

OBESITY AND PULMONARY FUNCTION IN NAVAJO AND HOPI CHILDREN

Background: Although several reports have shown an adverse cardiovascular and metabolic risk profile associated with childhood obesity, few reports have examined the effects of childhood obesity on pulmonary function.

Objective: The purpose of this study was to examine the influence of obesity on pulmonary function in Navajo and Hopi children.

Methods: Subjects included 256 (110 males, 146 females) Hopi children 6–12 years of age and 557 (274 males, 283 females) Navajo children 6–12 years of age ($N=813$). The body mass index was used to classify subjects as normal weight, overweight, or obese on the basis of international reference values. Forced vital capacity (FVC), forced expired volume in one second (FEV_1), $FEV_1\%$ (FEV_1 to FVC ratio; FEV_1/FVC), and forced expiratory flow between 25%–75% of vital capacity (FEF_{25-75}) were determined according to the American Thoracic Society recommendations.

Results: Approximately 26% of Navajo and Hopi children were defined as overweight (26.0% of boys and 25.6% of girls) and an additional 16% (14.6% of boys and 17.7% of girls) were defined as obese. In general, the patterns showed an increase in pulmonary function between normal weight and overweight children and a decrease in pulmonary function of obese children. Significant differences among groups existed for $FEV_1\%$ and FEF_{25-75} in boys and FVC and FEV_1 in girls.

Conclusions: The results indicate the pulmonary consequences of obesity in children and provide further evidence of the adverse consequences of pediatric obesity among Native Americans. (*Ethn Dis.* 2007;17:14–18)

Key Words: BMI, Overweight, Native Americans, Lung Function, Ventilatory Function

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INTRODUCTION

Childhood obesity is a major public health issue.^{1–5} Results from the recent National Health and Nutrition Examination Survey (NHANES) indicate that $\approx 30\%$ of US youth 6–19 years of age are overweight or obese (ie, body mass index [BMI] higher than the age- and sex-specific 85th percentile).¹ The prevalence rates of overweight and obesity have also been published among Native Americans.^{6,7} Prevalence rates of $\approx 45\%$ for combined overweight and obesity in Navajo⁸ and Hopi⁹ children have been reported.

The public health concerns of obesity and related co-morbidities are well recognized.¹⁰ Obesity causes illness even early in life, and childhood overweight increases the risk of adult overweight, the clustering of cardiovascular disease risk factors, and all-cause and cardiovascular disease mortality.¹¹ The relationships between obesity and cardiovascular and metabolic risk factors have also been examined in Navajo adolescents.¹²

Although much attention has been given to the cardiovascular and metabolic consequences of pediatric obesity, relatively few studies have examined the functional consequences of obesity on lung function during childhood and adolescence.^{13–17} In 1846, Hutchinson observed that vital capacity increased with body weight for a given height up to a certain point and then decreased.¹⁸ This finding was also reported by Shoenberg¹⁷ and termed the “muscularity effect” and “obesity effect.” Others have found similar results in adults¹⁹ and children and adolescents.^{13–16}

Pulmonary disease is common among persons who live in the southwestern United States and particularly affects the Navajo and Hopi Native Americans who reside in the Colorado Plateau. This region covers thousands of square miles

in Arizona, New Mexico, Utah, and Colorado. It is characterized by a high desert plain landscape of windswept, sandy soils typically covered with sage brush, grasses, sparse wild flowers, and some trees. Most Navajo and Hopi have an agrarian lifestyle; Navajos are heavily involved with herding sheep, cattle, and horses, along with some farming, while the Hopi are largely involved in subsistence crop farming. The Navajo tend to live in dispersed communities over large tracts of land while the Hopi tend to aggregate around small villages.

Pulmonary disease is a major cause of morbidity and mortality for both tribes. Pulmonary diseases such as bronchitis, pneumonia, coccidioidomycosis (Valley Fever) and tuberculosis are common. Pulmonary disease can only successfully be diagnosed and treated if a pulmonary nomogram (normal table) is available to determine the upper and lower limits of normal lung volumes and capacities. Pulmonary normal tables are race-specific and cannot usually be used to diagnose pulmonary disease in other racial groups. No pulmonary nomograms are available for Navajo or Hopi children. Therefore, the larger intent of this research project was to develop pulmonary nomograms for these two tribes. However, before developing these nomograms, we had to determine if pulmonary function was reduced in overweight and obese children. Since we previously showed that obesity is highly prevalent in this sample,^{8,9} we sought to examine whether pulmonary function was also reduced in this sample.

METHODS

Subjects

Participants were volunteers enrolled in elementary schools on the Navajo