

Analysis of Pediatric Waist to Hip Ratio Relationship to Metabolic Syndrome Markers

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ABSTRACT

Purpose: Waist to hip ratio (WHR) is a valid assessment tool to determine risk for the development or presence of metabolic syndrome, diabetes, and cardiovascular disease in adults. Evidence-based research on its validity with children and adolescents is limited. A retrospective analysis was con-

ducted to determine if WHR in overweight and obese pediatric patients is associated with metabolic syndrome laboratory markers.

Methods: Retrospective chart reviews were performed for 754 patients ages 6 to 17 years who were enrolled in a weight management program. Data collected included WHR, laboratory markers for metabolic disorder, body mass index, demographics, presence of acanthosis nigricans, and Tanner stage.

Results: WHR and high-density lipoprotein were negatively correlated, $r(N=597) = -0.20, p < .001$. WHR and triglycerides were positively correlated, $r(N=597) = 0.19, p < .001$, as were WHR and low-density lipoprotein, $r(N=596) = 0.09, p = .03$, and WHR and insulin, $r(N=414) = 0.16, p = .001$. In a subject sample with very restricted range, a one-way analysis of variance found a significant effect of WHR on body mass index percentile, $F(1, 754) = 22.43, p < .001, \eta^2 = 0.03$.

Conclusions: Increased WHR correlated in children and adolescents with known indicators that could be suggestive of increased risk for metabolic syndrome, specifically low high-density lipoprotein, high low-density lipoprotein, triglycerides, and insulin. These results suggest that evaluation of WHR may be a useful tool to indicate risk for developing metabolic syndrome and diabetes in children and adolescents. *J Pediatr Health Care.* (2015) 29, 319-324.

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KEY WORDS

Waist hip ratio, childhood obesity, type 2 diabetes, metabolic syndrome

Childhood obesity is more prevalent now than in all of recorded history. Nearly one in three children and adolescents in the United States are overweight (body mass index [BMI] $\geq 85\%$ - 94%) or obese (BMI $\geq 95\%$). Currently, more than a third of adults and 17% of

children and adolescents in the United States are obese (Ogden, Carroll, Kit, & Flegal, 2014; Sardinha et al., 2011). Childhood obesity potentially results in chronic disease previously seen only in the adult population. The acceleration of cardiovascular disease, type 2 diabetes, respiratory difficulties, compromised sleep patterns, psychological illness, and social challenges lead to higher health care costs for overweight and obese children and future adult generations than for their healthy-weight peers. Marder and Chang (2006) found that childhood obesity alone can carry health care costs of nearly \$14 billion per year, not including the associated mental, emotional, and physical stress.

As the financial, physiological and mental strain of this epidemic rises, the medical profession needs to shift chronic disease prevention efforts to include children. Risk stratification for obesity and associated diseases in children, including diabetes, metabolic syndrome, and hypercholesterolemia, is now necessary. BMI is increasingly used in medical encounters with children. Although BMI is a useful tool for determining risk for obesity, the additional measurement of waist to hip ratio (WHR) may prove beneficial in assessing persons at risk for metabolic disturbances. National

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Heart, Lung, and Blood Institute (1998) reports that the World Health Organization (WHO) defines WHR > 0.90 for adult males and > 0.85 in adult females as one of the indicators of metabolic syndrome. WHR is a proven clinical measurement for predicting cardiovascular disease risk in adults (Srikanthan, Seeman, & Karlamangla, 2009; and Welborn, Dhaliwal, & Bennett, 2003).

Fredricks, van Buuren, Fekkes, Verloove-Vanhorick, and Wit (2005) found an expected average trend of decline in WHR from birth to adulthood, with an increase returning during the geriatric period. Thompson (2009) reported that adults between the ages of 18 to 59 years have lower health risks for cardiovascular disease and metabolic disorders when WHR is within the range of 0.70-0.85 for females and 0.80-0.94 for males. Women aged 60 years and older can safely rise to a WHR as high as 0.90 and males to 1.03 (Thompson, 2009). Waist circumference measurements can provide indirect information about visceral adiposity, which tracks with cardiovascular and metabolic risk factors (Barlow, 2007).

Although waist circumference measurements are more easily performed than skinfold thickness measurements, according to Barlow (2007), reference values for children that identify risk over and above the risk from BMI category are not available. The ease of obtaining a waist to hip circumference ratio would make it especially useful for a pediatric population if risk standards for children could be identified.

D'Adamo, Santoro, and Caprio (2009) report that metabolic syndrome is a clustering of metabolic abnormalities such as dyslipidemia, elevated waist circumference, insulin resistance, hypertension, and acanthosis nigricans. The International Diabetes Federation (Zimmet et al., 2007) definition of metabolic syndrome among children consists of abdominal obesity and two or more clinical risk features, including high blood pressure, hypertriglyceridemia, low high-density lipoprotein-cholesterol complex (HDL-C), and elevated fasting glucose. Gardner, Parker, Krishnan, and Chalmers (2013) found that metabolic syndrome in children and adults increases the risk of developing type 2 diabetes, cardiovascular disease, and resultant cardiovascular morbidity and mortality. According to the IDF, an insufficient quantity of research data limits the diagnosis of metabolic syndrome in children younger than 10 years (D'Adamo et al., 2009). As shown in Table 1, children 6 to

16 years of age with a waist circumference equal to or greater than 90th percentile have abdominal obesity (Zimmet et al., 2007). These children and adult caregivers should be monitored and counseled extensively regarding the importance of weight reduction and healthy lifestyle habits (D'Adamo et al., 2009). According to the IDF, metabolic syndrome is defined

as having abdominal obesity with at least two other factors (Zimmet et al., 2007). Those factors and criteria are presented in Table 1. Ferreira et al. (2011) report that excess body fat may be the most identifiably important risk factor for metabolic syndrome. Early identification by health professionals of metabolic syndrome or factors leading toward the syndrome diagnosis may reduce the adverse consequences associated with central adiposity.

The purpose of this study was to explore the relationship of WHR measurements to blood serum laboratory values and physical findings associated with metabolic

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