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Original Research

Efficacy of an exercise intervention among children with comorbid asthma and obesity

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ABSTRACT

Objectives: Children with comorbid asthma and obesity present with more severe and harder-to-control disease than asthmatic children at healthy weight. Weight loss has been shown to improve asthma symptoms, yet physical activity may be difficult due to exercise-induced bronchospasm. Children with asthma have lower exercise rates than non-asthmatics. The objective of this study was to retrospectively evaluate attrition rates and program outcome measures (Body Mass Index [BMI] and maximum oxygen consumption [VO_2max]) among asthmatic and non-asthmatic participants.

Study design: Clinical data were collected from the Healthy Hearts Program, a 12-week nutrition and activity intervention program for children who are overweight, obese, or at risk for heart disease and other conditions, and used for the study.

Methods: Intervention data and demographics were obtained from medical records at the Children's Heart Center Nevada. Descriptive statistics, paired *t*-tests, Cox regression analysis, and analysis of covariance were conducted.

Results: The mean age of this population ($N = 232$) was 11 years; 54% were male, 64% were Hispanic, and 37% had asthma. Median time in the program was 9 weeks, and 58% of the population completed the program. Unadjusted analyses showed significant BMI decreases in asthmatic ($P = 0.002$) and non-asthmatic ($P = 0.001$) participants and increases in cardiorespiratory function for asthmatic males and females ($P = 0.003$, $P = 0.004$) and non-asthmatic males and females ($P < 0.001$ for both). Asthmatic and non-asthmatic children both had improved exercise intensity ($P = 0.033$, $P < 0.001$).

Conclusions: This program is both beneficial and practical for obese children with asthma for losing weight and improving cardiorespiratory function.

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Introduction

Obesity affects nearly 13 million children in the United States and is a risk factor for the development of asthma and reduced asthma control when compared with those patients who are not obese.[1,2] Physical activity (PA) interventions have been shown to improve symptoms in obese children with asthma, yet PA can be difficult for asthmatics due to exercise-induced bronchospasm (EIB), which influences lower participation rates in obese asthmatics than obese non-asthmatics.[4,5,6]

Excess weight in childhood can lead to adult obesity and chronic conditions such as cardiovascular disease, type II diabetes, and metabolic syndrome.[7,8] Furthermore, certain risk factors for obesity are more likely to be present in asthmatic children than in non-asthmatic children. Research demonstrated that children with asthma have >50% increased risk of becoming obese than non-asthmatics.[8] Weight loss has been shown to increase lung function and cardiovascular health and lead to control of asthma symptoms.[2,3,5,9]

An evaluation of a pediatric exercise intervention targeted children at risk for obesity.[10] The program included PAs, nutrition, and behavioral health components. Most participants were obese at the start of the program, although not necessarily asthmatic. Studies show that children are more likely to participate in PAs in group settings in which peer encouragement occurs and that children with asthma are more likely to participate when their asthma is not treated as a barrier.[11,12]

The Body Mass Index (BMI) is a convenient and inexpensive tool used to measure weight status. The BMI for children and adolescents (aged 2–20 years) is adjusted for age and sex and reported in percentiles.[13] Maximum oxygen consumption (VO_2max) is a commonly used measure of cardiorespiratory fitness and is measured in milliliters by kilograms per minute (mL/kg/min).[14]

The objective of this study is to retrospectively evaluate attrition rates and program outcome measures (BMI and VO_2max) among asthmatic and non-asthmatic participants in the Healthy Hearts Program (HHP), a 12-week nutrition and PA intervention program for children who are overweight/obese or at risk for heart disease.

Methods

Healthy Hearts Program description

The HHP, created in 2002 at the Children's Heart Center Nevada (CHC), promotes lifestyle changes by improving diet and PA levels in children and adolescents who are at risk for heart disease. The program is available statewide. Children may be referred to the HHP if diagnosed as overweight (>85th percentile); with high cholesterol (>170 mg/dL) or a parent with high cholesterol (>240 mg/dL); with family history of premature heart disease, or with risk factors for heart disease. After referral, the child meets with a cardiologist, the child and family meet with a registered dietician, and the child immediately enters the 12-week program.

Exercise sessions are 40-min long and include warmup, instruction, and PAs. Exercise physiologists design activities and coach participants in one of six exercises each week. The children also play games or participate in other types of PAs, which varies depending on the size and demographics of the participants. Treadmills are present but are used for the Rockport 1-mile walk test to calculate relative VO_2max (mL/kg/min) pre-intervention and postintervention. Treadmill speed is adjusted based on the child's tolerance to exertion. VO_2max is estimated using Klein et al.'s equation.[15] The child may also meet with a psychologist for motivational therapy. Those who do not enter the program may still receive nutritional counseling and follow-up appointments with dieticians, and the program may be repeated multiple times. During the program, height, weight, percent body fat, waist circumference, and blood pressure are measured at weeks 1, 6, and 12. The goal is weight maintenance for those entering the program with a BMI between the 85th and 96th percentiles if there are no other risk factors for heart disease, and the goal for those entering with a BMI percentile ≥97th is weight loss.

Data collection and variables

Data were collected to create a dataset of overweight/obese pediatric participants in the HHP, including those with asthma and a control group of those without asthma. The HHP patient information forms located in the electronic medical records (EMRs) contained most of the data collected. All children in this study participated in the 12-week intervention ($n = 232$).

Overweight/obese status in this study was defined as having a BMI of ≥90th percentile at the beginning of the intervention to avoid misclassification of weight status. Asthma was defined as having a physician diagnosis of asthma or reactive airway disease by evidence of a prescription for one or more asthma rescue or control medications. Inclusion criteria included participation in the study from 2004 to 2014 and age ≤18 years ($n = 232$). Exclusion criteria included records from those with developmental delay, severe congenital heart disease, or other medical inability to participate in the program (other than asthma).

The main outcome variables in this study were pre-intervention and postintervention BMI z-score and VO_2max. Pre-intervention and postintervention BMI percentiles and metabolic equivalents (METs) were collected to examine mean change. METs measure the intensity of activity as a ratio of active to resting metabolic rate. MET of 1 is equivalent to the energy expended sitting, MET of 3.0–6.0 is the range for moderate activity, and vigorous activity is >6.0 METs.[14]

Sociodemographic data included age in years, race/ethnicity (collapsed to Hispanic/non-Hispanic), sex (m/f), and insurance status (insured/uninsured, or Medicaid recipient—uninsured and Medicaid categories were combined to ensure adequate sample size). In addition, asthma status (y/n) and comorbid diagnoses were collected.

Program completion variables included number of weeks the child attended the program (coded 1-12) and whether the staff coded the program as completed (coded yes/no). If a child missed a week during the program, but participated the following week, the visits could be combined. For this reason,

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