Anthropometric assessment of nutritional status in school-aged children and adolescents

By Natasha Lelijveld

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Adolescents take part in a programme to improve nutritional status through iron and folic acid supplementation and the fortification of meals in Niger

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What this article is about: This article discusses anthropometric assessment in school-aged children and adolescents.

Key messages:

- Despite some increase in the number of studies assessing nutritional status in school-aged children and adolescents in recent years, these age groups remain largely overlooked in international and national research, policies and guidelines.
- For anthropometric assessment, the range of different age categories, reference data and indicators used hinders the understanding of malnutrition in these age groups.
- More data and greater standardisation of anthropometric indicators would aid efforts to increase nutrition programming, policies and guidelines for school-aged children and adolescents.

Being under- or over-nourished during childhood and adolescence is associated with adverse consequences including the risk of infectious disease, poor pregnancy outcomes, lower educational attainment and the risk of earlier onset of non-communicable diseases (Black et al, 2008; WHO, 2016). Across all age groups, anthropometric status is used to estimate nutritional status and subsequent health risks. However, there is currently a lack of evidence, clarity and standardisation on assessing and classifying malnutrition in school-aged children and adolescents. This hampers advocacy efforts around the scale and burden of malnutrition in children older than five years of age and subsequent investments into research and interventions to tackle this challenge. The nutrition of children aged five to 19 years is regularly overlooked in international and national development priorities, policies and guidelines. There has been very little investment to date in improving the nutritional status of this age group, despite the nutritional sensitivity of this stage in life and the potential for impact. There is also a lack of global and national nutrition targets identified for this age group and thus little motivation for assessing their nutritional status or for including them in national surveys.

In recent years, there have been positive strides to spotlight the importance of school-age and adolescent nutrition, including recognition in global initiatives such as The Lancet Commission on Adolescent Health and Well-being (Patton et al, 2016). In addition, the nutritional needs of adolescent girls are mentioned in the Sustainable Development Goals although the indicators are only for anaemia (Sachs, 2012; Ali et al, 2020). Large global datasets have also been recently utilised to summarise the prevalence of malnutrition in adolescents and anthropometric data has most comprehensively been reported in the papers summarised in Table 2. However, the age ranges used vary significantly in the reports and the reference data used to define thinness and overweight also varies, being either the World Health Organization (WHO) 2007 reference or the International Obesity Task Force (IOTF) reference, each with slightly different cut-off values (Table 1). Ambiguity and variations in how anthropometric status is defined is a major issue in understanding global and national prevalence rates, comparing rates across settings and understanding trends.

The Benedict et al paper (2018) was the first demographic and health survey (DHS) report to use adolescent-specific definitions of thinness

Table 1 Summary of references and cut-offs used for school-aged children and adolescents

	WHO 2007 growth reference	IOTF growth reference	CDC growth reference	WHO adult cut-off
Applicable age bracket	5-19 years	2-18 years	2-18 years	>18 years
Weight categories				
Thin or underweight	BAZ <-2	Equivalent to BMI<18.5 at 18 years	BAZ <5th percentile	BMI <18.5
Normal weight	BAZ -2 to +1	Equivalent to BMI 18.5 to <25 at 18 years	BAZ ≥5th percentile to <85th percentile	BMI 18.5 to <25
Overweight	BAZ >+1	Equivalent to BMI ≥25 at 18 years	BAZ ≥85th percentile	BMI ≥25
Obesity	BAZ >+2	BAZ >+2 Equivalent to BMI ≥30 at 18 years	BAZ ≥95th percentile	BMI ≥30

Abbreviations: BMI, body mass index (kg/m2); WHZ, weight-for-height z-score; WAZ, weight-for-age z-score; BAZ, BMI-for-age z-score; CDC, Centers for Disease Control; IOTF, International Obesity Task Force; WHO, World Health Organization.

[2] See research summary item in this edition of Field Exchange entitled "What's new in adolescent nutrition at The DHS Program"

and overweight (based on the WHO 2007 reference). Usually, DHS presents prevalence rates for 15 to 19-year-olds using adult thresholds i.e., body mass index (BMI)<18.5 for thinness and BMI>25 for overweight. This tends to greatly overestimate the prevalence of thinness and marginally underestimate the prevalence of overweight in adolescents. The WHO recommended definition for thinness, based on the 2007 reference, is BMI-for-age z-score <-2 and BMI-for-age >+1 for overweight. The WHO reference uses primary data from adolescents in the United States of America in the 1970s but is statically adapted to reflect more international norms based on the WHO 2006 reference for children under five years of age. The IOTF reference uses data on children from six countries to better align overweight and obesity estimates for children and adolescents with adult cut-offs. The threshold for thinness in this reference is aligned to adult BMI<18.5 and overweight is the equivalent to BMI≥25 in adults. The IOTF reference results in a greater prevalence of thinness and a lower prevalence of overweight than the WHO reference. Often IOTF thinness data is presented as "Grade 1 thinness"; this is not the same as a BMI z-score <-1 but it is similar.

Another widespread issue in the literature is the interchangeable use of the terms, thinness and underweight, making it difficult to know whether BMI or weight-for-age have been utilised. The variations between different references and other issues associated with anthropometry, including the effect of the differential timing of the adolescent growth spurt and the impact of muscularity on the accuracy of the references, make anthropometric assessment of this age group especially complex. Several previous studies have discussed these issues in detail (Tumilowicz et al, 2019; Rolland-Cachera & ECO Group, 2011). In the recent papers highlighted in Table 1, the prevalence of overweight was generally higher in school-aged children and adolescent girls in low- and middle-income countries than in boys. It was highest in the Middle East, ranging from 15-34% across reports. For thinness, there was far less data and almost no data on boys. For girls, the highest prevalence was in South Asia, at approximately 23%. Trend data has found the prevalence of obesity has increased globally from 0.7% in 1975 to 5.6% in 2016 in girls and from 0.9% in 1975 to 7.8% in 2016 in boys. The prevalence of thinness decreased from 9.2% in 1975 to 8.4% in 2016 in girls and from 14.8% in 1975 to 12.4% in 2016 in boys (NCD Risk Factor Collaboration, 2017).

The increasing number of studies presenting prevalence data for malnutrition in the school-aged children and adolescent population is promising. However, the heterogeny in age categories, reference data and indicators used hinders our understanding of the nutritional problems faced during this influential life period. More data and greater standardisation of anthropometric indicators would aid programmers and policymakers to monitor trends, design solutions and set national and global targets.

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Table 2 Summary of recent reports presenting prevalence rates of global adolescent anthropometric status

Author, date	Data used	Population and date of data	Thinness definition	Overweight definition	Reference used
Akseer et al, 2017	Global Burden of Disease (GBD) 2013 and WHO Data Repository, Global School-based Student Health Survey (GSHS)	10-24 years 186 countries 2009 to 2015	BMI-for-age Z <-2	BMI-for-age Z >+1	Not specified
Azzopardi et al, 2019	GBD – compiled secondary data	10-24 years 195 countries 2016	Not reported	BMI-for-age equivalent to BMI>25 at age 18 years (10-18 years) BMI ≥ 25 kg/m^2 (19-24 years)	IOTF
Benedict et al, 2018	Demographic and health surveys (DHS)	15-19 years 87 LMICs 2000 to 2017	BMI-for-age Z <-2	BMI-for-age Z >+1	WHO 2007
Caleyachetty et al, 2018	GSHS and Health Behaviour in School-aged Children (HBSC) surveys	12-15 years 57 LMICs 2003 to 2013	BMI-for-age z<-2	BMI-for-age z>+1	WHO 2007
Spinelli et al, 2021	Childhood Obesity Surveillance Initiative (COSI)	6-10 years 36 European countries 2015 to 2017	BMI-for-age z<-2	BMI-for-age z>+1	WHO 2007
Ng et al, 2014	GBD, 2013 - compiled secondary data	5-19 years 188 countries 1980 to 2013	Not reported	BMI-for-age equivalent to BMI>25 at age 18 years (some self-reported anthropometry included)	IOTF
NCD Risk Factor Collaboration, 2017	Non-communicable Disease Risk Factor Collaboration (NCD-RisC) database and WHO STEPS surveys	5-19 years 200 countries 2016	BMI-for-age z<-2	BMI-for-age z>+1	WHO 2007

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