

Adolescent obesity as a biopsychosocial health challenge

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Abstract

Background: Puberty is characterized by rapid biological, cognitive and social change. Excess adiposity during this period may interact with pubertal timing, body-image development and peer evaluation, creating risks that extend beyond cardiometabolic health. Objective: To synthesize current evidence on the social and psychological risks associated with obesity during puberty and to describe the epidemiological context using World Health Organization (WHO) data. Methods: A structured narrative review and secondary descriptive analysis were conducted using WHO global estimates, WHO Global Health Observatory definitions, the 2021/2022 Health Behaviour in School-aged Children (HBSC) report, and selected peer-reviewed reviews on puberty, obesity and psychosocial outcomes. Published aggregate percentages were compared descriptively; no individual-level data or inferential tests were used. Results: WHO estimated that more than 390 million persons aged 5–19 years had overweight in 2022, including over 160 million with obesity. The prevalence of overweight, including obesity, rose from 8% in 1990 to 20% in 2022, while obesity rose from 2% to 8%. HBSC data showed marked gender and socioeconomic inequalities: overweight or obesity affected 27% of boys and 17% of girls, and 27% of adolescents from less affluent families compared with 18% of affluent peers. Obesity during puberty was associated with weight stigma, bullying, body dissatisfaction, low self-esteem, impaired quality of life and increased vulnerability to depressive symptoms. Conclusions: Adolescent obesity is a chronic, multifactorial disease embedded in social environments. Prevention and care should be developmentally appropriate, family-centred, non-stigmatizing and supported by school, community, health-system and policy interventions.

Keywords: *adolescent obesity; puberty; weight stigma; body image; mental health; social inequality; bullying*

Introduction

Adolescence, defined by WHO as ages 10–19 years, is a period of rapid physical, cognitive and psychosocial development in which health-related behaviours and social identities become consolidated (1, 4, 7-9, 29-32). Puberty is the biological component of this transition and includes endocrine activation, sexual maturation, growth acceleration and changes in body composition. Although adolescence and puberty overlap, they are not synonymous: pubertal timing varies substantially within chronological age groups (19-22). This distinction is important because most international surveillance systems report age-standardized BMI rather than Tanner stage or hormonal markers (3, 5, 8-11). Obesity is classified by WHO as a chronic, relapsing disease arising from interactions among genetics, neurobiology, eating behaviour, access to healthy diets, commercial forces and the broader environment (2, 29-

31). For persons aged 5–19 years, WHO defines overweight as BMI-for-age greater than one standard deviation above the WHO Growth Reference median and obesity as greater than two standard deviations (30-32). BMI is useful for population surveillance but is a surrogate for adiposity and does not directly capture body composition, fat distribution, pubertal stage or individual metabolic health. Puberty may amplify obesity-related vulnerability. Physiological insulin resistance increases during normal pubertal development, body composition changes differently in girls and boys, and social comparison becomes more salient (16-18, 25). Obesity has been associated with earlier pubertal development in girls; evidence in boys is more heterogeneous, although recent work also indicates meaningful relationships between adiposity and pubertal timing (12-14, 26). At the same time, visible body changes may increase exposure to weight-based teasing, peer exclusion and internalized stigma. The public-health importance of this interaction is substantial. WHO estimates indicate that adolescent obesity has quadrupled since 1990 (23, 27, 31). Its consequences include earlier risk of type 2 diabetes and cardiovascular disease, but also poorer quality of life, impaired school performance, stigma, discrimination and bullying (22, 28, 30-32). The social and psychological burden is not an inevitable consequence of body size alone; it is produced through interactions between health status, identity development, family resources, school climate, media ideals and unequal access to supportive environments (15, 29).

This review aims to: (i) describe the global epidemiology of excess weight among school-aged children and adolescents using WHO data; (ii) examine puberty-specific biological and psychosocial pathways; (iii) synthesize social and psychological risks; and (iv) propose developmentally appropriate, non-stigmatizing priorities for prevention and care.

Methods

Design and data sources

A structured narrative review was combined with secondary descriptive analysis of published aggregate data. Core epidemiological sources were the WHO obesity fact sheet updated in 2025, the WHO Global Health Observatory indicator metadata, the NCD Risk Factor Collaboration pooled analysis of 3,663 population-representative studies, and the WHO/HBSC international report from the 2021/2022 survey (29-32). The HBSC report covers 11-, 13- and 15-year-olds in 44 countries and regions across Europe, central Asia and Canada.

Eligibility and synthesis

Documents were eligible when they addressed: prevalence or definitions of overweight/obesity in ages 5–19; the interaction of adiposity with pubertal development; or social and psychological outcomes in children and adolescents. Priority was given to WHO publications, large surveillance reports, systematic reviews and clinically oriented peer-

reviewed syntheses (29-32). Adult-only studies, commercial materials and sources that did not distinguish observation from treatment claims were excluded from the conceptual synthesis.

Statistical approach

Only descriptive comparisons were made. Absolute percentage-point change was calculated as the later prevalence minus the earlier prevalence. Relative change was expressed as the ratio of 2022 to 1990 prevalence. For HBSC comparisons, percentage-point gaps were calculated between boys and girls and between low- and high-affluence groups. No confidence intervals were reconstructed, no hypothesis tests were conducted, and no causal inference was attempted. Values may differ slightly across WHO webpages because of rounding and differences between modelled estimates and survey summaries.

Puberty-specific limitations

WHO global estimates include ages 5–19, while HBSC includes ages 11, 13 and 15. These ranges overlap substantially with puberty but do not measure biological maturation directly. The term “during puberty” is therefore used developmentally, not as a claim that all observations were stratified by pubertal stage. This limitation should be addressed in future studies through Tanner staging or validated hormonal and maturation indicators (29-32).

Limitations

This article is a narrative review and secondary descriptive analysis, not a systematic review or meta-analysis. The WHO global estimates cover ages 5–19, extending beyond the biological boundaries of puberty, and HBSC data are regional rather than globally representative (29-31). HBSC height and weight may be self-reported in participating systems, and body-image indicators are subjective by design. Published aggregate figures do not permit adjustment for confounding or analysis of interactions. Causal conclusions should therefore not be drawn from the descriptive comparisons.

Results

Global epidemiological burden

In 2022, more than 390 million children and adolescents aged 5–19 years had overweight, including more than 160 million living with obesity (29, 31). Overweight prevalence, including obesity, increased from 8% in 1990 to 20% in 2022, an absolute rise of 12 percentage points and a 2.5-fold relative increase. Obesity increased from 2% to 8%, a six-percentage-point rise and a fourfold relative increase. WHO reported that they were overweight in 21% of boys and 19% of girls in 2022 (32).

Table 1. Selected WHO and WHO/HBSC prevalence indicators. Sources: WHO (30) and WHO Regional Office for Europe [8]. Values are rounded published estimates

Indicator	1990	2022	Descriptive change
Overweight, including obesity, ages 5–19	8%	20%	+12 percentage points; 2.5-fold
Obesity, ages 5–19	2% (31 million)	8% (>160 million)	+6 percentage points; fourfold
Overweight by sex, ages 5–19	Not used	21% boys; 19% girls	2-percentage-point sex gap
HBSC overweight/obesity	21% in 2018	23% in 2022	+2 percentage points

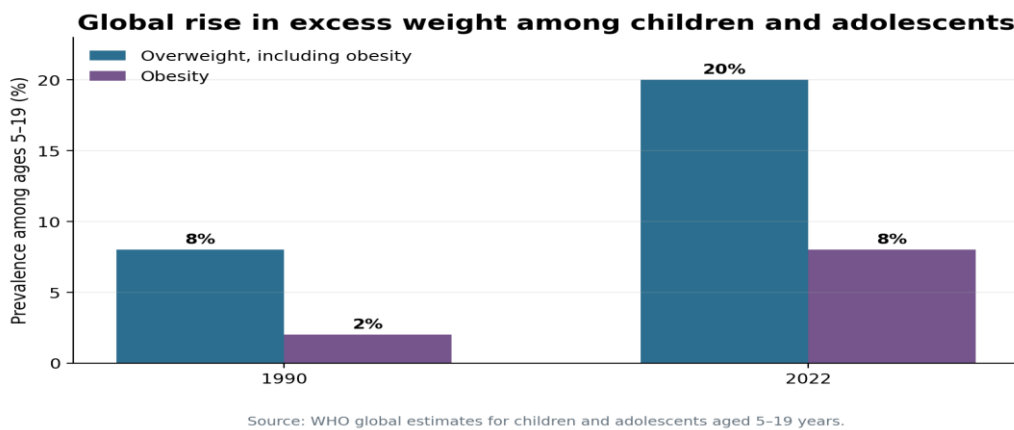


Figure 1. Global prevalence of overweight and obesity among children and adolescents aged 5–19 years, 1990 and 2022. Secondary visualization of WHO estimates (29).

Social inequalities and behavioral context

The HBSC survey showed that overweight and obesity were socially patterned. In 2022, prevalence was 27% among boys and 17% among girls, a ten-percentage-point gap. Adolescents from less affluent families had a prevalence of 27%, compared with 18% among more affluent peers, a nine-percentage-point difference (29). These inequalities occurred alongside differences in access to protective behaviours. Only 25% of boys and 15% of girls achieved 60 minutes of moderate-to-vigorous physical activity daily. Less affluent adolescents were also less likely to report healthy dietary behaviours and regular activity. Body-image findings did not mirror measured weight prevalence. Approximately 34% of girls and 24% of boys reported feeling “too fat” (28, 29). Thus, boys had higher measured overweight/obesity, whereas girls more frequently perceived their bodies as too large. This divergence illustrates why anthropometry, body image and psychological distress must be assessed separately. It also cautions against messages that intensify appearance surveillance.

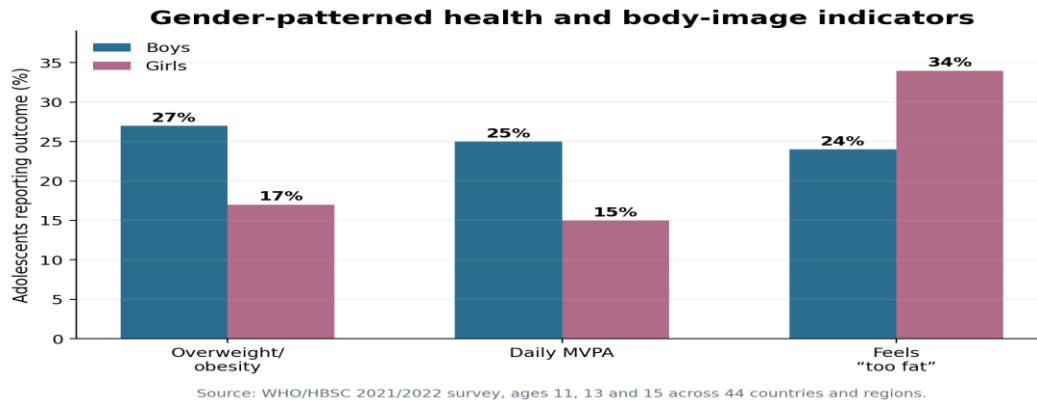


Figure 2. Gender-patterned weight status, daily physical activity and body-size perception in the WHO/HBSC 2021/2022 survey (29). The three indicators measure different constructs and should not be interpreted as a single scale.

Pubertal and developmental mechanisms

Normal puberty includes transient reductions in insulin sensitivity, rapid growth and sex-specific changes in fat and lean mass (29-32). When severe adiposity is present, these physiological processes may combine pre-existing insulin resistance and cardiometabolic risk. Adipose tissue also participates in endocrine signaling. Evidence consistently links higher childhood adiposity with earlier pubertal timing in girls, while the direction and magnitude of associations in boys vary by population and marker of maturation (25, 26). Pubertal timing has social meaning. Adolescents who mature earlier or whose bodies differ visibly from peer norms may receive unwanted attention, teasing or exclusion. Girls experiencing early maturation may face intensified body surveillance and sexualization; boys may experience pressure to conform to muscular ideals. These pathways are shaped by gender norms rather than biology alone. Clinical assessment should consider maturation, growth trajectory, family history, cultural context and the adolescent's own experience.

Social health risks

Weight stigma is a central social risk. It includes stereotyping, teasing, bullying, discriminatory treatment and the assumption that body weight reflects personal failure. Youth with higher body weight are more likely to report weight-based victimization, and stigma can occur in peer, family, educational, healthcare and digital settings. The effects may include social withdrawal, reduced participation in physical activity, avoidance of healthcare and deteriorating school engagement.

Socioeconomic inequality acts both upstream and downstream. Families with fewer resources may face higher prices for nutritious foods, unsafe environments for activity, limited recreational opportunities, time scarcity and greater exposure to inexpensive energy-dense products. Obesity-related stigma may subsequently affect educational participation and social

mobility. The WHO / HBSC affluence gradient indicates that individual counselling alone cannot correct structurally unequal exposure (30).

Psychological health risks

The psychological correlates most consistently reported in the literature are body dissatisfaction, lower self-esteem, depressive symptoms and reduced health-related quality of life (22-24). A meta-analysis found that obesity was associated with a substantially higher risk of body dissatisfaction and an increased risk of low self-esteem, although associations with anxiety and depression were less consistent across observational studies (tab.2)

Table 2. Social and psychological risk pathways during adolescence. Synthesized from WHO guidance and peer-reviewed reviews (29-32). Associations do not establish deterministic outcomes.

Risk domain	Potential pathway	Possible adolescent outcome	Assessment implication
Weight stigma and bullying	Teasing, exclusion, discrimination, internalized stereotypes	Distress, school avoidance, social withdrawal, reduced activity	Ask directly about weight-based victimization and school safety.
Body image	Pubertal change, appearance ideals, social comparison	Body dissatisfaction, low self-esteem, disordered eating	Assess perception separately from measured BMI.
Depressive symptoms	Stigma, functional limitation, shared determinants	Low mood, anhedonia, impaired functioning	Screen when indicated; evaluate suicide risk when clinically relevant.
Socioeconomic disadvantage	Food cost, neighbourhood safety, access barriers	Unequal exposure and reduced opportunity for protective behaviour	Assess material constraints; avoid attributing risk to motivation alone.
Healthcare stigma	Dismissive communication or diagnostic overshadowing	Delayed care and reduced trust	Use person-first language and evaluate symptoms on their merits.

This heterogeneity reflects differences in age, sex, severity of obesity, stigma exposure, measurement and study design. Directionality is bidirectional and context-dependent. Psychological distress may follow bullying, functional limitation and internalized stigma. Conversely, depression, sleep disturbance, adverse experiences or medication may affect eating, activity and weight trajectory. Shared determinants, including poverty, family stress and commercial food environments may influence both mental health and obesity. It is therefore scientifically inappropriate to treat obesity as a simple cause of psychological disorder or to assume that every adolescent with obesity is psychologically impaired. Body dissatisfaction can also contribute to restrictive dieting, binge eating, avoidance of movement

and other disordered behaviours. Weight-centred prevention that uses fear, shame or public weighing may therefore be counterproductive. Psychological safety requires confidential assessment, and attention to eating-disorder symptoms across the weight spectrum.

Implications for prevention and clinical care

A comprehensive response requires action across four levels. First, policy should improve food environments and regulate marketing of energy-dense, nutrient-poor products to minors. Second, schools should support nutritious meals, daily activity, anti-bullying policies and confidential pathways to counselling. Third, families should receive practical support that respects culture, finances and caregiving constraints. Fourth, healthcare should assess growth, pubertal development, metabolic risk, mental health, sleep, eating behaviour and stigma exposure. Treatment goals should extend beyond weight change. Relevant outcomes include metabolic health, fitness, sleep, quality of life, participation, emotional wellbeing and reduced weight-based victimization. Adolescents should participate meaningfully in decisions, and communication should use person-first, non-moralizing language. Mental-health referrals are indicated when distress, impairment, eating-disorder symptoms or suicidality are identified; obesity treatment and psychological care should proceed in coordination rather than sequentially.

Table 3. Multilevel response to obesity during puberty. Adapted conceptually from WHO recommendations

Level	Priority actions	Psychosocial safeguard
Policy and community	Affordable healthy foods; safe spaces; active transport; marketing regulation	Avoid campaigns that use fear, blame or stigmatizing imagery.
School	Inclusive physical education; nutritious meals; anti-bullying enforcement; counselling access	Do not publicly weigh, rank or isolate students by BMI.
Family	Supportive routines for meals, sleep and activity; model respectful body talk	Focus on health and function rather than appearance or blame.
Healthcare	BMI-for-age plus clinical assessment; pubertal history; metabolic and mental-health screening	Use confidential, person-first communication and shared decisions.
Research and surveillance	Disaggregate by age, sex and socioeconomic position; measure pubertal stage and stigma	Include adolescent-reported outcomes and avoid BMI-only definitions of success.

Research priorities

Future research should distinguish chronological age from biological maturation and report results by sex, socioeconomic position and obesity severity. Longitudinal designs are needed to clarify the direction of relationships among pubertal timing, stigma, body dissatisfaction, depression and weight trajectory. Intervention studies should measure adverse psychosocial

effects as well as metabolic outcomes. Surveillance should incorporate validated indicators of weight stigma, bullying, quality of life and disordered eating.

The use of BMI also requires precision. BMI-for-age is appropriate for population surveillance but does not diagnose individual health status in isolation. Clinical studies should complement it with growth trajectory, body composition where appropriate, cardiometabolic markers, functional measures and adolescent-reported wellbeing. Most importantly, research should test whether non-stigmatizing environments improve both participation and health.

Discussion

The reviewed evidence positions obesity during puberty as a developmental and social-health issue rather than solely an anthropometric problem. The global increase is unequivocal: obesity prevalence among ages 5–19 quadrupled between 1990 and 2022. Yet the psychosocial burden is unevenly distributed and depends on gender norms, socioeconomic resources, pubertal timing, stigma exposure and access to supportive services.

The puberty–obesity relationship should not be reduced to energy balance. Pubertal endocrine changes alter insulin sensitivity, appetite, sleep, body composition and social salience. At the same time, adolescents gain autonomy over food and activity within environments strongly shaped by family resources, transport, schools, advertising and digital media. WHO therefore emphasizes healthy food environments, physical activity, sleep, limits on harmful marketing and adolescent-responsive services (29).

The HBSC findings reveal two distinct gendered patterns. Boys showed higher measured overweight/obesity and higher activity participation, whereas girls more often perceived themselves as too fat. This apparent paradox is clinically important. It shows that body dissatisfaction is not a direct proxy for obesity and that girls may experience appearance pressure even at lower BMI. Boys may be under-recognized because larger body size can be culturally normalized or interpreted as strength. Gender-responsive care should avoid reinforcing either thinness ideals or muscularity pressures. The affluence gap supports a proportionate-universalist approach: universal prevention for all adolescents, with intensity and resources scaled to disadvantage. School meals, safe active transport, inclusive physical education and restrictions on marketing can modify exposure without singling out adolescents by body size. Clinical services should provide individualized assessment and treatment without using blame, humiliation or simplistic advice.

Conclusion

Obesity during puberty is associated with significant social and psychological risks, but these risks are neither uniform nor inevitable. WHO data document a fourfold increase in obesity prevalence among children and adolescents aged 5–19 between 1990 and 2022. During the same developmental period, rapid body change, peer evaluation and unequal access to

protective environments can intensify vulnerability to stigma, bullying, body dissatisfaction, low self-esteem, impaired quality of life and depressive symptoms.

An effective response must reject the false choice between physical and mental health. Prevention and treatment should address metabolic risk while protecting dignity, belonging and psychological safety. Developmentally appropriate care is family-centred, gender-responsive, attentive to pubertal timing and socioeconomic context, and free from blame. Population progress will require coordinated policies, supportive schools and communities, adolescent-responsive healthcare and research that evaluates wellbeing as rigorously as body size.

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