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Review Article

GLIMPSE ON BODY MASS INDEX

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Abstract :
Obesity is an important risk factor for cardio metabolic diseases including diabetes, hypertension, dyslipidemia and coronary heart disease (CHD). BMI has become the “gold standard” for identifying patients at increased risk of adiposity-related adverse health outcomes. BMI provided a simple numeric measure of a person's "fatness" or "thinness", allowing health professionals to discuss over-weight and under-weight problems more objectively with their patients.The BMI is one of the best ways to indirectly measure total body fat. Recently, experts have recommended that the BMI can be calculated at every pediatric check up along with the other routine measurements.In Industrialized countries, BMI during adolescence is significantly and positively correlated with concurrent diastolic blood pressure; that is, there is a recognized association between BMI and blood pressure.
Keywords: Obesity, Body Mass Index

INTRODUCTION

The History of BMI [2,4]

Obesity is an important risk factor for cardio metabolic diseases including diabetes, hypertension, dyslipidemia and coronary heart disease (CHD). BMI has become the “gold standard” for identifying patients at increased risk of adiposity-related adverse health outcomes.[10] Using a formula to calculate obesity is not a new concept. In the Nineteenth century, a Belgian statistician named Adolphe Quetelet came up with the Quetelet Index of Obesity, which measured obesity by dividing a person's weight (in kilograms) by the square of his or her height (in inches).

Formula: w/h2

Before 1980, Doctors generally used weight-for-height tables, one for men and one for women that included ranges of body weights for each inch of height. These tables were limited because they were based on weight alone, rather than body composition.

The public learned about the BMI at the late 1990s, when the American Government launched an initiative to encourage healthy eating and exercise.

In 1985, the United States National Institute of Health (NIH) Consensus Development Conference on the Health Implications of Obesity, defined obesity as BMI greater than 27.8 for men and greater than 27.3 for women. These figures were used from 1985 to 1998 to define overweight in NIH publications.In 1997, The World Health Organization (WHO) began using the index as a standard to determine not only overweight, but also added cutoffs for categories of underweight, pre obese, and three classes of obese.

In 1998, the National Institutes of Health lowered the overweight threshold for BMI 27.8 to 25 to match international guidelines.Recently the NIH advises Doctors and their patients to include BMI in a complete assessment of a person's body size and overall health.

BMI provided a simple numeric measure of a person's "fatness" or "thinness", allowing health professionals to discuss over-weight and under-weight problems more objectively with their patients.

For a fixed body shape and body density, and given height, BMI is proportional to weight. However, for a fixed body shape and body density, and given weight, BMI is inversely proportional to the square of the height.

The BMI is one of the best ways to indirectly measure total body fat. Recently, experts have recommended that the BMI can be calculated at every pediatric check up along with the other routine measurements.

In Industrialized countries, BMI during adolescence is significantly and positively correlated with concurrent diastolic blood pressure; that is, there is a recognized association between BMI and blood pressure.[9]

Body mass index was recommended as the basis for anthropometric indicators of thinness and overweight during adolescence. BMI-for-age was recommended as the best indicator for use in adolescence.[9]

The use of body mass index (BMI) for the prediction of risk factor clustering among children and adolescents has significant clinical utility. In a large cross sectional study of adolescents, BMI has been shown to be a better index of body fatness compared to waist-hip ratio.[5]

Normal Body Mass Index[6]

According to the **World Health Organization**, the ideal **BMI** is between 18.50 and 24.99. They further break it down into various classifications as follows:

Underweight	**<18.50**
Severe Thinness	<16.00
Moderate Thinness	16.00 - 16.99
Mild Thinness	17.00 - 18.49
Normal Range	**18.50 - 24.99**
Overweight	**≥25.00**
Pre-Obese	25.00 - 29.99
Obese	**≥ 30.00**
Obese Class 1	30.00 - 34.99
Obese Class 2	35.00 - 39.99
Obese Class 3	≥40.00

International variations[1]

These recommended distinctions along the linear scale may vary from time to time and country to country, making global, longitudinal surveys problematic. In 1998, the U.S. National Institutes of Health brought U.S definitions into line with World Health Organization guidelines, lowering the normal/overweight cut-off from BMI 27.8 to BMI 25. It also recommends lowering the normal/overweight threshold for South East Asian body types to around BMI 23, and expects further revisions to emerge from clinical studies of different body types.

These ranges of BMI values are valid only for the **South East Asian** body type:

Category	**BMI range -**
Starvation	less than 14.9
Underweight	from 15 to 18.4
Normal	from 18.5 to 22.9
Overweight	from 23 to 27.5
Obese	from 27.6 to 40
Morbidly Obese	greater than 40

BODY WEIGHT CALCULATIONS: [8]

(1) Body mass index (Quetelet's index)

$$= \frac{\text{Weight (kg)}}{\text{Height}^2\text{ (m)}}$$

(2) Ponderal index

$$= \frac{\text{Height (cm)}}{\text{Cube root of body weight (Kg)}}$$

(3) Broca index

= Height (cm) minus 100

For example, if a person's height is 160 cm,

His ideal weight is (160 – 100) = 60 kg

(4) Lorentz's formula

$$= \text{Ht (cm)} - 100 - \frac{\text{Ht (cm)} - 150}{\text{2 (women) or 4 (men)}}$$

(5) Corpulence index

$$= \frac{\text{Actual weight}}{\text{Desirable weight}}$$

The body mass index and the Broca index are widely used.

BMI as per age: [7]

Using BMI in adults:-

In adults, the weight status based on the BMI is as follows:
BMI less than 18.5 = Underweight
BMI 18.5 - 24.9 = Normal
BMI 25 - 29 = Overweight
BMI over 30 = Obese

BMI in children and in Adolescents – BMI-for-age

Unlike for adults, the BMI values vary with the age and sex of the child. The BMI in children is called BMI-for-age. The BMI value itself is plotted on a specific BMI chart. The BMI charts, contain a series of lines which indicate specific percentiles.

In children instead of looking at the actual BMI value itself, we focus on the specific percentile of the BMI according to age and gender. The BMI percentile allows comparison with children of the same sex and age.

BMI Percentiles indicate the following:
BMI-for-age less than the 5th percentile means *Underweight.*
BMI-for-age 85th to 95th percentile means the child is at *risk for Overweight.*
BMI-for-age greater than 95th percentile means the child *is Overweight.*

BMI-for-age importance:-

Recent studies have shown that cardiac disease risk factors are associated with the BMI for age. 60% of children aged 5-10 years with a BMI-for-age greater than the 95%, had at least one obesity-related condition such as high blood pressure, high cholesterol, or high insulin levels (an indication type 2 diabetes). 20% of these children had 2 or more such abnormalities. The BMI for age is now recommended method for screening overweight and underweight in all children from 2 to 20 years of age.

BMI Prime: [1]

BMI Prime, a simple modification of the BMI system, is the ratio of actual BMI to upper limit BMI (currently defined at BMI 25). As defined, BMI Prime is also the ratio of body weight to upper body weight limit, calculated at BMI 25. Since it is the ratio of two separate BMI values, BMI Prime is a pure, dimensionless number, without associated units. Individuals with BMI Prime < 0.74 are underweight; those between 0.74 and 0.99 have optimal weight; and those at 1.00 or greater are overweight. BMI Prime is useful clinically because individuals can tell, at a glance, what percentage they deviate from their upper weight limits. For instance, a person with BMI 34 has a BMI Prime of 34/25 = 1.36, and is 36% over his or her upper mass limit.

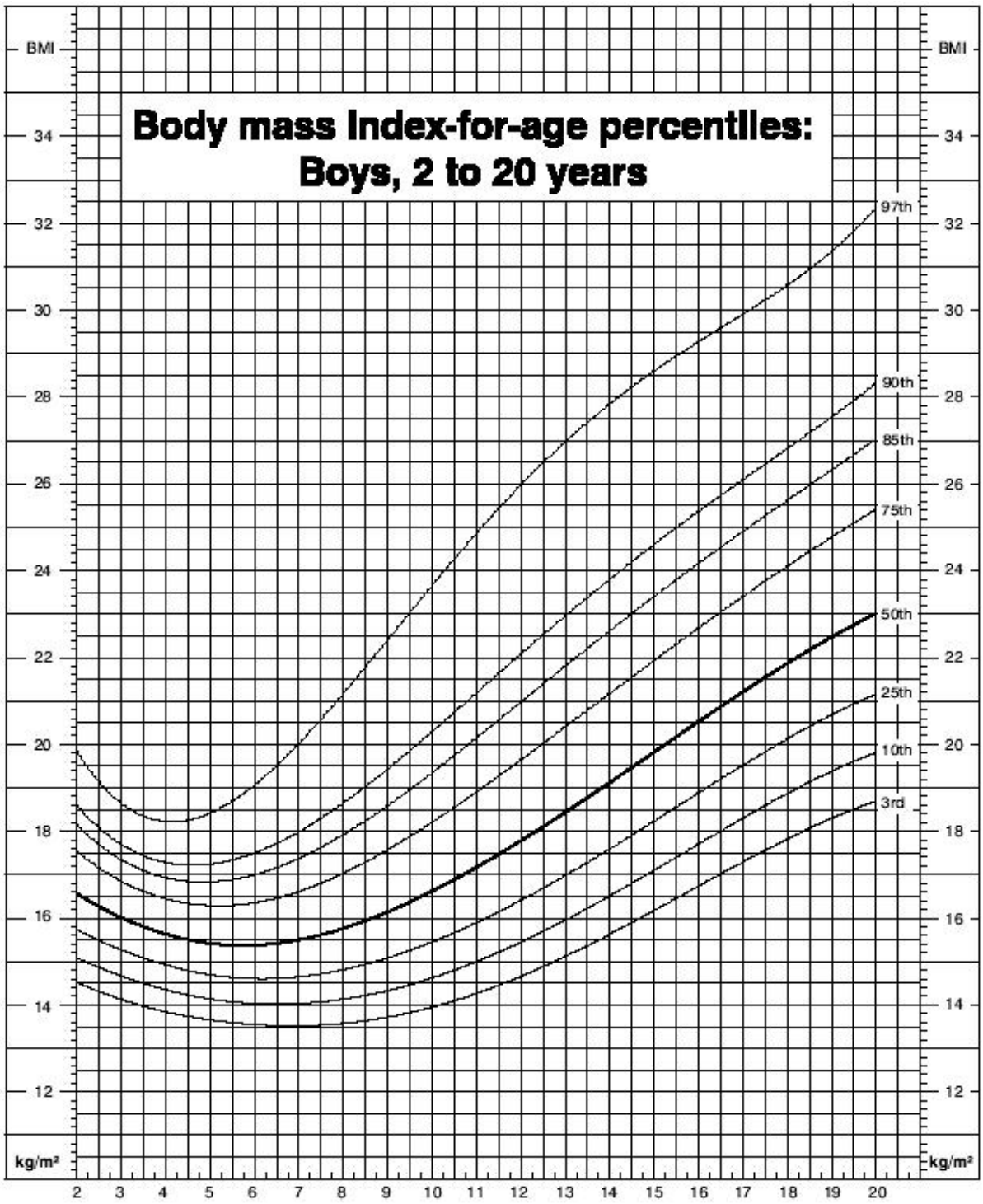
In Asian populations, BMI Prime should be calculated using an upper limit BMI of 23 in the denominator instead of 25. Nonetheless, BMI Prime allows easy comparison between populations whose upper limit BMI values differ.

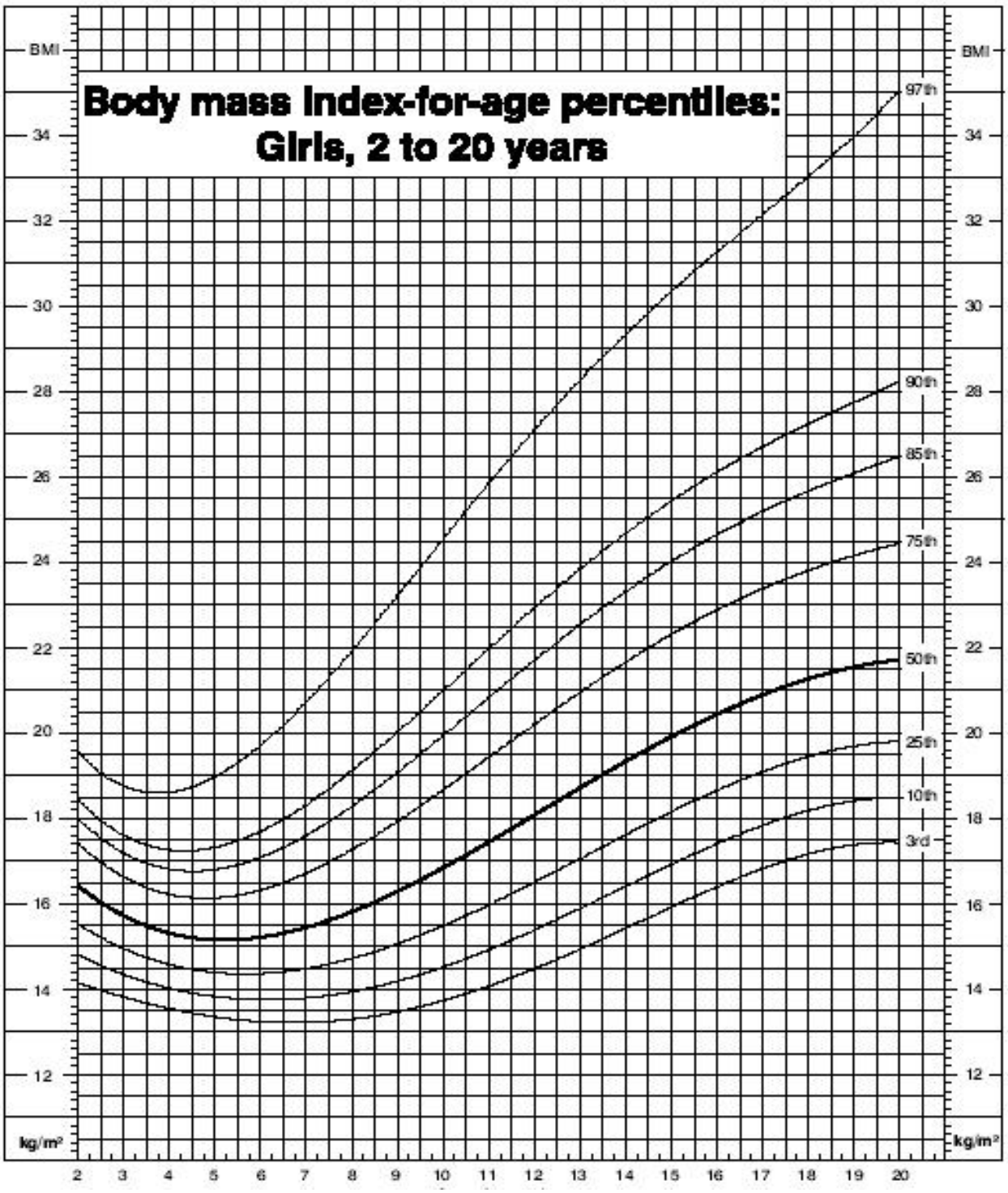
LIMITATIONS OF BMI [1]

BMI is a reliable indicator of total body fat, which is related to the risk of life-threatening diseases. The score is valid for both men and women, but it may overestimate body fat in athletes and others who have a muscular build. It may also underestimate body fat in older people and others who have lost muscle mass.

CDC Growth Charts [3] included in the next pages depicting BMI for age percentiles in boys and girls aged between 2-20 years.

CDC Growth Charts[3]





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