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EDITORIAL

Defining obesity risk status in the general childhood population: Which cut-offs should we use?

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During the past two decades, the prevalence of overweight and obesity in children has increased worldwide. Excess fat in childhood is a risk factor for later adult disease and is associated with impaired health during childhood itself, including increased risk of hypertension, insulin resistance, fatty liver disease, orthopaedic dysfunction and psycho-social distress, which may continue untreated for many years. Once established, obesity in children (as in adults) is hard to reverse. Monitoring the prevalence of obesity in order to plan services for the provision of care and to assess the impact of policy initiatives is essential.

Although there is agreement on the importance of using standard recommendations to determine obesity risk status in the general childhood population, definitions of overweight and obesity often differ across studies, and comparisons of cross-sectional prevalence data are difficult to make. The classification of overweight and obesity relies on three prior selections: an anthropometric indicator, a reference population with which to compare the index child or community, and cut-off points that best identify individuals and populations at risk of overweight/obesity-related morbidity and mortality.

Anthropometric indicator

Body mass index (BMI), which is a measure of body mass relative to height, has emerged as the most practical, universally applicable, inexpensive and non-invasive anthropometric indicator for classifying overweight and obesity. Although there is some reluctance to describe children as obese on the basis of BMI alone, i.e., without taking into account some more direct measure of body fat (1), recognition of the difficulties inherent in obtaining more proximate measures of body fat and lack of references to interpret them has resulted in BMI-for-age alone being used to define overweight and obesity. In its favour, increased BMI-for-age in childhood and adolescence is associated with higher percentages of body fat (2–4) and known risk factors for cardiovascular disease (5).

Reference population

There is now broad international consensus about the utility of the WHO Child Growth Standards (*www.who.int/childgrowth/en*) for assessing the growth of pre-school children (6). Because the standards depict physiological human growth under optimal environmental conditions, they provide an improved tool for assessing growth. The WHO standards have been well received worldwide and, at the time of this writing, they have been adopted by over 110 countries and many researchers.

However, there are no equivalent standards for children of school age. Contemporary population samples will show a marked rightward skew in their weight-based curves, thereby redefining overweight and obesity as "normal" (7). For example, in a

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recent Indian study (8), the 85th and 95th percentiles for BMI at 18 years are above 25 and 30, respectively. As the authors themselves acknowledge, using the 85th and 95th percentiles as cut-offs for defining overweight and obesity will be accepting higher BMI (overweight children) as "normal" at all ages. Lowering the proposed cut-offs for defining childhood overweight as updated growth curves become increasingly skewed upwards cannot be the solution. A better approach would be to construct growth curves using samples that have achieved expected linear growth while still not being affected by excessive weight gain relative to linear growth.

The case made for using a national reference has traditionally been that it is more representative of a country's children than any other reference could be. However, with the child obesity epidemic this no longer holds for weight or BMI. As soon as a new reference is produced, it is out of date. Furthermore, it is not possible to make accurate comparisons between countries when each one has used its own local reference curve.

To provide an internationally comparable dataset, the International Obesity TaskForce (IOTF) combined surveys undertaken in the Netherlands, Great Britain, Singapore, Hong Kong, Brazil and the USA (9). The resulting BMI centile curves published in 2000 provided cut-offs (see below), which have been used widely in the subsequent research literature (10,11). However, these cut-offs are not recommended for clinical use when assessing an individual child's growth.

Coinciding with the publication of the WHO Child Growth Standards for pre-school children, an expert group meeting in 2006 evaluated the feasibility of developing a single international growth reference for school-age children and adolescents (12). The group recommended that appropriate growth curves for these age groups be developed for clinical and public health applications. As a result, the WHO proceeded to reconstruct the US National Center for Health Statistics 1977 reference curves using the original sample (a non-obese sample with expected heights), supplemented with data from the pre-school WHO Child Growth Standards in order to facilitate a smooth transition at 5 years (13). The new curves are closely aligned with the WHO Child Growth Standards at 5 years, and the recommended adult cut-offs for overweight and obesity at 19 years (BMI of 25 and 30, respectively). The full set of tables and charts for height, weight and BMI is available at www.who.int/growthref/en, including application tools, such as software for clinicians and public health specialists (14). The WHO reference 2007 for school-age children and adolescents provides a suitable reference for the 5 to 19 years age group for use in conjunction with the WHO Child Growth Standards from 0 to 5 years, and is recommended by the WHO for both clinical and epidemiological use.

Cut-off points

Once an anthropometric indicator and a reference population have been selected, it is necessary to determine the limits of "normality". In the IOTF model, the definitions for overweight and obesity were taken as BMI 25 and BMI 30, respectively, at age 18, and tracked back along the centile lines to age 2 years, for boys and girls separately. The resulting sets of values, from age 2 years to 18 years at six-month intervals, were defined as the cut-off thresholds for overweight and obesity in children.

The WHO classifications for overweight and obesity in younger children (0–5 years) are detailed in the training course on child growth assessment (15). Children above +1 standard deviation (SD) are described as being "at risk of overweight", above +2 SD as overweight, and above +3 SD as obese. The WHO opted for a cautious approach because these children are still growing and thus far there are few data on the functional significance of the cut-offs for the upper end of the BMI-for-age distribution for such an optimally healthy population. The WHO standards sample was prescriptive, and unhealthy weights for length/height were excluded prior to constructing the curves (6). A further reason to be cautious is to avoid the risk of young children being placed on restrictive diets.

For older children, the WHO adolescence BMI-for-age curves at 19 years closely coincide with adult overweight (BMI 25) at +1 SD and adult obesity (BMI 30) at +2 SD. As a result, these SD classifications are extended down to 5 years.

It is recognised that the classification scheme differs between children under the age of 5 years and those over the age of 5 years. It is indeed confusing to think that children who were classified as overweight at 59 months should be classified obese at 61 months while they maintain the same z-score. However, it is important to consider the actual value in kg of "excess" weight at different cut-offs for a still-growing 5-year-old in contrast to an adolescent who has reached adult height at age 19. For example, the "excess weight" carried by a boy of median height-for-age with a BMI-for-age of 2 SD at 19 years is 23.3 kg, while the equivalent "excess" for a boy at age 5 is 3.7 kg. Assuming that there is "excess weight" in both cases, its implications are likely greater for the former, who has reached his adult height, than

for the latter, who could still grow (in terms of height) into his weight.

Researchers using these cut-offs need to make this point clear when reporting their data, and keep the classifications separate for the two age groups. Clinicians might prefer to avoid classifying a child at this age (0–5 years), and focus instead on the individual growth trajectory in relation to the published curves, as well as their clinical assessment. Clinicians can also assess more proximate measures of body fat in individual children, such as the triceps and subscapular skinfolds for which the WHO standards are now available.

Clearly, there is need for research into the health outcomes associated with these different cut-off points. Given that childhood and adolescence are periods characterized by rapid growth and physiological change, it is entirely possible that a given centile represents varying levels of risk depending on age and stage of development. The WHO's recommended cut-offs for classifying overweight and obesity will be revised as appropriate according to whatever new knowledge becomes available from the aforesaid research.

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