Effects of a Physical Activity Program on Heart Rate Variability in Obese Children

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Background

The prevalence of overweight children has substantially increased over the past two decades. [1,2,3] In addition, overweight children are likely to remain overweight as adolescents and adults.[4] Because the efficacy of treatment programs for adult obesity is poor[5], emphasis needs to be placed on the treatment of childhood obesity.[6] Heart rate variability (HRV) is a marker of cardiac parasympathetic and sympathetic activity. [7,8,9] Heart rate variability (HRV) is a multidimensional measurement of sympathetic and parasympathetic nervous system innervations of the heart. High levels of sympathetic activity and low levels of parasympathetic activity have been associated with obesity.[10] In obese individuals autonomic nervous system function is chronically altered with the sympathetic system being dominant in a supposed balanced system.[11] Body weight reduction has been associated with decreased sympathetic nervous system activity[12] and increased parasympathetic activity.[13] These findings have prompted researchers to study the methods of increasing HRV. Stein and colleagues[14] demonstrated that a regimen of prescribed exercise produced increases of HRV in older healthy adults. In the one study that examined the effects of a structured exercise program on HRV in obese children, the researchers demonstrated that HRV increased after four months of structured exercise and decreased when measured 4 months after withdrawal of the exercise program.[13] This study seeks to examine whether a prescribed after school physical activity program can increase heart rate variability and decrease body fat.

Design

This ongoing study has, to date, evaluated the effects of a physical exercise program on heart rate variability in 10 obese children ages 8 to 11 years old. The physical activity program involved a three-day per week after-school activity program for10 weeks. Sessions lasted for one hour, with children encouraged to participate in one or several types of aerobic activity for a minimum of 30 minutes. The goal is to accumulate 30 minutes of participation in aerobic activity, not to exercise for 30 consecutive minutes. Specific activities included, in-line skating, bicycling, walking, stair-climbing, step aerobic classes, and participation in select sport programs. Participants were encouraged to choose activities they enjoyed.

Measurements

Three five-minute trials of HRV data were collected by the 5th week of the program and again at the end of the ten-week program using the Biocom 1500 Heart Rhythm Scanner device. The first 5-minute trial was used as a stabilization period and not included in the data analyses. The Biocom device calculates HRV using a hybrid technique that combines typical ECG time analysis with a frequency or spectral analysis. Very low and low frequency parameters are associated with sympathetic activity. High frequency parameters are associated with parasympathetic activity. In addition, body composition was measured pre and post interventions using a skin fold evaluation.

Statistical Analyses

Cohen's Delta[15] was utilized to determine effect size change pre and post physical activity intervention. Cohen's Delta calculates the magnitude of the difference between means in standard deviation units.

Preliminary Findings

Using Cohen's Delta to determine effect size (ES) we found the very low frequency (m=284.7 +/- 216.5 m=402.1 +/- 230.4 ES=0.54) and the low frequency parameters (m=250.9 +/- 194.8 m= 342.9 +/- 291 ES= 0.47) increased moderately. Large increases were noted in the high frequency parameters (m=203.1 +/- 141.7 m= 397.3 +/- 425.0 ES= 1.37) and small increases were observed in the low frequency to high frequency ratio (m= 1.54 +/- 1.0 m = 1.35 +/- .94 ES= -0.19). Increases in all frequency-domain parameters indicate an overall increase in heart rate variability. There was also small to moderate decrease in the low frequency norms (55.8 +/- 14.7 m= 51.4 +/- 16.5) and an increase in high frequency norms (m= 44.2 +/- 14.7 m= 48.6 +/- 16.5) which indicates a small to moderate shift of autonomic balance towards increased vagal tonus (ES= 0.30). As a result of the intervention, there was a corresponding 4% reduction in body composition as measured by skin fold evaluation.

Comment

These findings are consistent with previous studies that reported decreases in sympathetic activity and increases in parasympathetic activity after participation in a physical exercise program.[12,13] The small to moderate shift in vagal tonus indicates that the regiment of after-school physical activity was effective in establishing autonomic balance. Longer-term involvement in such activities may offer a means to maintain autonomic balance thereby positively impacting the metabolism process and decreasing body fat. Interventions which produce increases in heart rate variability have the potential to positively affect overall health should be pursued.

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