Assessing adiposity using BMI z-score in children with severe obesity

Jessica G. Woo, PhD[1]; Tim J. Cole, PhD, ScD[2]

[1] Division of Biostatistics and Epidemiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

[2] Population, Policy and Practice Programme, UCL Great Ormond Street Institute of Child Health, London, UK

Address correspondence to:

Jessica G. Woo, PhD
Professor of Pediatrics
Division of Biostatistics and Epidemiology
Cincinnati Children's Hospital Medical Center
3333 Burnet Avenue, MLC 5041
Cincinnati, OH 45229-3039
(513) 636-9598 ph
(513) 636-7509 fax
Jessica.woo@cchmc.org

The question of how to assess the weight status of children with severe obesity has been debated for years. The US Centers for Disease Control and Prevention (CDC) growth charts were published in 2000, based on National Health and Nutrition Examination Survey (NHANES) data from the 1960's through the 1980's to determine the distribution of body mass index (BMI) in children, which varies by age and sex due to normal growth[1]. These growth charts, derived from cross-sectional data, are frequently used longitudinally to assess children's weight status and evaluate weight management program success.

As the prevalence of severe obesity has increased over time, we and others have questioned whether BMI percentiles and z-scores derived from the CDC 2000 growth charts are useful for assessing weight status and change in this population. BMI percentiles are bounded at 100%, so measures of weight status and weight status change above the 95th percentile are severely compressed, and this immediately rules them out[2]. However, it is not well known that BMI z-scores are also unsatisfactory at the highest BMI levels, because the statistical method used to construct the growth charts also compresses the z-score scale[3]. In 2009, Flegal et al established a new BMI metric for evaluating weight status for youth with obesity. This metric is calculated as observed BMI divided by the age-sex-specific 95th BMI percentile, and expressed as percent above the 95th percentile (%BMI_{p95}). Flegal et al also proposed 120% of the 95th BMI percentile as a new threshold for severe obesity[4].

Sadly, this initiative has not materially changed clinical practice, as electronic health record (EHR) systems largely continue to calculate BMI percentiles and z-scores, despite efforts to encourage adoption of the new nomenclature and standards in EHR systems[5]. Further, many studies to evaluate the success of weight management programs in children continue to rely on BMI z-score or BMI percentile as outcome metrics[6, 7].

In this issue, Freedman et al. (Obesity 2017) provide needed clinical evidence for why BMI z-score is an insufficient, and sometimes misleading, assessment tool in this context. They

analyzed NHANES data from 1999-2014 to determine how strongly various anthropometry indices correlated with measures of fat mass in children. In children with severe obesity, BMI z-score correlated poorly with measures of fat mass, including waist circumference, triceps skinfold thickness and DXA measures of fat mass. By contrast, the newer metric of $\%BMI_{p95}$, and a related measure of the *difference* between observed BMI and the 95^{th} BMI percentile, performed appreciably better in identifying differences in fat mass, which is a key driver of metabolic comorbidity risk in this population. Although this paper did not aim to determine the extent to which *change* in $\%BMI_{p95}$ also reflects *change* in fat mass longitudinally, it provides important biological and clinical support for the use of this newer metric.

This paper is consistent with a growing trend of identifying risk factor thresholds based on health outcomes, rather than expert opinion based on statistical distributions. Fortunately, in this case, evaluation of both statistics and child health outcomes agree on the need for a change in standard clinical practice with respect to assessing weight status in children with severe obesity.

References

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