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How do Italian adolescents see themselves? Body weight congruence and its determinants in the 2021/2022 HBSC study

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Abstract

Background Body weight self-perception refers to the level of agreement between an individual's perceived and actual weight status. Body weight congruence (BWC) indicates the correct perception of one's body weight compared with its actual value. Understanding the agreement between body mass index (BMI) and weight self-perception among adolescents might provide important information regarding health behaviours and psychosocial characteristics in this population. The aim of this study is to investigate the self-perception of body weight among Italian adolescents aged 11, 13, 15, and 17 years, and analyse its congruence with their BMI. Furthermore, it explores the association between BWC and selected socio-demographic and contextual factors.

Methods Data from the Italian Health Behaviour in School-Aged Children (HBSC) survey were used. HBSC is the first Italian population-based survey on adolescent behaviours, representative at national and regional levels and involving students (aged 11, 13, 15 and 17-year-olds have also been included) recruited from school classes throughout all Italian regions. The school class was the primary sampling unit, drawn by a stratified systematic cluster sampling from the list of all public and private schools.

Results In 2022 the Italian HBSC involving 89,321 adolescents. 63.8% of the population correctly perceived their body weight in relation to their BMI category. Overestimation of body weight was more frequent among girls than boys (26.3% vs. 9.3%); in contrast, boys were more likely to underestimate their weight (26.0% vs. 10.7%). Overestimation climbed from 11 to 17 years, whereas underestimation decreased with age. The risk of weight overestimation and underestimation was associated with adolescents' health perception; a greater risk was observed among adolescents who considered their health as poor.

Conclusions Overall, our findings corroborate existing literature: body weight misperception decreases with increasing age, girls tend to overestimate their weight, and boys tend to underestimate it. Sex differences represent an important aspect to consider when designing sex-specific interventions in public health.

Keywords Adolescence, Body mass index, Body weight perception, Body weight congruence

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Background

Self-concept, self-esteem, and self-perception are interrelated constructs that influence individuals' lifestyles and health-related behaviours, particularly during adolescence [1]. Overall, self-perception is associated with several factors, including age, educational level, income, race, smoking habits, physical activity, alcohol use, presence of chronic illnesses, and body mass index (BMI) [2].

Body weight self-perception refers to the level of agreement between an individual's perceived and actual weight status [3]. Body weight congruence (BWC) indicates the correct perception of one's body weight compared with its actual value, whereas incongruence reflects either overestimation or underestimation of one's body weight [4].

Based on the 2021/2022 results of the Health Behaviour in School-aged Children study (HBSC), more than one-fifth of adolescents were classified as overweight or with obesity. Furthermore, approximately one-third of 13- and 15-year-olds perceived themselves as too fat. The prevalence of overweight and obesity was higher among boys than girls; however, girls were more likely to consider themselves as excessively fat. Moreover, adolescents' body-image perceptions tended to decline with age [5].

Trend analysis of HBSC data from 2001/2002 to 2017/2018, collected across 26 European countries, revealed that approximately half of adolescents aged 11–15 accurately perceived their body weight. This proportion declined with increasing age, particularly among girls. Notably, girls were more than twice as likely as boys to overestimate their body weight, with rates of 26.4% versus 11.8%, respectively [6]. Similar sex differences have also been reported in a study conducted in Brazil, where girls more frequently perceived themselves as overweight compared to their male peers [7].

Understanding the agreement between BMI and weight self-perception among adolescents might provide valuable information about their health behaviours and psychosocial characteristics [8].

Indeed, adolescents' misperception of their weight can give rise to a range of adverse outcomes, including unhealthy behaviours, body dissatisfaction, diminished motivation for physical activity, depression, eating disorders, and an elevated perceived risk of non-communicable diseases (NCDs), potentially persisting into adulthood [9–14]. Individuals with excess weight frequently underestimate their weight status and fail to recognize obesity-related risks, often due to a lack of awareness or acknowledgment of the problem [15]. Among adolescent girls, dissatisfaction with body image is frequently linked to concerns about body weight and may lead to restrictive dietary practices or the adoption of other maladaptive eating behaviours [16, 17].

Another important aspect to consider in adolescents is the bidirectional relationship between excess weight/self-perception and overall well-being. Although no consensus exists on the directionality of this association, evidence indicates that overweight individuals often experience heightened psychological distress, which may, in turn, reinforce the persistence of excess weight [18]. In Scotland, a trend analysis (from 1990 to 2014) revealed that adolescents who perceived themselves as overweight were more likely to report reduced confidence and happiness, along with increased psychological symptoms, regardless of age or sex [19]. Similarly, a recent study from Korea identified a significant correlation between adolescents' BMI, subjective health perception, and body image perception [20].

Finally, it would also be interesting to examine the association between family culture and socioeconomic status and the adolescents' BWC in order to examine the potential influence of social contextual factors on their development [21]. Indeed, social determinants—such as family income, parents' education and occupation—are fundamental causes of health inequalities. These factors shape access to resources, health literacy, and social norms, which in turn might affect adolescents' perceptions of their body weight [22].

Within this framework, the present study examines the self-perception of body weight among Italian adolescents aged 11, 13, 15, and 17 years, and assesses its concordance with their real BMI. Additionally, it explores the relationships between BWC and various socio-demographic and contextual factors.

Materials and methods

Sample study population

We used data from the 2022 Italian Health Behaviour in School-Aged Children (HBSC) study. HBSC is a World Health Organization collaborative cross-national survey of school students, which collects data every four years to monitor and improve understanding of health, health behaviours, well-being, and social environments in early adolescence (aged 11, 13, 15, and, in Italy, also 17 years). The HBSC survey includes data from nationally representative samples from 50 countries across Europe and North America, all adhering to a detailed international study protocol [23].

Italy joined the HBSC international network in 2000, and since then, six waves of data collection have been carried out [24]. Since 2010, each survey has been supported and financed by the Ministry of Health and coordinated by the Italian National Institute of Health (ISS), in collaboration with the Universities of Torino, Padova, and Siena [25]. In Italy, the HBSC data collection is organized within the "Surveillance system for risk behaviours in 11–17-year-olds", and since2017, it became part of the

Prime Ministerial Decree "Identification of surveillance systems and registries of mortality, tumours and other diseases" [26].

The Italian survey involved a regional and national representative sample of students who filled out an online, self-completed, anonymous, and standardized questionnaire at school on weight status, body perception, well-being, as well as general information concerning their health and social background. Anonymity and confidentiality of all participants were ensured.

The primary sampling unit was the school class from public and private schools across Italy. A comprehensive explanation of the objectives, theoretical basis, and methodology of the international and Italian HBSC study is available in another source [27].

Measurements

Weight status

Weight status was determined using self-reported weight and height based on the following questions: "How much do you weigh without clothes?" and "How tall are you without shoes?". Body mass index (BMI) was calculated, and weight categories were assigned according to the internationally recognized age- and sex-specific cutoff values established by Cole and Lobstein for the International Obesity Task Force (IOFT) [28]. We grouped the IOFT classifications into four BMI-based categories: "underweight," "normal weight," "overweight," and "obese".

Body weight perception

Perceived weight status was assessed with the question: "Do you think your body is?" with response options: "much too thin", "a bit too thin", "about the right size", "a bit too fat", and "much too fat". The answers were grouped into three categories combining extreme values: "Much/a bit too thin", "about the right size", "a bit/much too fat" [23].

Body weight congruence (BWC)

To assess BWC, weight status and body weight perception were combined and classified into three categories: "correct weight perception" (congruence between perceived and self-reported weight status), "overestimation (perceived weight status higher than self- reported weight status), and "underestimation" (perceived weight status lower than self-reported weight status).

Covariates

Sex was assessed by asking respondents whether they were a boy or a girl. Age was computed from the respondent's month and year of birth and the survey assessment date.

Students were also asked to indicate their health status by answering the question "Would you say your health is…?". Possible answers for self-rated health were "excellent", "good", "fair" and "poor" [29].

Relative family affluence was assessed to measure socioeconomic status using the 6-item HBSC Family Affluence Scale (FAS), that includes number of cars in the family (0= "none", 1= "one", 2 = "two or more"), having one's own bedroom (0= "no", 1= "yes"), number of computers (0= "none", 1= "one", 2= "two", and 3= "more than two"), having a dishwasher (0= "no", 1= "yes"), number of bathrooms (0= "none", 1= "one", 2= "two", 3= "more than two"), frequency of family holiday (0= "not at all", 1= "once", 2= "twice", 3= "more than twice"). After summing the scores, FAS was categorized into three levels: low affluence (0–6), medium affluence (7–9), and 'high affluence' (≥ 10) [30].

Students can also indicate their parents' country of birth and educational level. Parents' country of birth was categorized into "both Italians", "one foreign parent", and "both foreigners". For these analyses the highest educational level between the two parents was considered, and three educational levels were taken into account: "low" (both parents with less than high school), "medium" (at least one of the parents with high school) and "high" (one of the parents with university degree or higher); a fourth category, regarding the answer "don't know", was also considered.

Statistical analysis

Descriptive statistics were used to summarize outcomes overall and sociodemographic characteristics of adolescents and families.

Multivariable logistic regression models were used to explore the association between BWC and age, sex, FAS, self-rated health, parents' educational level, and parents' nationality. The likelihood of correct weight perception, over- or underestimation was described using Odds Ratios (OR) with 95% Confidence Intervals (CI).

We conducted three separate models: Model 1 compared incorrect weight perception (including both overestimation and underestimation) with correct weight perception; Model 2 focused on overestimation of weight perception *versus* correct weight perception; and Model 3 examined underestimation of weight perception relative to correct weight perception.

Missing data were excluded from the analysis. Stata software version 18.0 was used for all statistical analyses (StataCorp College Station, TX, USA).

Results

Eighty-nine thousand three hundred twenty-one adolescents (48.5% females) participated in the 2021/2022 Italian HBSC wave: 25.0% aged 11, 6.3% aged 13, 25.6% aged 15, and 23.1% aged 17.

As shown in Table 1, 75.5% of the total population were of normal weight, 2.8% underweight, 17.6% overweight, and 4.1% were obese. The percentage of overweight (including obesity) was higher among boys and decreased with age (from 11 to 17 years). 29.9% of adolescents considered themselves too fat, and 12.5% assessed their body weight as too thin. Girls were more likely to consider themselves too fat (36.5%) compared to their male peers (23.7%). Conversely, boys tend to perceive themselves as thinner more frequently than girls (16.0% vs. 8.7%). At 11 years old, the percentage of adolescents who claimed being too fat was lower than in older age groups.

Regarding BWC, 63.8% of the population correctly perceived their body weight in relation to their BMI category. Overestimation of body weight was more frequent among girls than boys (26.3% vs. 9.3%); in contrast, boys were more likely to underestimate their weight (26.0% vs. 10.7%). Overestimation climbed from 11 to 17 years, whereas underestimation decreased with age.

Approximately 85.0% of adolescents reported an excellent/good perception of their health, with differences between girls and boys (80.3% vs. 89.9%). A marked decreasing trend in excellent/good health perception was observed from 11 to 17 years.

58.1% of students reported a medium level of the FAS, 82.3% had both Italian parents, while roughly 10.0% both foreign parents. One third referred to a high level of parental education.

Figure 1 showed the BWC for different BMI categories. Adequate weight assessment was most common in girls who were overweight and among boys classified as normal weight. 29.5% of girls and 11.2% of boys who were of normal weight overestimated their actual weight. 54.1% and 43.6% of underweight girls and boys, respectively, overestimated their body weight. Marked sex differences

Table 1 Characteristics of the sample by sex and age

	Total % (*N*)	Boys % (*N*)	Girls % (*N*)	11 years old % (*N*)	13 years old % (*N*)	15 years old % (*N*)	17 years old % (*N*)
Body mass index category							
Underweight	2.8 (2,532)	2.1 (1,003)	3.5 (1,529)	3.9 (815)	2.9 (635)	1.9 (462)	2.4 (620)
Normal weight	75.5 (66,901)	71.0 (32,425)	80.3 (34,476)	71.8 (15,096)	74.5 (17,021)	77.2 (16,987)	78.3 (17,797)
Overweight	17.6 (13,158)	21.5 (8,339)	13.4 (4,819)	19.3 (3,359)	18.3 (3,556)	17.0 (3,291)	15.9 (2,952)
Obese	4.1 (2,810)	5.4 (1,914)	2.8 (896)	5.0 (786)	4.3 (713)	3.9 (680)	3.4 (631)
Body weight perception							
Too thin	12.5 (11,457)	16.0 (7,621)	8.7 (3,836)	13.0 (2,815)	11.8 (2,744)	12.8 (2,939)	12.3 (2,959)
About right	57.6 (52,174)	60.3 (27,638)	54.8 (24,536)	61.0 (13,351)	57.0 (13,410)	56.1 (12,446)	56.6 (12,967)
Too fat	29.9 (25,269)	23.7 (9,783)	36.5 (15,486)	26.0 (5,203)	31.2 (6,797)	31.1 (6,707)	31.1 (6,562)
Body weight congruence							
Correct perception	63.8 (52,827)	64.7 (27,235)	63.0 (25,592)	63.4 (12,451)	64.5 (13,607)	62.6 (12,992)	65.0 (13,777)
Overestimation	17.6 (14,835)	9.3 (3,879)	26.3 (10,956)	15.5 (2,967)	17.8 (3,909)	18.5 (3,914)	18.5 (4,045)
Underestimation	18.6 (14,648)	26.0 (10,506)	10.7 (4,142)	21.1 (3,971)	17.7 (3,613)	18.9 (3,768)	16.5 (3,500)
Self rated-health							
Excellent	29.2 (25,717)	36.4 (16,406)	21.5 (9,311)	36.9 (8,004)	32.6 (7,518)	24.9 (5,435)	21.6 (4,760)
Good	56.3 (49,970)	53.5 (23,989)	59.3 (25,981)	54.8 (11,557)	55.5 (12,702)	57.1 (12,603)	58.2 (13,108)
Fair	12.5 (11,488)	8.7 (4,023)	16.6 (7,465)	7.4 (1,610)	10.3 (2,403)	15.3 (3,502)	17.4 (3,973)
Poor	2.0 (1,736)	1.4 (581)	2.6 (1,155)	0.9 (195)	1.6 (363)	2.7 (551)	2.8 (627)
Family Affluence Scale (FAS)							
Low	22.7 (16,575)	21.1 (7,871)	24.3 (8,704)	24.3 (4,308)	22.3 (4,205)	21.2 (3,829)	22.9 (4,233)
Medium	58.1 (51,399)	57.8 (25,507)	58.5 (25,892)	53.7 (11,356)	57.0 (12,932)	59.8 (13,085)	62.3 (14,026)
High	19.2 (18,805)	21.1 (10,376)	17.2 (8,429)	22.0 (5,106)	20.7 (5,285)	19.0 (4,642)	14.8 (3,772)
Parents' nationality							
Both italian	82.3 (70,113)	82.6 (35,601)	82.0 (34,512)	80.8 (16,382)	80.5 (17,596)	83.0 (17,645)	85.4 (18,490)
One foreign	7.9 (8,178)	7.8 (4,037)	8.0 (4,141)	7.8 (2,033)	8.6 (2,248)	7.8 (1,998)	7.2 (1,899)
Both foreign	9.8 (10,215)	9.6 (5,136)	10.0 (5,079)	11.4 (2,820)	10.9 (3,009)	9.2 (2,369)	7.4 (2,017)
Parents' educational level							
Low	10.0 (6,878)	9.8 (3,333)	10.2 (3,545)	4.7 (711)	10.9 (1,803)	10.8 (1,845)	13.7 (2,519)
Medium	37.1 (33,943)	36.4 (16,719)	37.8 (17,224)	18.6 (4,008)	38.0 (8,783)	43.6 (9,856)	48.7 (11,296)
High	29.8 (26,323)	30.0 (13,543)	29.6 (12,780)	28.6 (5,863)	29.9 (6,961)	31.7 (6,957)	28.9 (6,542)
Don't know	23.1 (20,889)	23.8 (10,883)	22.4 (10,006)	48.1 (10,481)	21.2 (5231)	13.9 (3,205)	8.7 (1,972)

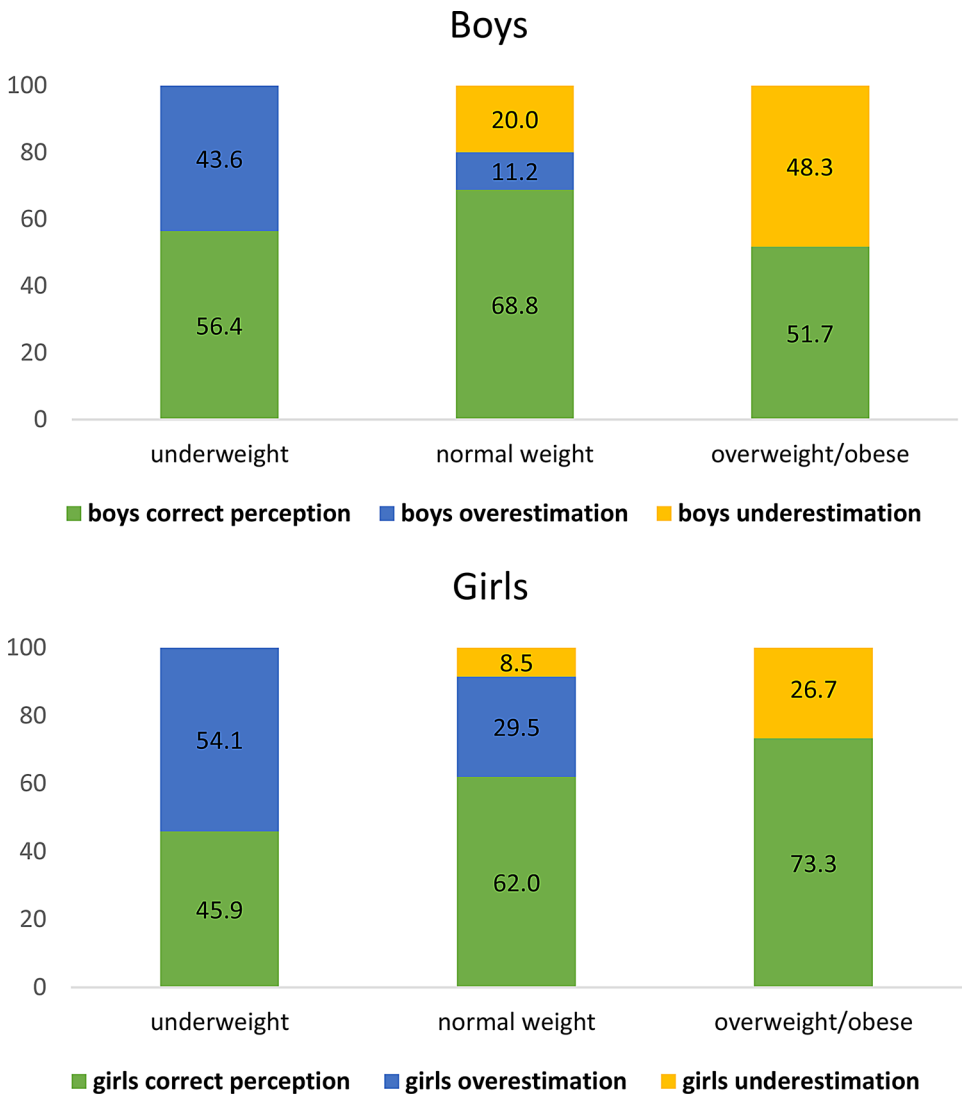

Fig. 1 Body weight congruence (BWC) for BMI categories by sex

were found concerning weight underestimation; girls were more likely to declare correct perception of their overweight/obesity than boys (73.3% vs. 51.7%).

The results of the logistic regression models on BWC are shown in Table 2. The findings from the multivariable analysis were consistent with those of the univariate analyses.

Model 1, which included results concerning both overestimation and underestimation showed a strong association of incorrect weight perception with self rated-health of adolescents. Model 2 highlighted a decrease in the risk of weight overestimation from 11 to 17 years old. Additionally, girls were more likely than boys to overestimate their weight. The risk of weight overestimation was associated with adolescents' health perception; a marked increase in the risk was observed from adolescents who considered their health excellent to those who perceived their health as poor. Moreover, having both foreign parents and living in a family with a high FAS was associated with a significant likelihood of overestimation.

As reported in Model 3, as young people's age increased, the risk of underestimating their own body weight decreased. The analysis also revealed different predictors of body weight underestimation in boys and girls. In analogy with Model 2, Model 3 showed that perceiving health as poor/fair was associated with a higher risk of underestimating their body weight. Moreover, living in a family with medium/high FAS was a protective factor against underestimation of body weight.

Discussion

This study investigated BWC among adolescents, considering both their self-perceived weight (too thin, about right, or too fat) and their nutritional status based on BMI (underweight, normal weight, overweight, or obesity). Moreover, the associations between BWC,

Table 2 Logistic regression models for BWC

	Model 1 Incorrect perception (underestimation + overestimation) vs. normal	Model 2 overestimation vs. normal	Model 3 underestimation vs. normal
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age			
11 years old (ref)	1	1	1
13-years old	1.02 (0.95–1.08)	**1.18 (1.10–1.25)**	**0.88 (0.83–0.93)**
15-years old	1.05 (1.00-1.10)	**1.13 (1.06–1.20)**	**0.93 (0.88–0.99)**
17-years old	0.96 (0.92–1.05)	**1.07 (1.01–1.14)**	**0.82 (0.77–0.86)**
Adolescent's sex			
Boys (ref)	1	1	1
Girls	1.02 (0.99–1.05)	**2.67 (2.56–2.79)**	**0.39 (0.38–0.42)**
Self rated-Health			
Excellent (ref)	1	1	1
Good	**1.38 (1.32–1.42)**	**1.67 (1.58–1.76)**	**1.20 (1.15–1.25)**
Fair	**2.12 (2.01–2.23)**	**3.05 (2.85–3.25)**	**1.43 (1.34–1.54)**
Poor	**2.93 (2.62–3.28)**	**4.53 (3.99–5.15)**	**1.64 (1.39–1.53)**
Parents' educational level			
Low (ref)	1	1	1
Medium level	1.37 (0.90–1.01)	0.99 (0.92–1.07)	**0.91 (0.84–0.98)**
High level	2.12 (0.91–1.03)	1.04 (0.96–1.13)	**0.91 (0.84–0.98)**
Don't know	2.93 (1.01–1.15)	**1.13 (1.03–1.23)**	1.03 (0.95–1.13)
Parent's nationality			
Both Italian (ref)	1	1	1
One foreign	**1.07 (1.02–1.13)**	**1.14 (1.07–1.22)**	1.01 (0.94–1.08)
Both foreign	**1.15 (1.10–1.21)**	**1.20 (1.13–1.28)**	**1.12 (1.05–1.19)**
Family Affluence Scale (FAS)			
Low (ref)	1	1	1
Medium	**0.95 (0.92–0.99)**	0.99 (0.95–1.04)	**0.90 (0.86–0.95)**
High	0.95 (0.91-1.0)	**1.07 (1.00-1.13)**	**0.85 (0.80–0.90)**

*Statistically significant results are in bold

*Adjusted Odds Ratio for all variables list in the Table 2

***The highest educational level between the two parents

body image satisfaction, age, sex, self-rated health, and sociodemographic characteristics were examined. The analysis was performed on a representative sample of 89,321 Italian adolescents aged 11–17 years.

Regarding BMI, approximately 75.0% of our sample was of normal weight, 17.6% were overweight, and 4.1% were obese. Differences by sex and age were observed, aligned with international HBSC data [5],

Our results highlighted that 57.6% of the Italian adolescents considered their body weight "about right", while nearly one-third perceived themselves "too fat"; a larger proportion of girls perceived themselves as too fat compared to boys (36.5% vs. 23.7%), whereas boys were more likely to consider themselves too thin (16.0% vs. 8.7%). Body image perception tended to worsen with age, a finding consistent with the most recent international HBSC report (2022) on youth body image [5].

The results of our study also indicated that more than half of adolescents correctly gauged their body weight (63.8%). Overall, 17.6% of teenagers overestimated and 18.6% underestimated their weight. Consistent with previous research [6, 21, 31, 32], weight overestimation occurred more frequently in girls (26.3%) than in boys (9.3%), whereas underestimation was more common in boys (26.0% vs. 10.7%). As reported in literature, differences in the pubertal timing and puberty-related changes might explain this sex gap. During this period, girls typically experience increases in body weight and fat mass, possibly widening the gap between their body shape and cultural beauty ideals. Conversely, boys tend to build muscle mass during maturation, matching widely accepted body norms [33]. In general, adolescents' misperception of their body weight decreased with increasing age [34].

Regarding adolescents' self-perception of health, our findings highlighted a marked decline in their perception of excellent health between ages 11 and 17. Additionally, girls were less likely than boys to report feeling in excellent health. These results were in line with the 2022 international HBSC survey [35]. It is difficult to establish

a directional relationship between self-rated health and self-body weight perception [18]; indeed, some evidence indicates a complex interplay where perception influences health behaviours and outcomes, and health status may also affect self-perception. Individuals with inaccurate perceptions of their body weight are more likely to experience poor self-rated health, and vice versa [18, 36].

Our study showed a strong association between self-rated health and self-body weight perception; in particular, it was evident that adolescents with fair or poor health perception were more likely to have a major misperception of their weight. According to our results, other studies have documented the association between these two dimensions. Neumark-Sztainer et al. (2006) [37] found that adolescents who perceive their health as fair or poor tend to have a higher likelihood of perceiving their weight inaccurately, often underestimating or overestimating it. Similarly, among adolescents, an incorrect perception of body weight and the adoption of unhealthy lifestyles have been observed in relation to a low perception of their health, according to Bodde et al. (2014) [8]. Paxton et al. (2006) [38] found that body dissatisfaction was a risk factor for depressive mood and low self-esteem in both girls and boys but in different phases of adolescence. Another study noticed an association of accurate perception of body weight with healthier behavioural patterns and improved health outcomes [39].

Finally, our results suggest that social and cultural context, such as family income, may influence adolescents' behaviours and health perceptions; these findings support existing evidence in the literature [37].

Adolescents from non-Western cultures often hold perceptions of the ideal body size that can differ from Western norms. When these adolescents are exposed to Western media, they may encounter conflicting standards, which can lead to an overestimation of their weight as they strive to align with the Western thin ideal [40]. This tendency is particularly pronounced among adolescents whose parents are foreign-born; immigrant families often uphold cultural perceptions of body size and health that influence their youth's body image [41].

In line with other study [37], our findings underlined that the High FAS is a protective factor against weight underestimation. In general, individuals with higher socioeconomic status mostly have higher health literacy, enabling them to better understand health information, including weight status [42]. Higher socioeconomic status often correlates with increased access to health education, resources, and supportive environments that promote accurate health perceptions [22]. Consequently, individuals with greater affluence are better equipped to recognize health risks and adopt appropriate health behaviours; for example, adolescents from higher-income families are more likely to engage in regular physical activity and other healthy habits, which correlates with better awareness of healthy weight ranges [22, 43, 44].

Given that inadequate weight assessment may have several adverse consequences for adolescents' health [6, 9–14, 38], identifying the individual and social factors involved in this tendency should be fundamental to improving educational and intervention strategies [6]. Our results contribute to understanding sex and age differences in adolescents' perception of weight and health, supporting the need for targeted, evidence-based interventions.

Strengths and limitations

The HBSC study enables both national and international comparisons, as well as trend analyses over time. The International protocol and measurement instruments are validated and reliable, ensuring that the data accurately represent adolescents within the target age groups (11, 13, 15, and 17 years). Furthermore, the response rate among Italian adolescents (97.3%) and school (88.8%) participation rate for the national HBSC survey were remarkably high.

The HBSC study encounters specific limitations associated with its cross-sectional methodology, which limits the capacity to determine directional relationships among determinants. Furthermore, a significant limitation arises from the reliance on self-reported data, which may introduce response bias. Among adolescents self-reported height and weight might cause discrepancies from direct measurements. However, self-reported BMI can be a useful surveillance tool for monitoring obesity trends in adolescent populations, especially when direct measurements are impractical. Moreover, the utility of self-reported data lies in its cost-effectiveness and feasibility for large-scale monitoring, which is crucial for public health surveillance [45, 46].

Finally, our analysis did not account for the pubertal timing, which might be an important factor influencing body weight perception during adolescence. Puberty is a critical developmental period characterized by rapid physical, hormonal, and psychological changes that can significantly impact adolescents' body image and self-esteem [47]. Variability in pubertal timing—early, on-time, or late maturation—has been associated with differences in body composition, such as adiposity and muscle development, which in turn affect how adolescents perceive their bodies [33]. Moreover, the developmental changes associated with puberty exhibit differently in girls and boys: whereas girls typically experience an increase in adipose tissue, boys tend to show a reduction in body fat accompanied by a growth in muscular mass [48]. Such sex-specific physiological and morphological variations may significantly influence body perception and, in turn, contribute to diverse trajectories

of overall well-being [49]. Future research should include information to assess pubertal timing providing a clearer understanding of the developmental processes influencing body image during adolescence.

Conclusions

Overall, our findings corroborate existing literature: body weight misperception decreases with increasing age, girls tend to overestimate their weight, and boys tend to underestimate it. Furthermore, the results highlight that a higher family socio-economic status appears to act as a protective factor for accurate body weight perception, while poor self-rated health is associated with an increased risk of misperception. Sex differences represent an important aspect to consider when designing sex-specific interventions in public health. Additionally, the overall perception of health among adolescents seems to influence their lifestyle choices, although a bidirectional relationship between perceived health status and behaviours should also be considered.

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Author contributions

S.C., P.N. conceptualized and designed the study; D.P. analysed the data; S.C., P.N., D.P., I.B. wrote the first draft; S.C., P.N., D.P., I.B contributed to the interpretation of data and reviewed the manuscript; S.C., P.N., D.P., I.B., S.A., P.D., G.L., A.V. critically reviewed the manuscript and approved the final version. All authors have read and agreed to the published version of the manuscript.

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Data availability

The data presented in this study are available in accordance with the 2022 Italian HBSC data access policy. Requests should be directed to the Principal Investigator, Dr. Paola Nardone (paola.nardone@iss.it).

Declarations

Ethics approval and consent to participate

The Italian HBSC study protocol and questionnaire 2021/22 were formally approved on 15 November 2021 by Ethics Committees of the Italian National Institute of Health (AOO-ISS-22/11/2021–0040602 Class: PRE BIO CE01.00). Informed consent was obtained from all the subjects involved in the study. The data collection was anonymous, and no directly identifiable information on individual pupils was collected. Passive consent was obtained from the parents of adolescents involved in the study.

Consent for publication

The authors have obtained consent to publish from the survey participants.

Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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