Workshop on childhood obesity: summary of the discussion[1–3]

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ABSTRACT Childhood obesity is rapidly emerging as a global epidemic that will have profound public health consequences as overweight children become overweight adults. To address this problem, action is needed at national and international levels. However, well-documented evidence of the trends in and global prevalence of obesity in children and adolescents is required to develop sound public health policies. There is no internationally acceptable index to assess childhood obesity nor is there an established cutoff point to define overweight in children. The purpose of the workshop was to establish a reasonable index with which to assess adiposity (overweight) in children and adolescents worldwide. We present here a summary of the discussion on the establishment of an index. The participants concluded that although body mass index (BMI; in kg/m^2) is not a perfect measure in children because it covaries with height, it has been validated against measurements of body density. Because a consistent and pragmatic definition for overweight in children and adolescents is required, BMI may therefore be appropriate. However, other alternatives may be considered in the future. The group suggested a scheme for cutoff points for children and adolescents based on internationally accepted BMI cutoff points for adult morbidity of 25 and 30 to identify grade 1 and grade 2 overweight, respectively. Use of these cutoff points would provide a new approach to identifying childhood obesity and make the definition for children and adolescents consistent with that for adults. *Am J Clin Nutr* 1999;70(suppl):173S–5S.

KEY WORDS Children, adolescents, obesity, international, standards, BMI, body mass index, skinfold thickness

INTRODUCTION

Four main issues were identified for discussion in the attempt to establish a reasonable index with which to assess adiposity (overweight) in children and adolescents worldwide: *1*) choice of an index measure, *2*) choice of a reference population, *3*) definition of cutoff points for overweight and obesity, and *4*) use of ancillary measures to validate the index.

AN INDEX TO MEASURE OVERWEIGHT

Weight-to-height indexes

Adiposity is the amount of fat in the body, expressed either as total fat mass (in kg) or the fraction (percentage) of total body fat. *Overweight* describes excess body weight. Body weight is reasonably correlated with body fat but is also highly correlated with height, which is weakly correlated with body fat. Therefore, weight adjusted for height is a far more useful index with which to assess overweight and is a reasonable indicator of fatness. Weight adjusted for height squared [body mass index (BMI; in kg/m^2)] is now used widely to measure adult overweight.

BMI

The measurements used to derive BMI as an assessment of adiposity in children and adolescents are reliable and nonintrusive; furthermore, BMI has been validated against measures of body density. Many countries have published BMI-for-age charts for their populations, and some have also defined cutoff points on these charts to define overweight and obesity. However, the cutoff points vary from country to country and the rationale for the choice of cutoffs is rarely provided. As a result, different BMI-for-age values define overweight and obesity in different populations.

Participants in the workshop debated the validity of BMI as a measure of adiposity in children and adolescents. An ideal index will predict early morbidity or mortality from chronic diseases. However, because obesity in children is rarely associated with morbidity or mortality, the likelihood that obesity will persist into adulthood may have to be used as such an indicator. For example, the risk of developing adult obesity (BMI > 28) in children aged > 9 y who are obese [defined as BMI above the 95th percentile of weight in the second National Health and Nutrition Examination Survey (NHANES II)] is up to 80% at age 35 y (1).

Limitations of BMI

Although weight was considered one indicator of fatness, children of the same weight but at different stages of height can have widely different levels of adiposity. BMI, however, adjusts for height by using the square power. Although the adjustment for height does not completely eliminate the stature effect, it partially adjusts weight for stature. One effect of this correlation between BMI and height is that taller populations will appear to

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have a higher prevalence of obesity (2). Use of BMI in a clinical setting requires additional measures to confirm that a high BMI reflects excess body fat and not height.

Other weight-to-height indexes

Other options for a weight-to-height index include a series of weight-to-height ratios such as the ponderal index (weight:height^3) or the Benn Index (weight:height^p). These ratios were discussed in detail by Franklin (2). If height is restricted to whole-power indexes, height squared is the best compromise because it is already used widely and has been validated against measures of body density. If a fractional index is to be used, then researchers must decide whether such an index would be acceptable on a global basis.

Ethnic differences in BMI

One study in whites and Asians showed differences of 2–3 BMI units in adults with the same body fat composition (3). In another study of BMI and body fat in young adults (4), differences were appreciable by ethnic and racial groups. Because the methods were standardized the differences were considered biological. However, there are still no cross-cultural data available in children that compare the validity of BMI.

Use of BMI for adolescents

In boys, skinfold thicknesses (SFTs) vary during the adolescent growth spurt. Extreme SFT values generally begin to decline ≈6–12 mo before peak height velocity occurs, suggesting that fat is redistributed during growth. One study found that obese adolescents, regardless of how they were classified as obese, tended to be more advanced in skeletal maturity than nonobese adolescents (5). Physical maturity, which may vary by ethnicity, may confound analysis of BMI in adolescents of different cultures. However, the overall efficiency of BMI in predicting percentage body fat as measured by triceps SFT or densitometry in adolescents of different ethnic origin was >0.8 (5), suggesting that BMI could be useful in international epidemiologic studies.

Skinfold thickness and circumference measures

The workshop participants debated whether SFT measurements provide an advantage over BMI or whether the difficulty in measuring SFTs outweighs the additional information it provides. SFTs or circumferences may indicate fat distribution and may help capture ethnic and sex differences in fat distribution. In addition, SFTs may help identify patients who are overfat and not merely overweight. However, the validity of SFT measurements in different populations has not been carefully explored. Furthermore, no evidence suggests that SFT measurements predict hyperinsulinemia, hypertension, or other illnesses in children better than does BMI. Results from several data sets suggest that childhood BMI remains stable into adulthood better then does SFT. This observation may reflect measurement error in SFT or changes in fat distribution.

The group noted that circumferences (eg, waist or hip) may reflect morbidity in adults, but the relation between visceral fat and morbidity in children and adolescents has not yet been clarified.

DEVELOPING A REFERENCE POPULATION

To apply newly developed BMI-for-age reference cutoff points internationally, a globally representative reference population may be essential. One way to develop such a population is to combine data from populations having a low prevalence of undernutrition. However, the criteria for determining whether a data set merits inclusion in the reference population must be established. The degree of overlap between data sets should be considered and differences between populations must be explored.

Reasonable criteria for combining data are: *1*) the sample is representative of the country, *2*) the data collection process included measures of reliability and validity and data were collected within a specified period, *3*) the origin of the sample is specified, *4*) the population is adequately described, and *5*) the sample is large ($n \geq 10\,000$). Note that the representativeness of data may be less important than other considerations because many countries in Africa and Asia lack nationally representative samples.

The group concluded that data conforming to the criteria would be used to produce growth charts for the different populations. Differences between them would be explored. Of particular interest is how superimposable those data sets are, how they differ at the extremes, and whether population-specific differences exist in the use of BMI.

DEFINING CUTOFF POINTS FOR OVERWEIGHT AND OBESITY

Absolute, relative, and prescriptive cutoff points

Several alternative cutoff points were discussed. These included an absolute cutoff value, a relative one, and one that is physiologically based. An absolute cutoff point requires an underlying criterion, such as the risk for long-term ill health. For example, in adults, a BMI cutoff point of 25 is used to define overweight. This cutoff is based on an increased risk for morbidity and mortality.

A less satisfactory approach is to define obesity statistically by a cutoff such as a percentile-for-age relative to a reference population. For example, the United States has adopted the 85th and 95th percentiles of NHANES II to define overweight and obesity in children (6). Similarly, the 97.7th percentile of a reference population of British children is sometimes used in the United Kingdom to define obesity (7). A consequence of this approach is that the prevalence of overweight and obesity is set to a fixed proportion for all ages of both sexes. Thus, 15% of the NHANES II population is overweight (>85th percentile) and 5% is obese (>95th percentile). Because populations may change with time, a further problem arises if new standards are based on current data because use of current data to establish standards eliminates the capacity to show secular trends. Therefore, percentiles should be based on a reference population that does not change with time.

A third, prescriptive, approach defines a healthy population and then defines normal growth by the distribution of that population. This approach has been adopted by a World Health Organization working group in its definition of a reference population aged 0–5 y (8). Breast-fed children were considered the physiologic prescriptive population because the pattern of their growth seems to be the same now as it was 100 y ago.

The problem with the prescriptive approach is that characteristics of the reference population may change with time. In addition, long-term follow-up studies that aid in defining healthy BMIs for children have not been performed. Nevertheless, the prescriptive approach was not considered to be unworkable but to require further discussion.

Setting cutoff points

Children tend to retain the same BMI percentile ranking as they become older. Therefore, another alternative would be to use the percentiles in late adolescence identified by the adult BMI values used to establish overweight and obesity (25 and 30, respectively). A BMI of 25 corresponds to about the 80th percentile of the National Center for Health Statistics (NCHS) standards at age 18 y in both males and females. Therefore, the 80th percentile would be used to define overweight in children and adolescents of all ages. Interestingly, a BMI of 30 corresponds with the 95th percentile of the NCHS standards for 18-y-old males. Therefore, the 95th percentile could be used throughout childhood and adolescence to identify obesity. This method makes the definition of overweight and obesity for children and adolescents consistent with that for adults.

The development of a reference population is critical to this approach. However, once a reference population is defined, the percentile values at different ages corresponding to BMIs of 25 and 30 at age 20 y would serve as the absolute reference cutoff points throughout childhood and adolescence. For example, if a BMI of 30 identifies the 95th percentile for a 20-y-old, the 95th percentile would be used to identify obesity in adolescents and children. This approach could be tested on available but pooled data sets.

A concern was raised about the application and use of the cutoff points in parts of the world where undernutrition exists. A potential risk in such areas is that interventions designed for overweight persons may have adverse effects on underweight persons.

USE OF ANCILLARY MEASURES TO VALIDATE THE INDEX

The newly established BMI-for-age cutoff points could be used to assess the prevalence of morbidity in new or existing cohorts. For example, how children's plasma insulin concentrations, cholesterol concentrations, and blood pressure correlate with the index should be explored. Similarly, indexes that combine BMI with waist circumference or SFT measurements may facilitate the identification of persons with hyperinsulinemia.

SUMMARY CONCLUSIONS FROM THE WORKSHOP

The workshop participants set out to establish a reasonable index with which to assess obesity in children worldwide. The choice of an index was therefore influenced by the need to determine a population prevalence of obesity. Although BMI is not a perfect measure in children because it covaries with height, it was selected because it is an easy measure of body fat that is reproducible and valid. A clinical decision about whether a child with a given BMI is truly overfat may require additional information, such as SFT measurements, comorbidity, family history, and recent health history.

The participants agreed that a reference population widely representative of the world's population should be established. Data from several countries should be pooled to create a provisional reference population. These countries include the United Kingdom, Singapore, the United States, Japan, France, Hong Kong, and Netherlands. The group recommended that before the data sets are pooled and additional cohorts are included, the sampling system must be specified, the data must be broadly representative of the population, and quality assurance practices must be applied to the data-checking process.

The participants also emphasized that the process of developing a reference population would have to be considered provisional because the data that now meet these criteria represent countries comprising < 5% of the world population. However, the group recommended that the World Health Organization address this issue and initiate activities to establish a reference population.

A novel approach to setting the childhood percentile for overweight and obesity based on adult morbidity cutoff points was proposed. Other analyses using data sets that have information on glucose and insulin concentrations and responses to glucose tolerance tests should be used to validate these percentiles.

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