The Metabolic Syndrome: An Adult Disease that Begins in Childhood

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Introduction

In adults, the aggregation of multiple cardiovascular risk factors was observed in the early part of the twentieth century. More recently, however, similar clustering has received renewed attention and several terms such as syndrome X,[1] insulin resistance syndrome,[2] and metabolic syndrome[3] have been proposed to describe the connection between obesity, insulin resistance, hypertension, dyslipidemia, type 2 diabetes mellitus, and atherosclerotic cardiovascular disease. Despite this well-known association in adults, the definition of metabolic syndrome varies in terms of the indicators that are used and the cut-points that are required to make the diagnosis.[4-6] The most common criteria were proposed by *The Third Report of The National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults* (the Adult Treatment Panel III or ATP III)[5] and those criteria from the World Health Organization (WHO)[6] are most commonly used in adults. Two of these common definitions[4,6] include measures of insulin resistance. This inclusion reflects the proposed causal role of insulin and its interaction in the development of the metabolic syndrome in adults.

Metabolic Syndrome in Children

Multiple attempts in the pediatric literature have been made to characterize the metabolic syndrome using similar criteria that have been developed for adults.[7-9] There are several problems with this extrapolation. It is not easy to develop strict criteria in children. The criteria will vary by race, age, ethnicity, and gender. The use of adult cut-points or single-set cut-points would be inappropriate for children. In addition, disturbances that are observed in adults as metabolic indicators may be moderate or subclinical in children. This does not mean, however, that the early precursors of the metabolic syndrome do not exist in children. To complicate matters further, there is a lack of normal acceptable ranges for insulin concentration across all ages and genders in childhood. Further complicating this issue is the insulin resistance observed in puberty.

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The most common measure for obesity in children currently is BMI. It is perhaps more accurate to measure central adiposity (using waist circumference measurements) to predict the risk of developing the metabolic syndrome in young adults. Very few, if any, pediatricians and family practitioners utilize waist circumference in their daily practice. To complicate the use of waist circumferences further, standard normal tables are not available. These tables may be developed by the CDC in the future but they are clinically not available today.

There are also multiple differences in the baseline lipid levels among various races and genders, and they are affected by the stage of puberty.

All of these differences or variables make a single definition for the metabolic syndrome in children impossible.

The approximate prevalence of metabolic syndrome in children varies then by the definition that is used. For example, an assessment of 2430 children from The Third National Health and Nutrition Examination Sur-

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vey (from 1988 to 1994) reported the prevalence of 4%, but the prevalence in overweight children increased to 30%.[10] Therefore, as the degree of obesity increases, the prevalence of metabolic syndrome increases. In this same study, the prevalence was 38.7% in moderately obese children (defined as a mean BMI of 33.4 kg/m) but increased to 49.7% in severely obese children (mean BMI 40.6 kg/m). As the obesity epidemic increases and the prevalence of obesity among children increases, it is logical to conclude then that the prevalence of metabolic syndrome, however it is defined, will continue to increase in young adults.

Clinicians are not commonly recognizing that variable components may coexist together in children and lead to future atherosclerotic cardiovascular disease in young adults.

Clinicians are not commonly recognizing that these components may coexist together in children and lead to future atherosclerotic cardiovascular disease in young adults. This is somewhat amazing because all of the precursors have been well described in children. In addition, the incidence of these precursors is increasing at an alarming rate as the obesity epidemic continues to increase. Autopsy studies such as the Bogalusa Heart Study have shown conclusively that the extent of early atherosclerosis of the aorta and coronary arteries is directly associated with levels of lipids, blood pressure, and obesity in childhood and adolescence.[11] Obesity, especially abdominal obesity, and insulin resistance are directly related, both clinically and epidemiologically, to the development of the metabolic syndrome and the associated cardiovascular risk in children.

Obesity and the Metabolic Syndrome in Children

Obesity has been strongly associated with insulin resistance and type 2 diabetes. This has been shown in children as well as adults. Currently more than 20% of all children in adolescence in the United States are overweight. This increase in childhood obesity has been coincidentally associated with elevated blood pressure, elevated triglycerides, low high-density lipoproteins, and abnormal glucose metabolism. This is true for both genders and all races. Despite this fact, there is no commonly accepted definition for the metabolic syndrome in children. Currently, a group of experts has been convened by the NIH to begin to recommend a common definition for the metabolic syndrome that could be used by clinicians as well as researchers. Once this definition is agreed upon and published, clinicians may begin to identify patients who are at risk for developing the metabolic syndrome as young adults. These criteria will be published in a future issue of this journal. In the meantime, efforts should continue to decrease the obesogenic environment in which children exist. Continued efforts should be made to increase physical activity and to decrease caloric intake. This would include but not be limited to healthier foods offered in schools and the increased opportunity to engage in daily physical activity. In addition, the opportunities for sedentary activity must be decreased. This includes but is not limited to the decreased use of television, video games, and computers. In addition, the opportunities to engage in unhealthy activities must be decreased. This would include the elimination of sweetened beverages in schools and the increased opportunity to consume fresh fruits and vegetables.

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The future effects of the metabolic syndrome are not going to be obvious in young children. However, these precursors, once they exist, will be very difficult to eliminate. We cannot wait for a definition of the metabolic syndrome in children to prevent its occurrence. ■

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