseline levels or, at worst, that children begin to exercise less after beginning an intervention program. Due to data suggesting at least minimal improvements in health behaviors during and after pediatric obesity interventions (Kamath, Vickers, Ehrlich, McGovern, Johnson, Singhal, et al, 2008) the former scenario seems more feasible.

Individuals who participate in health behavior change interventions often feel particularly motivated at the beginning of the program but this motivation wanes as the program continues (Rothman, 2000). In addition, treatment with high-risk children – namely those whose families are of low-SES, are of racial and ethnic minorities, or have at least one obesity co-morbidity – may be especially challenging due to high attrition (Skelton, et al, 2008) and the multiple barriers to healthier lifestyles these families face (Fitzgibbon & Stolley, 2004; Sonneville, et al, 2009; Thompson, 2009). High socioeconomic status in childhood is strongly associated with higher physical activity and fitness levels as well as with greater likelihood of increasing physical activity and fitness in comparison with low SES children. Such effects persist from an early age into adulthood (Cleland, Ball, Magnussen, Dwyer, Venn, 2009). Thus, children who are most at risk for developing obesity and comorbidities resulting from obesity are least likely to be exposed to and engage in the preventive behaviors necessary to stave off associated health problems.

In addition to possible economic, social and environmental barriers, children in the present study may have engaged in decreasing physical activity because they perceived their

efforts to be ineffective. Learned helplessness (Seligman, 1975) has been used to explain obese children's difficulty with exercise. Children who are obese may perceive events or circumstances, such as their obesity, as unchangeable and resulting from internal causes (i.e perceived inadequacy) (Sothern, Hunter, Suskind, Brown, Udall, & Blecker, 1999). Obese children may come to believe that their efforts to exercise, which they perceive to be more difficult than for children who are not overweight, are ineffective and hence they give up trying (McWhorter, et al, 2003). In most pediatric weight management programs improvements in BMI, though important, are small (Kamath, Vickers, Ehrlich, et al, 2003). The combination of economic, social and environmental variables with lack of perceived success at attaining a healthy weight may have been too much for these children (and their parents) to bear and their motivation to exercise slowly faded.

This possibility is supported by children's scores on the Hope Scale. From baseline to post-intervention, children perceived greater ability to develop routes to achieving their goals (pathways) yet experienced no change in their confidence that they could use these pathways to actually achieve desired goals (agency). When applied to the drop in exercise, it is possible that the children gained the knowledge necessary to change health behaviors but, due to aforementioned barriers and learned helplessness, felt unable to make the changes occur.

One bright spot in these apparently bleak findings was that moderate physical activity increased slightly, from a daily average of about 30 minutes to 34 minutes. However, because this finding was not statistically significant it is not clear whether children actually exercised more or whether this increase could be attributed to statistical error. Moderate exercise is effective for pediatric weight loss and management (Sothern, et al, 1999) and even small decreases in BMI can lead to important health improvements (Kirk, et al, 2005). Thus, small

increases in physical activity and other positive health behaviors are an important first step for children who are obese.

Ethnic differences in physical activity. Hispanic children exercised significantly less than White, non-Hispanic and African American children, and African American kids appeared to exercise more than both Hispanic and White, non-Hispanic children. In addition, African American children engaged in the most minutes of vigorous physical activity, though the total amount across all the children was so low this difference may not be clinically significant.

Research has indicated that children of racial and ethnic minority groups are generally less physically active than White, non-Hispanic children and adolescents. These lower rates are linked to reduced participation in physical education, lower maternal education and family income, and higher levels of neighborhood crime (Gordon-Larson, et al, 2000). However, these data and many other studies with similar findings (i.e. Kumanyika, 2006) reflect the experience of the whole population of minority group children rather than only those minority children who are obese. There do not appear to be any population-based studies which have examined physical activity differences among obese children from different ethnic groups. Racial and ethnic minority differences in physical activity among children who are obese could be an interesting avenue for future research, as it may point to important differences in which populations would benefit from which interventions (i.e. dietary changes in African American children versus activity changes in Hispanic children).

Age differences in physical activity. Older age predicted lower moderate and vigorous physical activity, which is consistent with research suggesting children become less active throughout early and later adolescence (Van Mechelen, et al, 2000). The habitual physical activity that is present in younger children declines sharply at early adolescence, although

activity through organized sports generally goes unchanged (Van Mechelen, et al, 2000). In other words, it is normal for children to engage in fewer bouts of spontaneous physical activity as they hit puberty, but if they are involved in organized sports they continue being active in these more structured situations. Among children who are obese, however, activity levels show sharp declines that occur earlier in childhood than for non-overweight children (Gillis, 2007).

The natural progression of activity levels for obese children may represent a vicious cycle. Due to stress on joints and the higher effort required for participation, obese children often perceive exercise as physically uncomfortable (Shulz, Anner, & Hills, 2009), as well as emotionally challenging due to undeveloped skill sets and lack of confidence in physical abilities (Cairney, Hay, Mandigo, et al, 2007; Woods, Bolton, Graber, & Crull, 2007). As a result, some obese children may learn that physical activity is not a positive experience subsequently inhibit tendencies toward physical activity. Lack of physical activity may then maintain their obesity. The present study did not include measures of pain perception during physical activity or specific reasons for a dislike of physical activity, thus any hypotheses must be considered speculative. However, this potential cycle is supported by the present and past findings, and illustrates the importance of turning physical activity into a positive experience for children who are obese.

Affective response

Like children's activity levels, there was a statistically significant linear decline in affective response to exercise over the course of the intervention. Contrary to the hypothesized outcome – that the children would enjoy exercise more over the course of the program – the children reported more negative affective responses at the end of the program than at the beginning. One explanation of this finding could relate to the original hypothesis, that experience with exercise would breed greater enjoyment of exercise. In fact, children exercised consistently

less across longitudinal measurements, and their affective response to exercise decreased in a parallel fashion. Thus, it is possible that greater familiarity with exercise could have led to greater enjoyment, but because children were exercising less they enjoyed it less.

Deci and Ryan (1985) propose that motivation changes with perceived competence. Specifically, they argue that intrinsic motivation is enhanced by positive self-evaluations of competence and is decreased by circumstances that lower perceived competence. It is possible that because these children never increased their levels of exercise, they may not have gained an improved sense of competence. Furthermore, their lack of physical activity suggests they did not develop intrinsic motivation for physical activity.

Another possible explanation for the children's negative affective response to exercise relates to the theory of learned helplessness (Seligman, 1975). Children may have felt a sense of hopelessness when they did not perceive positive results from their efforts to attain a healthy weight. As a result, the difficulty associated with exercise for children who are obese, combined with the impression that exercise was not helping them reach the goal of a healthy weight, may have contributed to their decline in exercise enjoyment.

Ethnic differences in exercise enjoyment. African-American children appeared to enjoy exercise slightly more than other participating children, though this difference did not reach statistical significance. Because there are so little data on obese children's affective responses to exercise it would be premature to draw any conclusions from this near-significant effect. Replicating this study with a larger sample of ethnically-diverse children would allow for an adequately powered examination of between-group differences.

Age differences in exercise enjoyment. Older children endorsed an increasingly positive response to physical activity as the intervention progressed. Children's natural activity patterns

are characterized by short bursts of vigorous activity throughout early and middle childhood, with an early-onset decline in physical activity taking place prior to adolescence among obese children (Gillis, 2007; Van Mechelen, 2000). Adolescents who are not overweight tend to stay involved in organized sports, allowing physical activity to remain a part of their daily lives. However, the same does not appear to be true for obese children (Gillis, 2007). As children enter late childhood and early adolescence, self-consciousness is at an all-time high (Rankin, Lane, Gibbond, & Gerrard, 2004). This self-consciousness may be especially salient for obese children as they are more likely to be teased by peers, receive attention from teachers, and have low self-esteem (Pearce, Boergers, & Prinstein, 2002; Puhl & Latner, 2007; Wang, Wild, Kipp, Kuhle, & Veugelers, 2009). Obese children's dislike of exercise and lack of confidence in their athletic abilities could make physical activity with other children especially challenging.

One potential explanation for older children's increased enjoyment could be they benefited from the positive feedback, individualized attention and positive exercise environment in the intervention. Children may have been accustomed to gym class or activities with other, non-obese children where they are teased or ignored (Pearce, et al, 2002). In the present intervention, their perceived competence may have increased when compared to other children in the program. Another explanation may be that older children better understood how to regulate the intensity of their exertion in order to remain at an ideal ventilatory threshold, which is linked to higher enjoyment (Rose & Parfit, 2010). Furthermore, because older children tend to be less active than younger children (Gillis, 2007; Van Mechelen, 2000) they may have had more to gain from exercise participation. These explanations are speculative, however, and should be further explored.

The concern, however, is that younger children enjoyed exercise less despite the positive program environment. If health professionals cannot get obese children to derive at least a moderate amount of enjoyment or satisfaction from engaging in exercise, it will be difficult to help these children become and stay healthy. Exercise is one of the most important actions one can do for overall health (Blair & Morris, 2009; Janiszewski & Ross, 2009), and early physical activity is linked to activity later in life. Setting the early foundation for an active lifestyle may be one of the most important targets for health behavior interventions.

Body mass differences in exercise enjoyment. Children who were more overweight and whose parents were more overweight showed slight trends to enjoy exercise more, though these trends were not statistically significant. Regarding parent BMI, it is possible that it was simply a predictor of child BMI and lacks a unique effect as a stand-alone factor. However, parent and child BMI were not correlated, so this possibility appears unlikely. A second possibility is that parents who are obese and willing to engage in a family-focused pediatric obesity program may be especially motivated to make changes compared to parents who are not overweight or are only moderately overweight. Parents of children participating in school-based BMI screening and education about healthy behaviors may be more likely to take interest in healthy cooking techniques and exercise classes than their normal weight counterparts, and these effects appear to be strongest for ethnic minority parents (Johnson, Pilkington, Lamp, He, & Deeb, 2009). Parental modeling of health behaviors is a key component for success in these interventions. If parents in the present study, like those in Johnson et al, were especially interested in seeking information and assistance in getting healthy, it is possible that their children benefitted from their positive modeling and found the changes (i.e. physical activity) more enjoyable.

It will be important for researchers to look more carefully at the potential relationship between children's BMI and their enjoyment of physical activity. Obese adults (i.e. BMI above 30) tend to enjoy exercise less and prefer different activities than their normal-weight counterparts (Ekkakakis & Lind, 2006). However, there are little existing data illustrating obese children's enjoyment of exercise. Thus, it is difficult to judge the generalizability of these findings.

A speculative explanation for this finding is that there is an enjoyment "threshold" separating children who are not overweight from those who are. There may be two distinct groups of children: those who like exercise (non-overweight) and those who don't (obese). In addition to obvious between-group differences, present findings suggest there would also be significant within-group variability in enjoyment among the obese children. One predictor of this within-group variability could be BMI. For instance, it is possible that children on the upper end of the obesity continuum who participate in an obesity intervention may enjoy exercise more than their less obese counterparts for a variety of reasons, such as that they get more attention from "teachers" relative to their past experiences, learning new strategies gives them more hope for change, or other factors. It is also possible that children who are on the low end of the obesity continuum could in some cases enjoy exercise more because they might be better able to learn new skills or feel less physical pain during exercise. It remains to be seen whether the same enjoyment effect would hold true for all obese children.

Hope

Children reported stronger pathways beliefs at the end of the intervention compared to baseline though they did not report increased agency. Further, children appeared to have greater post-intervention hope compared to baseline. However, because the increase in hope was not

statistically significant, it impossible to know whether the mean increase was due to actual change or to statistical error. Hope theory (Snyder, 1989) describes pathways thinking as one's ability to develop multiple plausible routes to attain a desired goal, and agency is described as the perceived capacity to use one's pathways to reach a desired goal (Snyder, 2002). It follows that because these two constructs comprise the larger construct of hope they will likely change concurrently. At the end of the present intervention, however, children perceived significantly greater ability to develop multiple ways to accomplish a desired goal (i.e. drink less soda to attain a healthy weight) but did not report a change in the degree to which they believed they could actually use these pathways to achieve goals.

Snyder (2002) suggested that individuals who have mixed patterns of high pathways and low agency beliefs have active routing thoughts but lack the motivational thinking necessary to put perceived pathways into practice. Children who are obese may provide a good illustration of this particular form of mixed hope. The present pediatric obesity intervention emphasizes psychoeducation as an impetus for health behavior change. Although children and parents are exposed to lots of new information about nutrition, physical activity, reinforcement for desired behaviors and other topics, increased knowledge may not lead to behavior change. In other words, the children may have gained the knowledge necessary to develop multiple pathways (i.e. drink more water, eat more produce and whole grains, exercise more) but, not seeing results (i.e. reduced BMI), they may not have increased belief in their capacity to actually achieve the goal.

Hispanic children reported the highest increase in pathways beliefs from baseline ($\underline{M}$=11.75, SD=4.808) to post-intervention ($\underline{M}$=14.33, SD=3.892; p=0.012). Hispanic children also had the largest decline in physical activity, which supports the conclusion that pathways beliefs may be stronger than agency beliefs after a health behavior change intervention.

In other words, throughout the intervention Hispanic children appeared to gain confidence in their ability to discern healthful, effective routes to achieve a healthy weight but perceived no increased ability to put these routes into practice. Again, there appears to be little to no information about hope among children who are obese, especially in relation to health behavior change. Thus, this would be a fruitful area for future research.

Limitations

The small sample size limited definitive conclusions regarding the generalizability of the present findings. Additionally, although the substantial number of Hispanic and African-American participants allowed evaluation of the most at-risk groups, it would have been preferable to have an equally-large number of White, non-Hispanic children for comparison. Furthermore, it was difficult to get children to attend each group, to complete the affect measure and to wear the activity monitor on the prescribed weeks. However, absenteeism and attrition are factors frequently encountered when working with low-SES, minority populations as they are more likely to have difficulties with transportation, child care, inflexible work schedules, and other barriers previously discussed.

Conclusions

Obesity is a notoriously difficult health issue to prevent and treat. Despite the increasingly urgent calls for effective intervention and prevention of obesity, obesity rates have abated slightly for some populations yet continued climbing for others (Ogden, et al, 2010; Wolf & Woodworth, 2009). Thus, it is not surprising when success in obesity intervention programs is measured in small changes with the norm being little to no change in major outcomes.

There were several statistically significant changes among the children in the present study, though some of these were opposite the expected direction. Obese children exercised less

and enjoyed exercise less at the end of the intervention than at the beginning. However, there were improvements in perceived ability to determine routes to achieving desired goals and possibly in moderate physical activity. African American children enjoyed exercise the most and appeared to get the most exercise compared to White and Hispanic children. Older children exercised less and enjoyed exercise less than their younger counterparts. Those children who were more obese and whose parents were more obese appeared to enjoy exercise more than children who were less obese.

There was not a statistically significant predictive relationship between affective response to exercise and subsequent physical activity. However, both factors changed in similar ways, suggesting replication with a larger sample could reveal a predictive relationship between affective response and physical activity. The next step is to test this hypothesis in another, preferably larger sample to discern whether a predictive relationship could be found.

The complex relationship between pathways and agency beliefs should be further explored in this population. It is possible that further intervention or more specialized emphases could improve children's agency beliefs, or confidence in their ability to make health behavior changes. Furthermore, pathways and agency beliefs may influence children's exercise enjoyment and physical activity. Children may have expanded their knowledge of health behaviors yet felt they were making little to no progress toward reaching their goal. Thus, they may have developed greater confidence in their ability to develop strategies while failure to achieve their goal (i.e. lose weight) reinforced a lack of confidence to put these strategies to use. Research has shown that hope and self-efficacy can be improved through targeted intervention (Bandura, 1997; Snyder, 2002), and a greater understanding of these traits in obese children may inform future interventions.

It may be that for some children, especially those who are overweight or obese, exercise cannot be enjoyed as a stand-alone activity. Rather, these children may view exercise as obligatory and only useful for losing weight. In the present study, children engaged in less exercise and enjoyed exercise less as the intervention progressed. One explanation for this pattern could be that the children felt their efforts were disproportionately difficult compared to the benefits, or rather the lack thereof. A reasonable conclusion from this explanation is that obese children may not enjoy the process of physical activity but see it only as the prescribed avenue toward something else.

There is room to expand our knowledge regarding the importance of affective response to exercise and its effect on physical activity levels in this population. Family-focused behavioral interventions are the gold standard for alleviating pediatric obesity, yet there is room for improvement in this extremely challenging task. Understanding enjoyment in the context of physical activity may be one of the next logical steps in better understanding how to help kids get, and stay, healthy.

References

Ainsworth, B.E., Haskell, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Strath, S.J., O'Brien, W.L., et al. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Medicine & Science in Sports & Exercise*, *32*, S498-S516.

American Academy of Child & Adolescent Psychiatry. Obesity in Children and Teens, "Facts for Families." May, 2008. 79, 1-2.

American Academy of Pediatrics (2007). Policy Statement, Committee on Nutrition: Prevention of Pediatric Overweight and Obesity. *Pediatrics, 112,* 424-30.

Anderson, P.M., & Butcher, K.F. (2006). Childhood obesity: Trends and potential causes. *The Future of Children, 16,* 19-45.

Annesi, J.J. (2005). Improvements in self-concept associated with reductions in negative mood in preadolescents enrolled in an after-school physical activity program. *Psychological Reports, 97,* 400-4.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Baur, L.A., & O'Connor, J. (2004). Special considerations in childhood and adolescent obesity. *Clinics in Dermatology, 22,* 338-44.

Berger, B.G., & Owen, D.R. (1992). Mood alteration with yoga and swimming: Aerobic exercise may not be necessary. *Perceptual and Motor Skills, 75,* 1331-43.

Blair, S.N. & Morris, J.N. (2009). Healthy hearts –and the universal benefits of being physical active: Physical activity and health. *Annals of Epidemiology, 19, 4,* 252-6.

Brage, S., Brage, N., Wedderkopp, N., & Roberg, K. (2003). Reliability and validity of the computer science and applications accelerometer in a mechanical setting. *Measurement in Physical Education and Exercise Science, 7,* 101-119.

Buckworth, J. (2000). Exercise determinants and interventions. *International Journal of Sport Psychology, 31,* 305-20.

Burdette, H.L., & Whitaker, R.C. (2005). Resurrecting free play in young children: Looking beyond fitness and fatness to attention, affiliation, and affect. *Arch Pediatr Adolesc Med, 159*, 46-50.

Cairney, J, Hay, J, Mandigo, J, et al. (2007). Developmental coordination disorder and reported enjoyment of physical education in children. *European Physical Education Review, 13*, 82-98.

Caspersen, C.J., Powell, K.E., & Christiensen, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*, 126-31.

Castelli, DM, & Valley, JA (2007). Chapter 3: The relationship of physical fitness and motor competence to physical activity. *Journal of Teaching in Physical Education, 26*, 358-74.

Centers for Disease Control and Prevention (2008a). "About BMI for children and teens." Retieved January 1, 2009: http://www.cdc.gov/nccdphp/dnpa/healthyweight/assessing/bmi/childrens_BMI/about_childrens_BMI.htm#How%20is%20BMI%20used%20with%20children%20and%20teens

Centers for Disease Control and Prevention (2008b). "Childhood overweight and obesity." Retrieved January 3, 2009: http://www.cdc.gov/nccdphp/dnpa/obesity/childhood/index.htm

Cleland, V.J., Ball, K., Magnussen, C., Dwyer, T. & Venn, A. (2009). Socioeconomic position and the tracking of pjusocal activity and cardiorespiratory fitness from childhood to adulthood. *American Journal of Epidemiology, 170, 9*, 1069-77.

Cofer, C.N. (1981). The history of the concept of motivation. *Journal of the History of Behavioral Sciences, 17,* 48-53.

Daley, A.J., Copeland, R.J., Wright, N.P., Roalfe, A., & Wales, J.K.H. (2006). Exercise therapy as a treatment for psychopathologic conditions in obese and morbidly obese adolescents: A randomized, controlled trial. *Pediatrics, 118,* 2126-34.

Daniels, S.R., Greer, F.R., & Committee on Nutrition (2008). Lipid screening and cardiovascular health in childhood. *Pediatrics, 122,*198-208.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and selfdetermination in human behavior. New York: Plenum Press.

DiLorenzo, T.M., Stucky-Ropp, R.C., Vander Wal, J.S., & Gotham, H.J. (1998). Determinants of exercise among children. II. A longitudinal analysis. *Preventive Medicine, 27,* 470-7.

Dishman, R.K., Motl, R.W., Saunders, R., Felton, G., Ward, D.S., Dowda, M., & Pate, R.R. (2005). Enjoyment mediates effects of a school-based physical activity intervention. *Medicine & Science in Sports & Exercise, 37,* 478-87.

Dishman, RK, Motl, R, Sallis, JF, Dunn, A.L, Birnbaum, A.S., Welk, G.J., Bedime-Rung, A.L., et al. (2005). Self-management strategies mediate self-efficacy and physical activity. *American Journal of Preventive Medicine, 29,* 10-18.

Ekeland, E., Heian, F. & Hagen, K.B. (2005). Can exercise improve self esteem in children and young people? A systematic review of randomized controlled trials. *British Journal of Sports and Medicine, 39,* 792-8.

Ekkekakis, P. & Lind, E. (2006) Exercise does not feel the same when you are overweight: The impact of self-selected and imposed intensity on affect and exertion. *International Journal of Obesity, 30,* 652-60.

Emmons, R.A., & Diener, E. (1986). A goal-affect analysis of everyday situational choices. *Journal of Research in Personality, 20,* 309-26.

Enders, C. K. (2010). *Applied missing data analysis.* New York, NY: Guilford Press.

Epstein, L.H., Kilanowski, C.K., Consalvi, A.R., & Paluch, R.A. (1999). Reinforcing value of physical activity as a determinant of child physical activity level. *Health Psychology, 18,* 599-603.

Epstein, L.H., Roemmich, J.N., Saad, F.G., & Handley, E.A. (2004). The value of sedentary alternatives influences child physical activity choice. *International Journal of Behavioral Medicine, 11,* 236-42.

Eyler, A, Nanney, MS, Brownson, RC, Lohman, D, Haire-Joshu, D (2006). Correlates of after-school activity preference in children ages 5-12: The PARADE study. *American Journal of Public Health Education, 37,* 69-77.

Fitzgibbon, M.L. & Stolley, M.R. (2004). Environmental changes may be needed for prevention of overweight in minority children. *Pediatric Annals, 33,* 45-9.

Fogelholm, M. (2008). How physical activity can work. *International Journal of Pediatric Obesity, 3,* 10-14.

Fogelholm, M., Stallknecht, B., & Van Baak, M. (2006). ECSS position statement: Exercise and obesity. *European Journal of Sport Science, 6,* 15-24.

Francis, N, Kentel, JA (2008). The fun factor: Adolescents' self-regulated activity and the implications for practitioners and researchers. *Leisure, 32,* 65-90.

Freedman D.S., Dietz W.H., Srinivasan S.R., & Berenson G.S. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics, 103,* 1175–82.

Freedson, P.S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc., accelerometer. *Medicine & Science in Sports & Exercise,* 30, 777-81.

Gillis, L.J., Kennedy, L.C., & Bar-Or, O. (2007). Overweight children reduce their activity levels earlier in life than healthy weight children. *Clinical Journal of Sport Medicine, 15,* 51-5.

Goodwin, R.D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine, 36,* 698-703.

Gordon-Larson, P., McMurray, R.G. & Popkin, B.M. (2000). Adolescent physical activity and inactivity vary by ethnicity: The National Longitudinal Study of Adolescent Health. *Journal of Pediatrics, 135,* 301-6.

Grieser, M, Neumark-Sztainer, DN, Saksvig, BI, Lee, JS, Felton, GM, Kubik, MY (2008). Black, Hispanic, and White girls' perceptions of environmental and social support and enjoyment of physical activity. *J Sch Health, 78,* 314-20.

Hagger, M, Cale, L, Almond, L. (1997). Children's physical activity levels and attitudes toward physical activity. *European Physical Education Review,3,* 144-64.

Hall, E.E., Ekkekakis, P., Petruzzello, S.J. (2002). The affective beneficence of vigorous exercise revisited. *British Journal of Health Psychology, 7,* 47-66.

Hendelman, D., Miller, K., Baggett, C., Debold, E., & Freedson, P. (2000). Validity of accelerometry for the asssesment of moderate intensity physical activity in the field. *Medicine & Science in Sports & Exercise, 32,* S442-S449.

Jago, R., Baranowski, T., Baranowski, J.C., Thompson, D., & Greaves, K.A. (2005). BMI from 3-6y of age is predicted by TV viewing and physical activity, not diet. *International Journal of Obesity,* 29, 557-64.

Janiszewski, P.M. & Ross, R. (2009). The utility of physical activity in the management of global cardiometabolic risk. *Obesity, 17, Suppl. 3,* S3-S14.

Janz, K.F., Kwon, S., Letuchy, E.M., Eichenberger Gilmore, J.M., Burns, T.L., Willing, M.C. & Levy, S.M. (2009). Sustained effect of early physical activity on body fat mass in older children. *American Journal of Preventive Medicine, 37,* 35-40.

Johnson, S.B., Pilkington, L.L., Lamp, C., He, J. & Deeb, L.C. (2009). Parent reactions to a school-based body mass index screening program. *Journal of School Health, 79,* 216-23.

Kalarchian, M.A., Levine, M.D., Aslanian, S.A., Ewing, L.J., Houck, P.R., Cheng, Y., Ringham, R.M., et al. (2009). Family-based treatment of severe pediatric obesity: Randomized, controlled trial. *Pediatrics,124,* 1060-8.

Kamath, C.C., Vickers, K.S., Ehrlich, A., McGovern, L., Johnson, J., Singhal, V., Paulo, R., et al. (2008). Behavioral interventions to prevent pediatric obesity: A systematic review and metaanalyses of randomized trials. *Journal of Clinical Endocrinology and Metabolism, 93,* 4606-15.

Kim, Y. & Lee, S. (2009). Physical activity and abdominal obesity in youth. *Applied Physiology, Nutrition, and Metabolism, 34,4,* 571-81.

Kirk, S., Zeller, M., Claytor, R., Santangelo, M., Khoury, P.R., & Daniels, S.R. (2005). The relationship of health outcomes to improvement in BMI in children and adolescents. *Obesity Research, 13,* 876-82.

Kumanyika, S.K. (2008). Environmental influences on childhood obesity: Ethnic and cultural influences in context. *Physiology & Behavior, 94,* 61-70.

Larun, L., Nordheim, L.V., Ekeland, E., Hagen, K.B., & Heian, F. (2006). Exercise in prevention and treatment of anxiety and depression among children and young people. *Cochrane*

Database of Systematic Reviews, 3, Art. No. CD 004691, DOI: 10.1002/14651858.CD004691.pub2.

Lobstein, T. & Jackson-Leach, R. (2007). Child overweight and obesity in the USA: Prevalence rates according to IOTF definitions. *Int J Pediatr Obes, 2,* 62-4.

Lutfiyya, M.N., Lipsky, M.S., Wisdom-Behounek, J., & Inpanbutr-Martinkus, M. (2007). Is rural residency a risk factor for overweight and obesity for U.S. children? *Obesity, 15,* 2348-56.

Macfarlane, D, Kwong, WT (2003). Children's heart rates and enjoyment levels during PE classes in Hong Kong primary schools. *Pediatric Exercise Science, 15*, 179-90.

McCarthy, P.J., Jones, M.V., & Clark-Carter, D. (2008). Understanding enjoyment in youth sport: A developmental perspective. *Psychology of Sport and Exercise, 9,* 142-56.

McGuigan, M.R., Tatasciore, M., Newton, R.U. & Pettigrew, S. (2009). Eight weeks of resistance training can significantly alter body composition in children who are overweight or obese. *Journal of Strength and Conditioning Research, 23,* 80-5.

McWhorter , J.W., Wallman, H.W. & Alpert, P.T. (2003). The obese child: Motivation as a tool for exercise. *Journal of Pediatric Health Care, 17*, 11-7.

Mei Z, Grummer-Strawn LM, Pietrobelli A, Goulding A, Goran MI, Dietz WH. Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *American Journal of Clinical Nutrition* 2002;7597–985.

Motl, RW, Dishman, RK, Saunders, R, Dowda, M, Felton, G, Pate, RR (2001). Measuring enjoyment of physical activity in adolescent girls. *Am J Prev Med, 21*, 110-7.

O'Brien, JO, Martin, KA (1998). Up and running: Interventions in exercise psychology. *The Irish Journal of Psychology, 19,* 439-46.

O'Brien, M., Nader, P.R., Houts, R.M., Freidman, S.L., Belsky, J., Susman, E., and the NICHD Early Child Care Research Network (2007). The ecology of childhood overweight: A twelve-year longitudinal analysis. *International Journal of Obesity, 31,* 1469-78.

Ogden, C.L., Carroll, M.D., Curtin, L.R. et al. (2010). Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA, 303, 3,* 242-9.

Paxton, RJ, Nigg, C, Motl, RW, Yamashita, M, Chung, R, Battista, J, Chang, J (2008). Physical Activity Enjoyment Scale short form – does it fit for children? *Research Quarterly for Exercise and Sport, 79,* 423-7.

Prochaska, J.J., Sallis, J.F., & Long, B. (2001). A physical activity screening measure for use with adolescents in primary care. Archives of Pediatric and Adolescent Medicine, 155, 554-559.

Prochaska, JJ, Sallis, JF, Slymen, DJ, McKenzie, TL (2003). A longitudinal study of children's enjoyment of physical education. *Pediatric Exercise Science, 15,* 170-8.Reed, J., & Ones, D.S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise, 7,* 477-514.

Rothman, A.J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology, 19,* 64-9.

Rowland, T.W. (1998). The biological basis of physical activity. *Medicine and Science in Sports and Exercise, 30,* 392-9.

Sallis, JF, Prochaska, JJ,Taylor, WC, Hill, JO, Geraci, JC (1999). Correlates of physical activity in a national sample of girls and boys in grades 4 through 12. *Health Psychology, 18,* 410-15.

Salmon, J, Ball, K, Hume, C, Booth, M, Crawford, D (2008). Outcomes of a group-randomized trial to prevent excess weight gain, reduce screen behaviors and promote physical activity in 10-year-old children: Switch-Play. *International Journal of Obesity, 32,* 601-12.

Scanlan, T.K., & Simons, J.P. (1992). The construct of sport enjoyment. In G.C. Roberts (Ed.), *Motivation in sport and exercise* (pp.199-215). Champaign, IL: Human Kinetics.

Seligman, M.E.P. (1975). *Helplessness: On depression, development, and death*. New York: W.H. Freeman.

Shin, NY, & Shin, MS (2008). Body dissatisfaction, self esteem, and depression in obese Korean children. *Journal of Pediatrics, 152,* 502-6.

Shultz, S.P., Anner, J. & Hills, A.P. (2009). Paediatric obesity, physical activity and the musculoskeletal system. *Obesity Review, 10, 5,* 576-82.

Sirard, J.R., Melanson, E.L., Li, L., & Freedson, P.S. (2000). Field evaluation of the Computer Science and Applications, Inc., physical activity monitor. *Medicine & Science in Sports & Exercise, 32,* 695-700.

Skelton, J.A., DeMattia, L.G. & Flores, G. (2008). A pediatric weight management program for high risk populations: A preliminary analysis. *Obesity, 16,* 1698-1701.

Smith, J.C., & Crabbe, J.B. (2000). Emotion and exercise. *Int J Sport Psychol, 31,* 156-74.

Snyder, C.R. (2002). Hope theory: Rainbows in the mind. *Psychological Inquiry, 13,* 249-75.

Sonneville, K.R., LaPelle, N., Taveras, E.M., Gillman, M.W. & Prosser, L.A. (2009). Economic and other barriers to adopting recommendations to prevent childhood obesity: Results of a focus group study with parents. *BMC Pediatrics, 21,* 81.

Sothern, M.S., Hunter, S., Suskind, R.M., Brown, R., Udall, J.N. & Blecker, U. (1999). Motivating the obese child to move: The role of structured exercise in pediatric weight management. *Southern Medical Journal, 92*, 577-84.

Spear, B.A., Barlow, S.E., Ervin, C., Ludwig, D.S., Saelens, B.E., Schetzina, K.E., & Taveras, E.M. (2007). Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics, 120,* S254-88.

Stathopoulou, G., Powers, M.B., Berry, A.C., SMits, J.A.J., Otto, M.W. (2006). Exercise interventiosn for mental health: A quantitative and qualitative review. *Clin Psychol Sci Prac, 13*, 179-93.

Stucky-Ropp, RC, DiLorenzo, TM (1993). Determinants of exercise in children. *Preventive Medicine, 22,* 880-9.

Thompson, J.L., Jago, R., Brockman, R., Cartwright, K., Page, A.S. & Fox, K.R. (2009). Physically active families – de-bunking the myth? A qualitative study of family participation in physical activity. *Child Care, Health and Development, 36, 2,* 265-74.

Tudor-Locke, Kronenfeld, Kim, Benin, & Kuby (2007). A geographical comparison of prevalence of overweight school-aged children: The National Survey of Children's Health 2003. *Pediatrics, 120*, e1043-50.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta, GA: National Center for Chronic Disease Control and Prevention.

van der Heijden, G.J., Wang, Z.J., Chu, Z.D., Sauer, P.J., Haymond, M.W., Rodriguez, L.M. & Sunehag, A.L. (2010). A 12-week aerobic exercise program reduces hepatic fat accumulation and insulin resistance in obese, Hispanic adolescents. *Obesity, 18*, 384-90.

Van Mechelen, W., Twisk, J.W.R., Post, G.B., Snel, J. & Kemper, H.C. (2000). Physical activity of young people The Amsterdam longitudinal growth and health study. *Medicine and Science in Sports and Exercise, 32,* 1610-16.

Wadden, T.A., Vogt, R.A., Foster, G.D., & Anderson, D.A. (1998). Exercise and the maintenance of weight loss: 1-year follow-up of a controlled clinical trial. *Journal of Consulting and Clinical Psychology, 66,* 429-33.

Walker Lowry,K., Sallinen, B.J., Janicke, D.M. (2007). The effects of weight management programs on self-esteem in pediatric overweight populations. *Journal of Pediatric Psychology, 32, 10,* 1179-95.

Wang, F., Wild, T.C., Kipp, W., Kuhle, S., Veugelers, P.J. (2009). The influence of childhood obesity on the development of self-esteem. *Health Reports, 20,* 21-7.

Wang, Y. & Beydoun, M.A. (2007). The obesity epidemic in the United States – gender, age, socioeconomic, racial/ethnic, and geographic characteristics: A systematic review and meta-regression analysis. *Epidemiologic Reviews, 29,* 6-28.

Weiss, MR (1993). Children's participation in physical activity: Are we having fun yet? *Pediatric Exercise Science, 5,* 205-9.

Williams, D.M., Dunsinger, S., Ciccolo, J.T., Lewis, B.A., Albrecht, A.E., & Marcus, B.H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychol Sport Exerc., 9,* 231-45.

Williamson, D., Dewey, A., & Steinberg, H. (2001). Mood change through physical exercise in nine and ten year old children. *Perceptual and Motor Skills, 93,* 311-6.

Wolf, A.M. & Woodworth, K.A. (2009). Obesity Prevention: Recommended strategies and challenges. *American Journal of Medicine, 122, 4, Suppl. 1,* S19-23.

Woods, AM, Bolton, KN, Graber, KC, Crull, GS (2007). Chapter 5: Influences of perceived motor competence and motives on children's physical activity. *Journal of Teaching in Physical Education, 26,* 390-403.

Table 1: Weekly schedule of procedures

	Pre-HH	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Post-HH	Study Total
Consent & Demographic	X													1
PACES		X	X	X	X	X	X	X	X	X	X	X		12
PACE+		X	X	X	X	X	X	X	X	X	X	X		12
Hope Scale		X										X		
Actigraph		X		X		X		X			X			5
*Actigraph collection			X		X		X		X			X		5
*Actigraph feedback & prize				X		X		X		X		X	X	5
Weekly Total	1	4	3	4	3	4	3	4	3	3	3	5	1	

Table 2. Participant characteristics and demographics.

Variable	Descriptive values
Participant age	*M*=10.92 (SD=2.16)
Gender	Male: n=15 (60%) Female: n=10 (40%)
Race/Ethnicity	African-American: n=10 (40%) Hispanic: n=12 (48%) White, Non-Hispanic: n=3 (12%)
Participant BMI	BMI score: *M*=30.99 (SD=6.71) BMI percentile: *M*=98.28 (SD=1.89) BMI z-score: *M*=2.27 (SD=0.39)
Parental BMI[1]	Maternal BMI: *M*=33.99 (SD=5.72)
Attendance	Sessions: *M*=6.96 (SD=2.7)

[1] N=23; for two children, their grandmothers attended in place of their mothers.

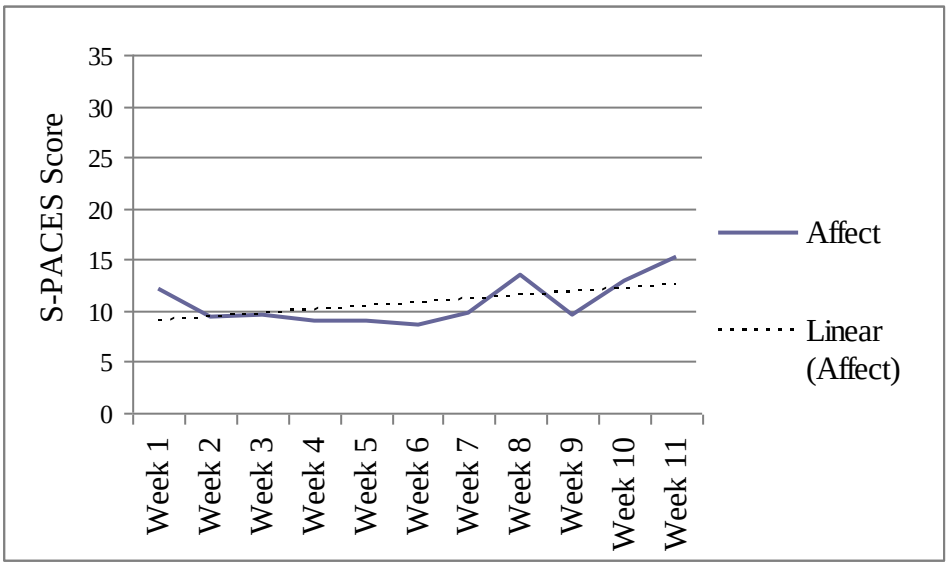
Table 3. Primary Outcome Variable Descriptive Information.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
S-PACES (affect) Rating	*M*=12.08 *SD*=5.09	*M*=9.35 *SD*=2.87	*M*=9.57 *SD*=3.9	*M*=8.96 *SD*=2.35	*M*=8.95 *SD*=2.95	*M*=8.66 *SD*=2.002	*M*=9.78 *SD*=2.9	*M*=13.54 *SD*=5.99	*M*=9.62 *SD*=3.9	*M*=12.83 *SD*=5.95	*M*=15.18 *SD*=10.06
Avg. Total PA	*M*=701.4 *SD*=123.6	N/A	*M*=706.8 *SD*=80.4	N/A	*M*=693 *SD*=139.8	N/A	*M*=604.2 *SD*=77.4	N/A	N/A	*M*=672.2 *SD*=56.4	N/A
Avg. Low PA	*M*=85.39 *SD*=27.13	N/A	*M*=88.24 *SD*=33.45	N/A	*M*=76.35 *SD*=9.89	N/A	*M*=72.9 *SD*=23.92	N/A	N/A	*M*=78.51 *SD*=15.96	N/A
Avg. Mod. PA	*M*=30.64 *SD*=18.75	N/A	*M*=31.98 *SD*=20.28	N/A	*M*=31.56 *SD*=14.08	N/A	*M*=27.47 *SD*=18.98	N/A	N/A	*M*=34.08 *SD*=14.16	N/A
Avg. Vig. PA	*M*=3.26 *SD*=2.96	N/A	*M*=2.58 *SD*=2.13	N/A	*M*=2.18 *SD*=2.15	N/A	*M*=4.21 *SD*=3.56	N/A	N/A	*M*=2.44 *SD*=3.08	N/A
Hope	*M*=25.27 *SD*=1.49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*M*=26.87 *SD*=1.37
Agency	*M*=12.55 *SD*=3.97	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*M*=12.51 *SD*=4.59
Pathways	*M*=12.72 *SD*=4.28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	*M*=14.36 *SD*=4.18

Table 4. Correlations among Primary Variables.

	Attend	BMI	Par. BMI	Avg. PA	Avg. LPA	Avg. MPA	Avg. VPA	Avg. Affect	Pre-Agency	Pre-Path.	Post-Agency	Post-Path.
Attend.	1	.317	.196	-.069	.054	-.213	-.036	-.492*	.118	-.008	.464*	-.493*
BMI	.317	1	.304	.193	.319	-.150	-.049	-.360	.209	.102	.459*	.027
Par. BMI	.196	.304	1	-.078	-.066	-.132	-.289	-.354	.027	.301	.507**	.207
Avg. PA	-.069	.183	-.078	1	.047	.279	.503*	.200	.054	-.126	.112	.080
Avg. LPA	.054	.319	-.066	.047	1	.700**	-.036	-.008	.175	-.368	.056	-.057
Avg. MPA	-.213	-.150	-.132	.279	.700**	1	.216	.364	.135	-.286	-.126	.026
Avg. VPA	-.036	-.049	-.289	.503*	-.036	.216	1	.194	.152	.009	-.001	-.072
Avg. Affect	-.492*	-.360	-.354	.200	-.008	.364	.194	1	-.159	-.196	-.479*	.097
Pre-Agency	.118	.209	.027	.054	.175	.135	.152	-.159	1	.625**	.531**	.387
Pre-Path.	-.008	.102	.301	-.126	-.368	-.286	.009	-.196	.625**	1	.440*	.577**
Post-Agency	.464*	.459*	.507**	.112	.056	-.126	-.001	-.479*	.531**	.440*	1	.224
Post-Path.	-.493*	.027	.207	.080	-.057	.026	-.072	.097	.387	.577**	.224	1

Figure 1. Affective Response to Exercise.



Note: Higher affect scores denote lower positive affect.

Figure 2. Mean daily hours of physical activity.

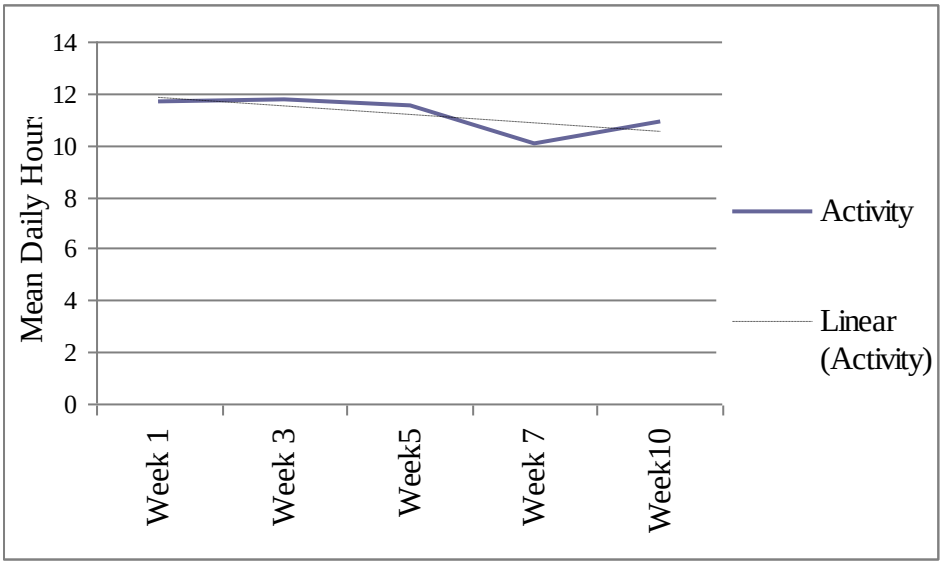
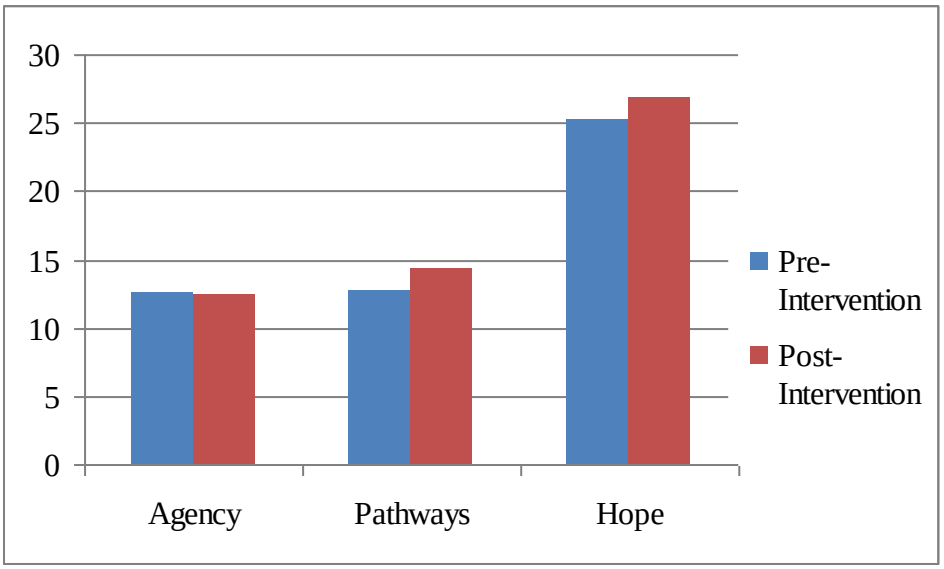


Figure 3. Baseline and Post-Intervention Hope Scale and Subscale Scores.



Appendix A: Healthy Hawks Patient Information Form

Date**:** _____

Child's name: _____Child's Date of Birth: _____

Child's Gender: Male Female

Child's Race:

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White or Caucasian
- ❑ Hispanic or Latino
- ❑ Other_____

Child's Ethnicity:

❑ Hispanic or Latino ❑ Not Hispanic or Latino ❑ Other:_____

Native country or origin: _____

Home address: _____

Home Phone Number: _____

Your name: _____ Your Date of Birth: _____

Your Gender: Male Female Home Phone:_____ Cell Phone:_____

Work Phone:_____ Best phone number to reach you: _____

What is your relationship to the child? _____

Other children living in the home:

Name of child	Date of Birth	Gender

Other adults living in the home:

Name of adult	Date of Birth	Gender

Please put a star (*) next to all children and adults listed above who you think may attend the Healthy Hawks program. Remember, EVERYONE is invited and encouraged to participate in our fun program, and we can provide child care with advance notice.
Is there anyone else who you think might attend Healthy Hawks with you and your family (Grandma, caretaker, uncle, etc.)? If so, please name them here:
_____
_____.

What is the name of your child's primary doctor?
_____

Appendix B: BMI information tracking form

Name								
Week	**Weight**	**Height**	**Weight**	**Height**	**Weight**	**Height**	**Weight**	**Height**
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Appendix C: Physical Activity Enjoyment Scale

Think about the times when you exercise. Then, read the following questions by beginning each numbered statement with: "When I am active…" Use the 1-5 scale to rate how much you agree or disagree with each sentence.

When I am active… **Disagree a lot**

Agree a lot

1. I feel bored	**1**	**2**	**3**	**4**	**5**
2. I dislike it	**1**	**2**	**3**	**4**	**5**
3. It's no fun at all	**1**	**2**	**3**	**4**	**5**
4. It makes me depressed	**1**	**2**	**3**	**4**	**5**
5. It frustrates me	**1**	**2**	**3**	**4**	**5**
6. It's not at all interesting	**1**	**2**	**3**	**4**	**5**
7. I feel as though I would rather be doing something else.	**1**	**2**	**3**	**4**	**5**

Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? ¿Durante las ultimas 7 días, cuantas días estaba activo/active físicamente por un total por lo menos de 60 minutos por día?

0 days/días **1** **2** **3** **4** **5** **6** **7 days/**días

Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes per day? ¿Durante o en una semana típica, cuantas días es activo/activa físicamente por un total por lo menos de 60 minutos por día?

0 days/días **1** **2** **3** **4** **5** **6** **7 days/**días

Appendix D: Children's Hope Scale

Questions About Your Goals

The questions below describe how children think about themselves and do things in general. Please mark the response that best describes how you think you are in most situations. If you think you do something most of the time, you might circle "Most of the time." If you think you think you don't do something very often, you might circle "A little of the time." There are no right or wrong answers.

1. **I think I am doing pretty well**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time

2. **I can think of many ways to get the things in life that are most important to me.**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time

3. **I am doing just as well as other kids my age.**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time

4. **When I have a problem, I can come up with lots of ways to solve it.**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time

5. **I think the things I have done in the past will help me in the future.**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time

6. **Even when others want to quit, I know that I can find ways to solve the problem.**

None of the time	A little of the time	Some of the time	A lot of the time	Most of the time	All of the time