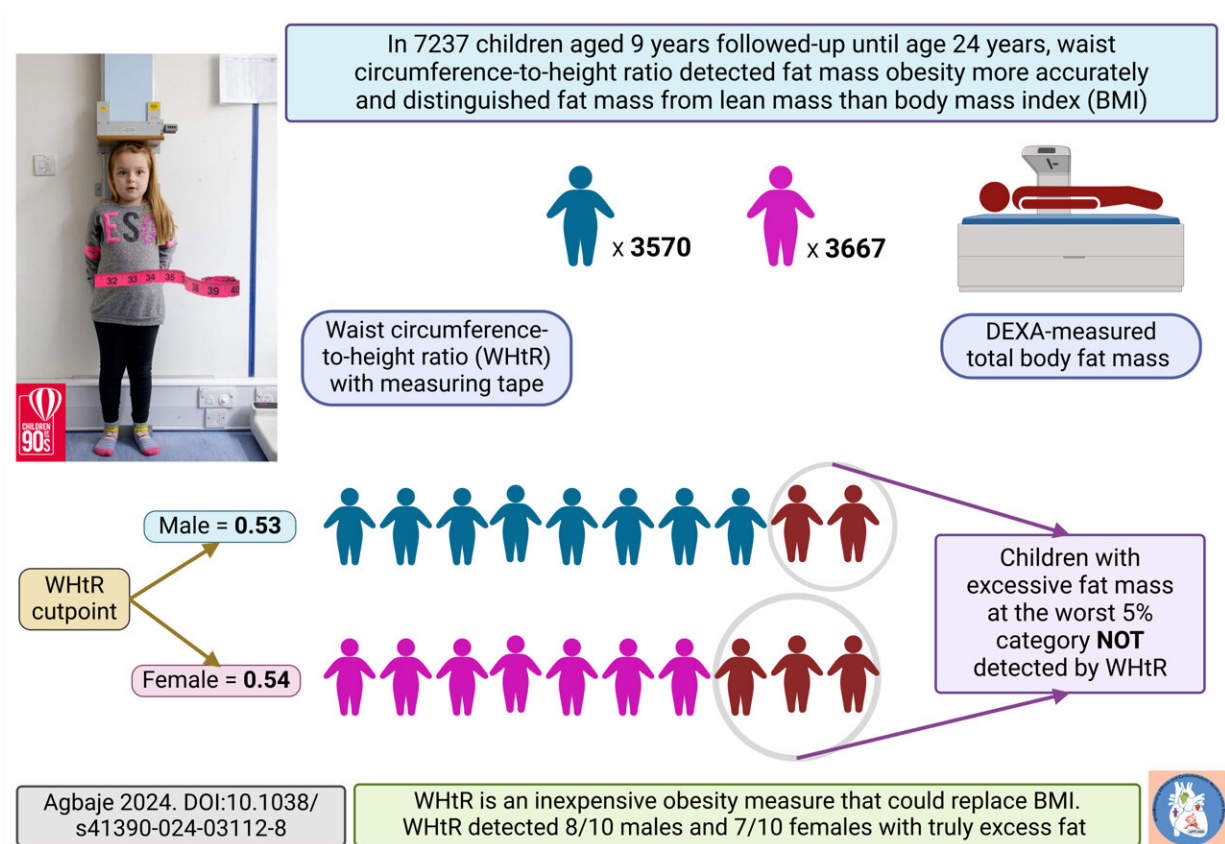# Waist-to-height ratio detects obesity in children and adolescents significantly better than BMI, finds study

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Waist circumference-to-height ratio may be universally adopted, as non-invasive and inexpensive fat mass overweight and obesity surveillance, monitoring, and prevention initiatives in routine pediatric health care practice, also in low-resource settings. Credit: Andrew Agbaje

An inexpensive measure of obesity in children and adolescents that could replace body mass index (BMI) has been identified in a new study as waist circumference-to-height ratio. This measure detected excess fat mass and distinguished fat mass from muscle mass in children and adolescents more accurately than BMI.

The study was conducted in collaboration between the University of Bristol in the U.K., the University of Exeter in the U.K., and the University of Eastern Finland. The results were published in *Pediatric Research*.

The prevalence of childhood and adolescent obesity has reached an epidemic proportion and is affecting nearly 1 in 4 children in the current decade. Unfortunately, obesity in the young population has been associated with cardiovascular, metabolic, neurological, musculoskeletal diseases and premature death in adulthood. Accurately detecting overweight and obesity in children is critical to initiating timely interventions.

For nearly a generation, weight-to-height ratio charts and BMI for age and sex have been used to diagnose children with obesity. However, these surrogate assessment tools are inaccurate in childhood and adolescence since they do not distinguish fat mass from muscle mass. For instance, two children with similar BMI might have different proportions of fat and muscle mass which makes obesity diagnosis difficult.

Expensive tools such as the dual-energy X-ray absorptiometry (DEXA) scan accurately measures fat and muscle content of the body, but this device is not readily available in primary health care centers. Recently, the American Academy of Pediatrics (AAP) published a clinical guideline on childhood obesity and requested urgent research on inexpensive and accurate alternative measures of obesity.

Emerging studies in adults appear to suggest that waist circumference-to-height ratio predicts premature death better than BMI and could be a potential added tool to BMI measure in improving the diagnosis of obesity.

However, there has been no former evaluation of how much waist circumference-to-height ratio measurements agree with DEXA-measured fat mass and muscle mass during growth from childhood to young adulthood. In addition, the threshold of waist circumference-to-height ratio needed to detect excess fat in children is not clear, hence this study.

The current study is the largest and the longest follow-up DEXA-measured fat mass and muscle mass study in the world using the University of Bristol's Children of the 90s data (also known as the Avon Longitudinal Study of Parents and Children). The study included 7,237 children (51% females) aged 9 years who were followed up until age 24 years. Their BMI and waist circumference-to-height ratio were measured at ages 9, 11, 15, 17, and 24 years.

When different devices measure a variable with an exact resemblance, it is described as perfect agreement of the devices with a score of 100%. For example, two DEXA scans from different manufacturers would measure fat mass with a near-perfect agreement of 99 to 100%.

Waist circumference-to-height ratio had a very high agreement of 81%–89% with DEXA-measured total body fat mass and trunk fat mass, but a low agreement with muscle mass (24%–39%). BMI had a moderate agreement with total fat mass and trunk fat mass (65%–72%) and muscle mass (52%–58%). Since BMI had a moderate agreement with DEXA-measured muscle mass, it is difficult to specify whether BMI measures excess fat or muscle mass.

The optimal waist circumference-to-height ratio cut points that predicted the 95th percentile of total fat mass in males was 0.53 and 0.54 in females. This cut point detected 8 out of 10 males and 7 out of 10 females who truly had excess DEXA-measured fat. The cut point also identified 93 out of 100 males and 95 out of 100 females who truly do not have excess fat.

"This study provides novel information that would be useful in updating future childhood obesity guidelines and policy statements. The average waist circumference-to-height ratio in childhood, adolescence, and young adulthood is 0.45, it does not vary with age and among individuals like BMI. Waist circumference-to-height ratio might be preferable to BMI assessment in children and adolescent clinics as an inexpensive tool for detecting excess fat.

"Parents should not be discouraged by the BMI or weight of their children but can inexpensively confirm whether the weight is due to increase in excess fat by examining their kid's waist circumference-to-height ratio," says Andrew Agbaje, physician and pediatric clinical epidemiologist at the University of Eastern Finland.

  More information: Andrew O. Agbaje, Waist-circumference-to-height-ratio had better longitudinal agreement with DEXA-measured fat mass than BMI in 7237 children, *Pediatric Research* (2024). DOI: 10.1038/s41390-024-03112-8