A HYPOTHETICAL INDEX FOR ADIPOSITY "BODY MASS ABDOMINAL INDEX" – THAT WILL PREDICT CARDIOVASCULAR DISEASE RISK FACTORS IN CHILDREN

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ABSTRACT

Obesity in preschool children is a risk factor for cardiovascular diseases in adolescents and adults. The adiposity in preschool children is measured by using weight for length, waist-to-height index and body mass index. These ratios theirselves have some pros and cons and mathematical complexities. This hypothesis has coined a new term – "Body Mass Abdominal Index" which is derived by the product of two independent ratios- weight for length and waist-to-height. On the other hand this index is also a product of body mass index and waist circumference, which signifies that it's a function of both lean mass and fat compartments of the body. Thus this index measures adiposity and will be related as a risk factor for cardiovascular disease in adolescents and adults.

Key words: pediatric obesity, weight/height index, BMI, waist/height index

INTRODUCTION

The prevalence of overweight in children in the United States has increased over the last 20 years (1). Rapid weight gain during infancy is a risk factor for obesity (2) and hypertension (3) in children and adults. The pediatric growth charts include weight for age, weight for length and BMI for age (4). Currently increase in weight gain and obesity in preschool children are measured independently either by weight for length index (5), waist-to-height ratio (6) or BMI for age (5). Age is a major criteria for adjusting weight for height index (7). In one of the study, weight for length was used during infancy but later at 3 years of age BMI was the criteria for measurement of obesity (5). Some other studies state that BMI is a poor indicator for assessing adiposity in the child (8). Another index, waist-to-height ratio relates to abdominal obesity, but recent investigations states that this ratio should also be adjusted with optimal power of height (9). Therefore all these ratios have mathematical complexity.

THE HYPOTHESIS

This Hypothesis combines the two indices-weight for height and waist-to-height ratio. They are two independent variable ratios, so the product of these ratios will be more accurate for measuring adiposity and thus will be an important cardio-vascular disease risk factor in children. Interestingly the final derivation gives rise to BMI, along with waist circumference as a cofactor. Therefore, it suggests that BMI can be used in preschool children but waist circumference will be influencing the final results of this index. The new term coined for this index is "Body Mass Abdominal Index" (BMAI).

Mathematically:

Weight / Height x Waist Circumference / Height = Weight / (Height)2 x Waist Circumference

= BMI x Waist Circumference = Body Mass Abdominal Index (BMAI)

Where Weight is expressed in Kg; Waist Circumference and Height is expressed in Meters.

For example, in a hypothetical case comparison, there are 2 male children, 2 years of age with some what similar growth measurements. First child's measurements are: Weight – 14 kg, Height – 90 cm, Waist Circumference – 49 cm. Second child's measurements are: Weight – 13.5 kg, Height – 88 cm, Waist Circumference – 43 cm.

First child's BMI= 17.3, Weight/Height = 15.5, Waist/Height = 0.54; BMAI = 8.5

Second Child's BMI = 17.4, Weight/Height= 15.3, Waist/Height = 0.49; BMAI = 7.5

The above comparisons show that BMI, Waist/ Height and Weight/Height values are close but BMAI value clearly separates the 2 cases. The BMI includes lean mass and fat components of the body. In this scenario, although BMI value is very close but the lean mass and fat components may be totally different. The BMAI is mostly influenced by Waist circumference which will mostly include fat compartment. This signifies measurement of adiposity is better reflected in BMAI rather than BMI or Waist/Height ratio alone.

EVALUATION OF THE HYPOTHESIS AND DISCUSSION

Recent research on rapid increase of weight for length (WFL) in the first 6 months of life is associated with increased risk of obesity at 3 years of age (5). Previous studies are limited by weight criteria alone (10). In fact, Benn RT has proposed mathematical properties of weight for length as a measurement of adiposity (11).

Another index, waist circumference and waist-to-height ratio is directly proportional to abdominal obesity. The central fat distribution is a risk factor for metabolic syndrome and cardiovascular diseases (12). In children, it had been studied that waist-to-height ratio is a better predictor of cardiovascular disease than Body Mass Index (BMI) (13).

The BMI is calculated as body weight (Kg) divided by square of the height (Meters). The BMI is dependent on lean body mass, fatness and age (14). Although one of the studies shows that the total body fat and percentage body fat have moderate to high correlations to BMI (15), but some other studies show that percentage body fat and BMI depends on the gender (8). In addition, Schaefer et al showed in boys that obesity is predicted appropriately by BMI in upper 3rd of percent body fat percentiles, not in lower 2/3rd of sample (16). In children with similar BMI there arn't have similar levels of adiposity. Thus BMI is a poor indicator for assessing adiposity in child.

Cole TJ has already shown that weight for height index should be adjusted for Age (Weight/Height) by determining appropriate power of height (p) (7). The optimal value of 'p' is 2, 3 and 2 in preschool children, at 11 years of age and at puberty respectively. Therefore 'p' is variable throughout the infancy and childhood. Similarly recent research on waist-to-height index (Waist/Height) shows that optimal power of height (p) increases from age 2 to 8 years (9). Its <1, 1 and >1 in ages <6 years, 6 years and 6 – 13 years respectively. There is another Index; Conicity Index which is a function of weight, height and waist circumference, but it has been shown in one of the studies that BMI is better than conicity index in predicting coronary artery disease (17).

The BMAI will take into account both BMI and Waist Circumference. That will include both lean body mass and fat components of the body. The denominator of BMAI is (Height)2 which includes optimal value of 'p'; that is 2 in preschool children. This will adjust weight for height index for age. There are a lot of mathematical interpretations for calculation of percentage body fat and adiposity. Every index is complicated by complex mathematical interpretations. BMAI is a very simple index to use and all the three main body measurements – weight, height, waist circumference are included. The measurement of adiposity is included in BMAI in the form of waist-to-height ratio, therefore BMAI will be an important tool in assessing cardiovascular risk factors in children. This hypothesis could be tested in cohorts of infants and preschool children. The correlation could be established with the help of DXA scanning (Dual energy Xray Absorptiometry).

Assessing adiposity in children is difficult. Recent research projects are focusing on weight for length and waist-to-height ratios in preschool children. The assessment bears direct relationship with cardiovascular risk factors in early age. Appropriate early interventions can prevent obesity related diseases in adolescents and adults. Therefore this index – "Body Mass Abdominal Index" will be useful in measuring adiposity and will predict cardiovascular risk factors in preschool children.

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