Visceral fat mass in childhood: a potential early marker for increased risk of cardiovascular disease1-4

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Although notable progress has been made during the past 25 y to significantly reduce the incidence of cardiovascular disease, it remains the leading cause of death in the United States (1). During this time, many epidemiologic studies have identified various risk factors for cardiovascular disease (2-4). One of these risk factors is obesity or excess body fatness, usually assessed in these epidemiologic studies by one or more anthropometric measurements, such as body mass index, multiple skinfold thicknesses, and waist-to-hip circumference ratio. When taken together, these studies have shown that body shape and regional fat distributions, especially elevated truncal obesity, appear to predict an increased risk of coronary artery disease, arteriosclerosis, and diabetes. From these studies of adults it has been proposed that the specific fat deposit most related to negative health effects is visceral fat, also referred to as intraabdominal adipose tissue (IAAT) mass (5). Furthermore, it has been suggested that adolescence is a sensitive period for the development of central obesity (3). Tracking of risk on the basis of the level of abdominal adiposity or general obesity from an earlier age has not been done.

Most studies of visceral fat (or IAAT) have been performed in older adults. If visceral fat accumulation rather than general obesity is indeed a more direct predictor of human cardiovascular disease in adulthood, then an early measure of this fat deposit may be useful in identifying an individual’s increased risk. Our knowledge of the immediate or long-term health effect of this fat component in children and adolescents is severely limited. Visceral fat accumulation has been observed in healthy, nonobese, prepubertal children. It may be related to dyslipidemia and glucose intolerance in older obese children and adolescents (6). The role of abdominal fat during growth and sexual development is unknown. However, in healthy nonobese adults it appears that abdominal adiposity determines the serum concentration of growth hormone–binding protein (7), i.e., serum growth hormone–binding protein concentrations are more strongly correlated with abdominal fat mass than with growth hormone secretion. It is possible that growth hormone–binding protein arises from growth hormone receptors in visceral adipose tissue (7).

In this issue, Goran et al (8) report IAAT and subcutaneous abdominal adipose tissue (SAAT) measurements in white and African American prepubertal children. To accomplish this task, these investigators performed a single-slice abdominal computerized tomography scan at the position of the umbilicus. Total body fat mass and percentage fat were assessed by dual-energy X-ray absorptiometry. Not surprisingly, the girls had greater fat mass, a higher percentage of body fat, and greater SAAT than age-matched boys. The girls also had greater IAAT than the boys; this condition is usually reversed in adulthood. There was also an ethnic difference in the mean amount of IAAT, the African American children having lower mean values. This may suggest that there is an early ethnic-based difference in the partitioning of abdominal fat between the subcutaneous and visceral fat compartments. Alternately, accumulation of fat at other abdominal sites not examined in this study may also be different, such that the ratio of total visceral fat mass to subcutaneous fat mass is not ethnic dependent. Note, however, that less visceral fat also has been observed in adult African American obese women and is consistent with their reduced health risk associated with the same level of general obesity as seen in white women (9). Although total body fat, IAAT, and SAAT were strongly correlated in children, partial correlation analyses indicated that the relation between IAAT and SAAT was independent of total body fat, but was influenced by ethnicity.

Goran et al (8) concluded that prepubertal accumulation of visceral fat is highly variable but that IAAT relative to SAAT could be used as an index of visceral mass independent of total body fat. This finding tends to challenge the general tenet that obesity in children mainly reflects an increase in subcutaneous fat. Additional cofactors for obesity, such as dietary choices, physical activity, socioeconomic status, or body fatness of parents and siblings were not provided in this study. This research group, however, reported recently the effects of parental fatness (10) and dietary fat intake (11) on childhood adiposity. It was initially concluded that there were maternal

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influences for dietary fat intake, but subsequent covariate analyses indicated that "dietary fat independently plays a very minor role in increasing overall adiposity and does not specifically influence fat accretion in the intraabdominal region."

A review of the literature supports the assertion of Goran et al (8) that a valid index of visceral obesity is essential for assessing the importance of this fat compartment's relation with disease risk. To simply use BMI, waist-to-hip ratio, or any other anthropometric-based truncal fat index is no longer sufficient. The specificity of many biochemical tests for various cardiovascular and metabolic diseases must be matched with a more robust marker of visceral fatness or obesity than can be achieved by anthropometry. It is for this reason that many investigators have examined various methods for measuring the visceral fat mass. At present, these technologies include computerized tomography (as used by Goran et al (8)), magnetic resonance imaging, and sonography. Note that only computerized tomography involves ionizing radiation, thus limiting its usefulness in longitudinal studies, especially if children are to be examined. Furthermore, the issue remains as to what abdominal site is best to scan if only a single-slice measurement is made. Abate et al (12) answered this question partially when they examined magnetic resonance imaging scans of the entire abdomen in adult males. These investigators determined that a single intervertebral measurement at the L2-L3 lumbar spine region showed the highest and most consistent predictive values for the subcutaneous, intraperitoneal, and retroperitoneal adipose tissue masses.

It is evident that there is now sufficient knowledge of how to modify the adult diet to beneficially reduce the risk for cardiovascular disease, a process that is usually accompanied by a loss of truncal fat mass. From a preventive point of view, it remains to be shown whether low visceral fat in childhood will track with a reduced risk in adulthood. The general hypothesis is currently being tested in many long-term longitudinal health studies in the United States.

REFERENCES