Foundations for Fitness: A Multi-Cohort Pediatric Weight Management Intervention

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Abstract: This study examined the benefits of a 10-week childhood obesity intervention program on various measures of health. The program involved parents and children who met once weekly for two hours. Each session of the intervention program consisted of a structured dynamic warm-up an aerobic exercise component in a game play setting and a motor-skill specific instruction period. Subjects were recruited from pediatrician recommendation and a total of 99 subjects (n=48 boys, n=51 girls) completed both pretest and posttest intervention measures. The mean age was 9.86 (SD=0.02 years). Each of the following were assessed on pediatric assessment prior to and following the intervention program: height, weight, body mass index (BMI), waist circumference, resting heart rate, resting blood pressure, habitual physical activity, percent body fat, and quality of life. Assessment of the participant's cardiovascular fitness and the state of home environment in regards to nutrition and physical activity were completed as part of the first and tenth (final) intervention program sessions. Results indicated that the changes observed that were statistically significant included the categories of systolic blood pressure, height, weight, quality of life, habitual physical activity, FNPA score, and PACER scores. Improvements in outcomes measured were modest but this result was expected due to the short intervention program of only ten-weeks duration. Recommendations include increasing the length of the intervention and conducting follow-up assessment to determine long-term impact.

Keywords: Obesity, Overweight, Pediatric, Physical Activity, Physical and Health Education, Nutrition, Quality of Life, Self-Efficacy, BMI, Cardio-respiratory fitness, PACER.

INTRODUCTION

Research has clearly shown that obesity is a very complex issue. It is no longer viewed from a calorie in and calorie out perspective. The rapid changes in our lifetime in the obesity levels of adults and children have become very prevalent. Eating patterns in United States have shifted in the last 40 years to include large portions of caloric intake from convenient and calorie rich food (and nutritionally empty). Lifestyles of inactivity has been shown to be part of this complex problem as well. Social shifts have also led to increases in obesity in the United States [1]. The inherent results of this is an impact on views related to quality of life with some scales revealing similar attitudes of those suffering from serious mental health disorders.

BACKGROUND

Obesity is a significant concern across the entire United States and has reached epidemic proportions in many areas and in many age groups. The Center for Disease Control (CDC) has reported that 17% of children 2-19 years of age are obese (12.7 million) in the United States. The details state that the prevalence is 8.9% in two-to-five-year-olds, 17.5% in six-to 11-year -olds, and 20.5% for 12-20-year-olds [2].

Intervention programs for reducing obesity have produced mixed results. Stice *et al*. reported in a meta-analytic review of obesity prevention programs that successful treatments are difficult to find. Even those programs for adults that had an impact in reducing body weight eventually saw a return to weight gain within a few years of treatment. This same report indicated that similar results have been found in programs that sought to intervene with children and adolescents [3].

In a four-year follow-up of children and adolescents that participated in an obesity prevention program it was discovered that those who participated in a one-year follow-up program had success in decreasing overweight and this result was sustained for three years after the conclusion of the program. Additionally, the authors reported that when weight loss occurred during the intervention in the first three months, it was "highly predictive for long-term success" [4].

The concern for increases in obesity and the ineffectiveness of intervention programs is not just a concern in the United States. Other countries have demonstrated that this epidemic is overwhelming the globe – especially in developed and developing regions. Hughes, *et al*. reported that for the primary-aged children they measured (n=1548) in Glasgow 31.4% were overweight, 19.1% were obese and 12.4% were severely obese. They also reported that only 38% of those invited to be a part of a weekly intervention

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E-ISSN: 1929-4247/18

program chose to participate. This program did not report changes in obesity levels as it was a pilot program and only reported mean enjoyment ratings and mean effort ratings [5].

Methods and Instrumentation

This study examined and assessed the impact of a ten-week intervention program of health and physical activity for overweight and obese children. Each session of the intervention program consisted of

- a structured dynamic warm-up
- an aerobic exercise component in a game play setting
- motor-skill specific instruction to improve performance and physical activity participation/ compliance (directed by current college teacher education students).

The parents/guardians also participated in the program through a health education session in the format of lecture and discussion for 45-60 minutes each weekly program night. The remaining time of each session parents were encouraged to join in on the physical activity programming with their children. Parental participation in the activity portion was variable and not required, but encouraged as noted.

Subjects and Recruitment: Participants (child and parent/guardian) were recruited for the Foundations for Fitness program on referral from the local pediatric office from primary providers. A total of 99 subjects (n=48 boys, n=51 girls) completed both pretest and posttest intervention measures. The mean age was 9.86 (SD=0.02 years).

Instrumentation: Each of the following were assessed on pediatric assessment prior to and following the intervention program: height, weight, body mass index (BMI), waist circumference, resting heart rate, resting blood pressure, habitual physical activity, percent body fat, and quality of life. Assessment of the participant's cardiovascular fitness and the state of home environment in regards to nutrition and physical activity were completed as part of the first and tenth (final) intervention program sessions.

Height was measured using a stadiometer vertec (Detecto; Webb City, MO) with the participant's shoes removed. Measurements were recorded to the nearest 0.5 cm by trained college students (same trainer for all students but reliability not measured).

Weight and Percent Body Fat were measured using an electronic scale (Tanita; Arlington Heights, Illinois). Participants stepped on the scale for approximately 30 seconds with shoes and socks removed. After approximately 15 seconds the participants weight in kilograms was displayed to the nearest 0.1 kg. After an additional 15 seconds, the percent of body fat was indicated.

Body Mass Index was calculated using the collected height and weight values and the formula of kilograms divided by meters squared.

Waist circumference measurement was taken in centimeters around the widest part of the participant's abdomen while the participant was wearing a t-shirt. One centimeter was subtracted from the value which was recorded to the nearest 0.1 cm.

Resting heart rate was assessed manually using wrist pulse for 15 seconds. This value was multiplied by four to calculate the number of beats per minute.

Blood pressure was measured manually using standard protocol for pediatric subjects after a five-minute seated rest period.

Habitual Physical Activity was assessed using the Physical Activity Questionnaire for Older Children (PAQ-C) [6]. The validity and reliability of this instrument is well documented in the literature. The assessment includes nine subscales of daily physical activity. It assesses the activities that each child engages in including structured play, sport participation and individual leisure time activities. The questions are answered on a Likert scale of one to five with a score of one meaning none, and a score of five being seven or more (daily) participation. The scores reported are the mean of all nine subscales (PAQ-C summary score). A score of one indicates low physical activity and a score of five indicates a high level of physical activity [6].

Quality of life was assessed using a short questionnaire which is composed of a series of age appropriate questions on psychological outlook. The obesity-specific module of the *German Health Interview and Examination Survey for Children and Adolescents* (KINDLR) was used to assess these variables. This scale required the children to answer fifteen questions that relate to the frequency (never, seldom, sometimes, often, all the time) which they experience particular emotions or limitations due to weight. The maximum

score for this instrument was 75; higher scores on this instrument represent poorer quality of life [7].

The Family Nutrition and Physical Activity Survey (FNPA) was administered as a five-minute survey taken by the child's parent or guardian to evaluate the family's home environment. The survey targets the diet and nutritional habits of the family, physical activity patterns, and screen time. An example question would be "my child eats breakfast…" and the parent chooses one of the responses. This test includes a 20-item questionnaire with four potential answers (almost never, sometimes, usually, and almost always). This survey is designed to provide beneficial information and provide sources for counseling tips to promote healthy lifestyles in everyday life. It evaluates the home environment and parenting skills related to the risk for obesity. The total score can range from a low 20 of to a high of 80. High scores represent healthier choices and low scores indicate a higher risk for an obesogenic environment [8].

Cardiovascular fitness testing was conducted in a gymnasium setting as a group. The Progressive Aerobic Cardiovascular Endurance Run (PACER) test was used to assess cardiovascular fitness. The validity and reliability for this test has been extensively reported. Each participant was instructed to run 20 meter increments continuously in accordance with a electronic recording with instructions and music. The pace increased each minute, as each participant is required to reach the 20-meter mark before the sound of the next beep. Participants continued until they missed two consecutive marks in a row and the last on-time completed length was scored [9].

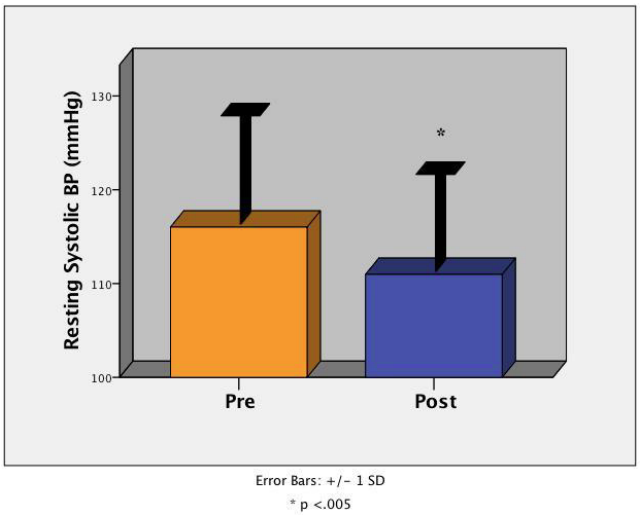

Figure 1: Comparison of Mean Systolic Blood Pressure Pre- to Post-Intervention.

RESULTS

The changes observed that were statistically significant include the categories of systolic blood pressure (Figure **1**), height, weight, quality of life (Figure **2**), habitual physical activity (Figure **3**), FNPA score (Figure **4**), and PACER scores (Figure **5**). Improvements in outcomes measured were modest but this result was expected due to the short intervention program of only ten-weeks duration. Table **1** shows all pre-intervention means in comparison to post-intervention values.

Participants with complete data (having both pre-intervention and post intervention assessment) were

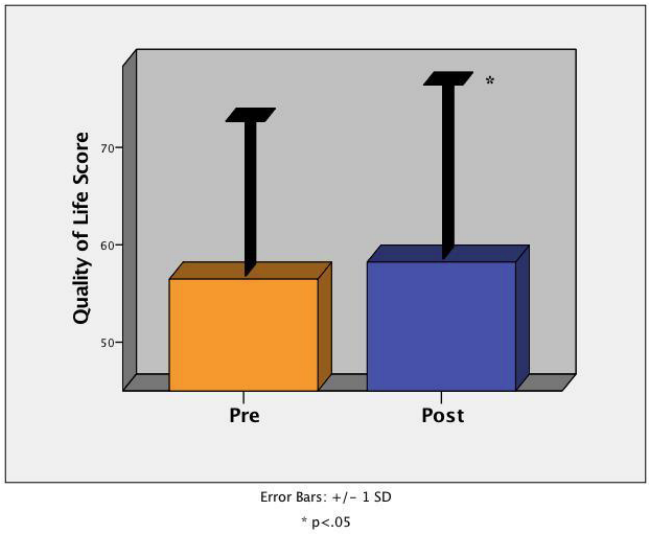

Figure 2: Comparison of Mean Quality of Life Score Pre- to Post-Intervention.

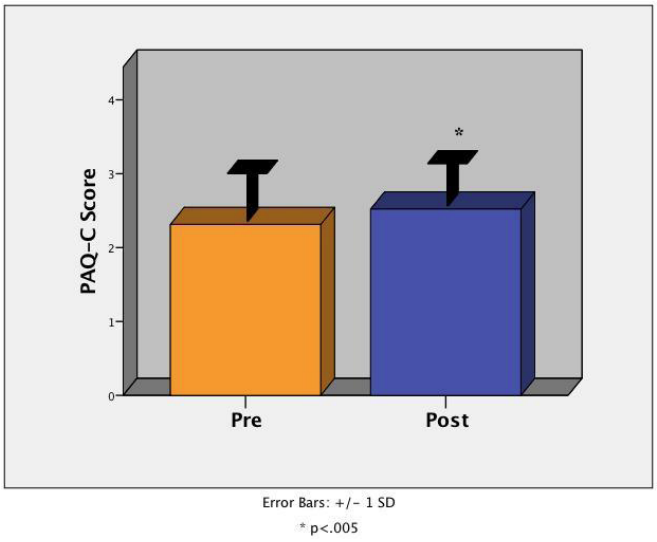

Figure 3: Comparison of Mean Physical Activity Participation Score Pre- to Post-Intervention.

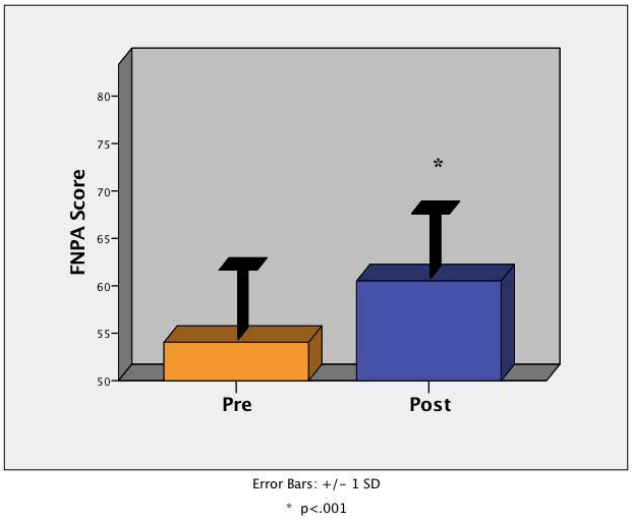

Figure 4: Comparison of Mean Family Nutrition Physical Activity Score Pre- to Post-Intervention.

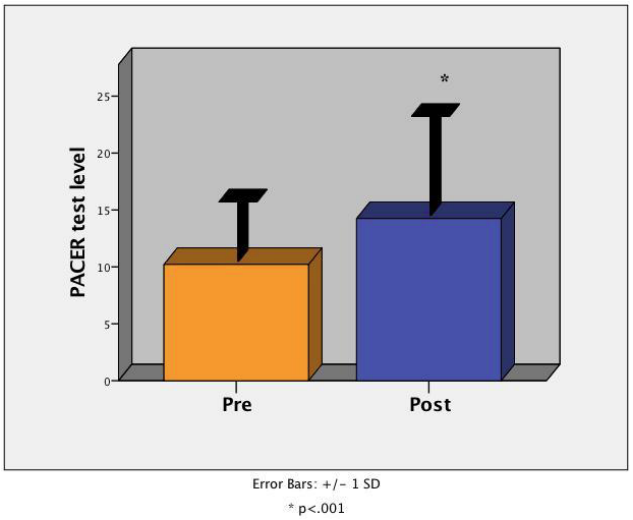

Figure 5: Comparison of Mean PACER test level Pre- to Post-Intervention.

Table 1: Comparative Means and Standard Deviations for all Variables Assessed Pre- and Post-Intervention

Measure	N=	Pre-intervention	Post-intervention	P-value sign. (p<.05)
Systolic BP (mmHG)	97*	115.69 (11.48)	110.99 (10.56)	.003†
Diastolic BP (mmHG)	97*	72.30 (7.98)	70.65 (7.68)	.115
Resting HR (bpm)	99	86.39 (12.75)	86.26 (12.97)	.936
Waist circumference (cm)	99	91.74 (14.54)	91.10 (13.98)	.297
Height (cm)	99	143.14 (13.43)	144.47 (13.39)	.000†
Weight (kg)	98**	59.59 (19.69)	60.41 (19.81)	.000†
Body Mass Index	98**	28.20 (5.27)	28.08 (5.28)	.205
Body Fat (%)	96***	40.56 (9.05)	40.59 (8.05)	.958
Quality of Life Score	92****	56.90 (15.88)	58.92 (17.50)	.023†
PAQ-C Score	63*****	2.31 (.67)	2.54 (.59)	.004†
FNPA Score	94******	54.00 (7.46)	60.33 (6.84)	.000†
PACER level	83*******	10.20 (5.35)	14.01 (8.76)	.000†

*two participants arm size too small for pediatric cuff.
**one participant exceeded maximum weight for the Tanita scale (>350 lbs).
***exceeded maximum % body fat measure or sent error message.
****participants age was below appropriate testing age.
*****cohorts one through three not administered this test.
******parent not present at either pretest or posttest.
*******child not present at either pretest or posttest.
†indicates significance.

compared to participants with incomplete data. There were no significant differences on any outcome measure between these two groups.

In general, the intervention was successful in building personal relationships through participation by parents and children. In other words, compliance was strong in the program through the ten-week intervention. This compliance was assessed by measuring the number that attended eight of the ten weekly sessions and those who completed the post-program assessment session. Adherence rate using this definition was just under 80%.

Overall, enthusiasm displayed for participation and the benefits of the program were substantial. The children came each week willing to participate. It was anecdotally observed that with the energy and contribution of the college-aged instructors, the motivation of participants was high throughout the program.

DISCUSSION

As indicated in the results, systolic blood pressure of participants decreased by 4.7 mmHg. These changes could be related to the onset of weekly structured exercise instruction, changes in nutrition, improvement in mood and increase in habitual physical activity outside the program. Similar findings were observed in a meta-analysis [10] investigating the impact of 8 to 32-week exercise interventions on blood pressure in children.

The mean height and weight of participants both increased significantly, but approximated the typical rates of growth [11] seen in pediatric populations. Further, weight gain could have been slowed from pre-intervention rates. Body mass index was stable over the course of the intervention program, which has been observed in several interventions [12] similar to this investigation. Other interventions included in the meta-analyses [12] did display a significant decrease in percent body fat which was not observed in the current investigation. This could have been due to the short duration of this study (10 weeks) in comparison to the mean durations of 16 and 23 weeks in the comparison studies. However, another intervention [13] of similar duration (10 weeks) did observe significant decrease (-2.2%) in percent body fat, but the program met with greater frequency compared to this investigation. Finally, waist circumference did not show any change over the course of the intervention and this has been observed elsewhere [16].

Quality of life scores on the KINDL-R obesity module showed a significant increase (+ 2.0 points) indicating that quality of life declined over the course of the intervention program. However, this may have been a result of participants having a more developed ability to perceive and express their emotions and factors impacting their quality of life. Further, this decline in quality of life could be related to the child's short-term displeasure with parents and/or guardians efforts to comply with lifestyle changes suggested in the educational sessions. Results from forthcoming follow-up assessments may show an increase in the quality of life values due to the long-term impact of the intervention. Using the generic version of the KINDL-R, researchers [14] showed a 2.5 increase in scoring on a 100-point scale over a 6-month physical activity and lifestyle intervention. Improvements in quality of life were sustained at 12-month follow-up.

Results indicated that physical activity summary scores for the PAQ-C improved by 10% from pre-intervention to post-intervention assessment. This type of significant improvement was not seen in a previous pediatric obesity intervention of the same duration [15]. PAQ-C scores were higher at baseline (2.72 vs 2.31) but there was decline in physical activity in the comparative intervention (2.65). This could have been due to diurnal variation in activity and was a deciding factor for conducting 8 cohorts of the 10-week intervention across various seasons in the current investigation.

One of the most encouraging changes seen pretest to posttest intervention was significant increase in in the FNPA mean score. Scores moved toward "healthy living" actions decreasing the risk for the creation of an "obesogenic" environment. The improvements in FNPA score in the current intervention are comparable to those in a 6-week stage 2, pediatric obesity intervention similar to the Foundations for Fitness program [16].

Cardiovascular fitness is a key indicator of long-term health. The results of the PACER indicated participants in the current intervention possessed poor cardiovascular fitness in comparison to peers of their own age and gender [17]. However, in comparison, another short-term intervention [18] for overweight children demonstrated a decline in PACER scores over five weeks, whereas the current study showed an improvement of almost four lengths in PACER scores. Further, a year-long school-based program to increase physical activity [19] saw a mean increase of three laps on the PACER test in a representative population. The improvements in the current study may have been the result of low baseline fitness typically observed in overweight and obese children.

In conclusion, the 10-week intervention program of health and physical activity for overweight and obese children was successful. Significant improvements were observed in systolic blood pressure, height and weight, quality of life, habitual physical activity, FNPA score, and cardiovascular fitness. In comparison to other intervention programs [20] for overweight and obese children, the current study possesses a low attrition rate but is shorter in duration than most. Results may have been more substantial with a greater duration or frequency per week, but attrition rate may have increased as a result. Conducting a community-based intervention program for overweight and obese children is novel and provided evidence of improvement in health biomarkers and predictors, as well as a service learning component for future health

educators and clinicians. Conducting follow-up assessments to identify long-term impact is warranted and suggested.

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Received on 29-12-2017 Accepted on 01-01-2018 Published on 28-02-2018

https://doi.org/10.6000/1929-4247.2018.07.01.2