HEALTH PROMOTION.

There is a correlation between nutritional status, Self-Rated Health and Life Satisfaction? Evidence from 2018 Health Behaviour in School-aged Children cross sectional study in a sample of Italian adolescents living in Tuscany Region

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Keywords

Obesity • Self-Rated Health • Life Satisfaction • Adolescents • Mental well-being

Summary

Background. *Overweight has been associated with several social and phycological problems and is perceived as one of the major health care challenges to focus on in the future. The purpose of the study is to investigate the correlations among nutritional status, assessed by the Body Mass Index, the perception of one's own health status and Life Satisfaction, detected in Italian adolescents living in Tuscany Region, and to investigate the influence of gender on them.*
Methods. *A statistically representative sample of 2760 Tuscan adolescents aged 11, 13 and 15 was involved in the 2018 Health Behaviours at School-aged Children survey. The participants were divided into three nutritional status class: underweight, normal weight and overweight (overweight + obese).*
Results. *The results show that there is a statistically significant difference in all categories between boys and girls aged 13 and 15 years; in girls aged 11 and 13 years, the Life Satisfaction of the overweight group is statistically lower than that of normal and underweight groups; Self-Rated Health is statistically lower in all age groups for overweight individuals compared to normal weight children, except for 11-year-old females.*
Conclusions. *Viewing the psychosocial problems related to overweight, more attention and care must be placed on adolescents to ensure their healthier development.*

Introduction

Adolescence is a unique developmental period representing the transition between childhood and adulthood and is characterized by great challenges and important physical and physiological changes. The quality of physical, social and nutritional environments may change trajectories of health [1-3]. Likewise, adolescence is also a "high-risk period" for weight gain. The World Health Organization (WHO) reports that one in three school-aged children, one in four adolescents and almost 60% of the adult population are overweight or obese [4].
Overweight and obesity cause more than 1.2 million deaths across the WHO European Region every year and are also the leading behavioural factor increasing the risk for disability. Prevalence of overweight and obesity among children and adolescents aged 5-19 has dramatically increased from 4% in 1975 to over 18% in 2016. Studies shows that the early childhood obesity correlates with a higher probability in adulthood to incur not only obesity but also a higher incidence of disability or even premature death [5]. Obesity is a complex disease, with multifaceted determinants and health consequences, and is considered a serious public health issue globally [5, 6]. Studies described obesity as a well-recognized risk factor for impaired Self-Rated Health (SRH), with a negative influence on subjective well-being and Life Satisfaction (LS) in different age groups, including adolescents [7-11]. SRH (also known as self-reported health or self-perceived health) refers to a single-item health measure in which people rate the current state of their own health using a four- or five-point scale from excellent to poor [12]. It is being adopted widely for its simplicity and is commonly implemented in public health studies. Despite its subjective nature, SRH has proved to be a good predictor of future health care needs [13]. The SRH status represents an individual's perceived health. Respondents are usually asked a question such as, "How is your health?". It is necessary to be prudent in performing comparisons between SRH. First of all, SRH is subjective, and answers may be different between and within countries due to sociocultural differences. Second, the subjective

health status of the general population declines with increasing age. Comparable findings have been found in other studies, which have shown that age is a risk factor for poor SRH [14, 15].

Well-being generally includes global judgments of LS, a concept associated with numbers of factors such as personal indicators, familiar and peer relationship factors [16, 17]. Since BMI is connected to many aspects of an individual's life, it is likely to have direct or indirect effects on person's overall LS. Indeed, overweight and obesity have been associated with lower subjective LS, with a deep impact on women. This trend has been observed also in teenage girls where lower level of LS is recorded compared to teenage boys [9, 10, 17-20]. Furthermore, body image (BI) is also strongly linked to LS. In the society, BI is recognized as the main cause of adolescent stress together with beauty. Specifically, BI becomes important in the adolescence development of one's self-concept and has an influence on self-esteem and interpersonal relations with peers [21]. Based on that, it is predictable that the higher the weight and the worse the BI, the worse the psychosocial indicators will be, and consequently, the subjective or perceived quality of life and LS [11, 18].

This study aimed to investigate the relationship between nutritional status, SRH, and LS in Tuscany Region Adolescents, as part of the Italian Health Behaviour in School-Aged Children (HBSC) survey.

Materials and methods

This study is based on the Italian HBSC 2018 study. HBSC is a WHO Collaborative Cross-National Survey run every four years. The sampling procedure and study methodology followed regularly updated international research guidelines [22]. As for the Italian Country, the Ministry of Health and the Ministry of Education have adopted HBSC as the national referral surveillance for adolescents. Therefore, the national sample was increased to reach regional representativeness [23]. According to the protocol, the school class was the primary sampling unit, and the participating schools were identified via systematic sampling from the Ministry of Education, University and Research list of all public and private schools. The final analytical Tuscany Region sample included 2760 adolescents aged 11, 13, and 15 years old [23]. A descriptive and cross-sectional study was designed. The research involved 2760 Tuscan adolescents (51.1% boys) of 11, 13 and 15 years old. A stratified multistage cluster random sampling method was used to recruit the participants.

When the participants' BMI data were coded, they were then grouped into the following three categories, using WHO standard deviation of BMI z score's reference: underweight (sd: < -2), normal weight ($-1 \leq$ sd < 1), overweight (sd: > 1), obese (sd: > 2) [24]. The Italian HBSC study protocol and questionnaire were formally approved by the Ethics Committee of the Italian National Institute of Health (PROT-PRE876/17, 20 November 2017).

The subjects completed the HBSC questionnaire [23], which evaluated, in addition to sociodemographic variables, the three variables under analysis.

Nutritional Status class. This was evaluated using the BMI, which was obtained through the weight and height data that was self-reported by the participants and calculated by the following equation: kg/m2. The validity of self-reported data in obtaining BMI in studies with children and youth has already been supported in previous research [25, 26]. According to their BMI, participants were grouped into the following categories: underweight, normal weight and overweight (which includes overweight and obese).

Self-rated health (SRH). The SRH measure assesses perceived health status. SRH was measured by the item "Would you say your health is?" (Response options were: "Excellent"; "Good"; "Fair" and "Poor").

Life Satisfaction (LS). To evaluate this variable, the Cantril Scale [27] was used, which is also included in the HBSC questionnaire. It consists of the following single item: "In general, where on the ladder do you feel you stand at the moment?" Responses range from 0 ("Worst possible life") to 10 ("Best possible life").

Data analysis

In order to determine whether there were differences in the variables under analysis (SRH and LS) based on participant gender, T-tests and Mann-Whitney test were performed. Additionally, an Analysis of Variance (ANOVA) and Krsukal-Wallis's test were carried out after checking the homogeneity between the groups, to determine whether there were mean differences in these variables based on the adolescents' weight category. The homoscedasticity assumption was checked using Levene's test. For the post hoc analysis of the differences found, the Bonferroni's correction test was performed. To study the effect of how weight status and gender interact in the variables under analysis, a multivariate ANOVA was carried out for LS. In all the analyses regarding differences, effect sizes (using Cohen's d, Eta-squared and Epsilon-squared) were examined with the corresponding tests. In order to determine whether there was a relation between categorical variables, a Chi-square test and Cramer's V to check the intensity of relation were used. All statistical analyses were performed using SPSS Version 22.0 for Windows (IBM Corp, Armonk, NY, USA).

Results

Descriptive analysis

Table I shows the sample distribution based on age, gender and BMI groups to which the participants belong. The results from Chi-square test, concluded that there was a statistically significant relationship between gender and BMI in general and in all age categories in the current sample ($p < 0.001$). As we can see, from the

Tab. I. Distribution of the sample according to the weight status of the participants, stratified by age-category and gender.

Age	N (%)	Sex	N (%)		Weight status		χ^2	Cramer's V
				Underweight	Normal weight	Overweight + obese	P[C]	
11	836 (30.3)	Boys Girls Total	427 (51.1)[A] 409 (48.9)[A] 836 (100)[A]	63 (14.8)[B] 78 (19.1)[B] 141 (16.9)[B]	234 (54.8)[B] 275 (67.2)[B] 509 (60.9)[B]	130 (30.4)[B] 56 (13.7)[B] 1868 (22.2)[B]	<.001	0.202
13	936 (33.9)	Boys Girls Total	467 (49.9)[A] 469 (50.1)[A] 936 (100)[A]	63 (13.5)[B] 76 (16.2)[B] 139 (14.9)[B]	281 (60.2)[B] 333 (71.0)[B] 614 (65.6)[B]	123 (26.3)[B] 60 (12.8)[B] 183 (19.6)[B]	<.001	0.171
15	988 (35.8)	Boys Girls Total	515 (52.1)[A] 473 (47.9)[A] 988 (100)[A]	55 (10.7)[B] 74 (15.6)[B] 129 (13.1)[B]	355 (68.9)[B] 357 (75.5)[B] 712 (72.1)[B]	105 (20.4)[B] 42 (8.9)[B] 147 (14.9)[B]	<.001	0.169
Total	2760 (100)	Boys Girls	1409 (51.1)[A] 1351 (48.9)[A]	181 (12.8)[B] 228 (16.9)[B]	870 (61.7)[B] 965 (71.4)[B]	358 (25.4)[B] 158 (11.7)[B]	<.001	0.177
		Total	2760 (100)[A]	409 (14.8)[B]	1835 (66.5)[B]	516 (18.7)[B]		

[A] Percentage by Colum; [B] Percentage by Row; [C] Comparison between boys and girls.

Table I shows the results of all the participants, as well as boys and girls separately, by age category, for the variables under analysis, *i.e.*, Self-Rated Health (SRH) and Life Satisfaction (LS), based on the BMI category to which they belong.

values of Cramer's V, this association is weak in general (0.18) and in all age categories, also we noticed a major intensity in 11 years-old category (0.20).

LS and SRH based on adolescent gender

Student's t-test results show that there was a statistically significant difference between boys and girls in general and in 13 years-old and 15 years-old in the mean LS, with a very small effect size in general (Cohen's d = 0.17) and with a small effect size in 13 years-old (Cohen's d = 0.30) and 15 years-old (Cohen's d = 0.23). Similarly, SRH showed significant differences as well: in fact, there was a very small effect size in general (Cohen's d = 0.09), in 13 years-old (Cohen's d = 0.12) and 15 years-old (Cohen's d = 0.17). As shown in Table II, boys had higher LS (7.65 *vs* 7.34) than girls in general and in 13 years-old (7.82 *vs* 7.30) and 15 years-old (7.37 *vs* 6.93), as well as higher levels of SRH than their girls' peers (mean of rank statistics not showed in the table).

Comparing LS by weight status, we observe a significant difference between boys and girls in 13 years-old (Underweight, medium effect size, Cohen's d = 0.60 - Normal weight, small effect size, Cohen's d = 0.28 - Overweight small effect size, Cohen's d = 0.39) and 15 years-old (Normal weight, small effect size, Cohen's d = 0.28). Considering the sample as a whole, a significant difference is observed (in Underweight, very small effect size, Cohen's d = 0.20 - Normal weight, very small effect size, Cohen's d = 0.17 - Overweight, small effect size, Cohen's d = 0.30).

Comparing SRH and weight status, we observe a significant difference between boys and girls in 11 years-old (Normal weight, very small effect size, Cohen's d = 0.09), 13 years-old (Underweight, small effect size, Cohen's d = 0.30 - Normal weight, very small effect size, Cohen's d = 0.11) and 15 years-old (Underweight, very small effect size, Cohen's d = 0.20 - Normal weight, very small effect size, Cohen's d = 0.19 - Overweight, small

Tab. II. Life Satisfaction (LS) and Self-Rated Health (SRH) based on age category, gender and weight status of the participants.

Variable	Weight Status	11 years old				13 years old				15 years old				Total			
		Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
		Mean	SD	Mean[b,c]	SD	Mean	SD	Mean[b]	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
LS	Underweight	7.86	1.80	8.25	1.80	8.08[a]	1.27	7.08[a]	2.00	7.04[a]	1.85	6.50[a]	2.38	7.68[a]	1.70	7.29 a	2.19
	Normal weight	7.99	1.81	8.03	1.71	7.86[a]	1.55	7.43[a]	1.51	7.44[a]	1.46	7.00[a]	1.61	7.72[a]	1.61	7.44 a	1.66
	Overweight+Obese	7.88	1.87	7.35	1.89	7.59[a]	1.43	6.87[a]	1.99	7.30[a]	1.58	7.10[a]	1.32	7.61[a]	1.66	7.10 a	1.80
	Total	7.93	1.82	7.98	1.77	7.82[a]	1.49	7.30[a]	1.67	7.37[a]	1.54	6.93[a]	1.74	7.65[a]	1.71	7.34 a	1.85
		Median[b,c]	IR	Median	IR	Median[b,c]	IR	Median[b]	IR	Median[b]	IR	Median[b]	IR	Median[b,c]	IR	Median[bc]	IR
SRH	Underweight	3.00	[3,4]	4.00	[3,4]	4.00[a]	[3,4]	3.00[a]	[3,4]	3.00[a]	[3,4]	3.00[a]	[3]	3.00[a]	[3,4]	3.00[a]	[3,4]
	Normal weight	3.00[a]	[3,4]	3.00a	[3,4]	3.00[a]	[3,4]	3.00[a]	[3,4]	3.00[a]	[3,4]	3.00[a]	[3]	3.00[a]	[3,4]	3.00[a]	[3,4]
	Overweight+Obese	3.00	[3]	3.00	[3,4]	3.00	[3,4]	3.00	[3]	3.00[a]	[3]	3.00[a]	[2,3]	3.00	[3,4]	3.00	[3,3.2]
	Total	3.00	[3,4]	3.00	[3,4]	3.00	[3,4]	3.00	[3,4]	3.00	[3,4]	3.00	[3]	3.00	[3,4]	3.00	[3,4]

[a] Boys > Girls, <.001; [b] Overweight < Normal weight.001; [c] Overweight < Underweight.001.

Table II Shows how Life Satisfaction (LS) and Self-Reported Health (SRH) are related to the age, gender and weight status of adolescents.

effect size, Cohen's d = 0.22). In general, we observe a significant difference (in Underweight, very small effect size, Cohen's d = 0.16 - Normal weight, very small effect size, Cohen's d = 0.13).
As shown in Table II, boys had higher LS in general (Underweight, 7.68 *vs* 7.29 - Normal weight, 7.72 *vs* 7.44 - Overweight, 7.61 *vs* 7.10), 13 years-old (Underweight, 8.08 *vs* 7.08 - Normal weight, 7.86 *vs* 7.43 - Overweight, 7.59 *vs* 6.87), 15 years-old (Underweight, 7.04 *vs* 6.50 - Normal weight, 7.44 *vs* 7.00 - Overweight, 7.30 *vs* 7.10) than girls, as well as higher levels of SRH than their girls' peers (mean of rank statistics not showed in the table).

SRH and LS based on adolescent weight status

ANOVA results show that adolescents' BMI groups differed in LS, only for girls in 11 and 13 years old ($p < 0.001$). Effect sizes for both age categories were very low ($\eta 2 = 0.022$ and $\eta 2 = 0.016$ respectively). The Bonferroni's test showed the existence of significant differences between underweight and overweight ($p = 0.011$, Cohen's d = 0.29), normal weight and overweight ($p = 0.025$, Cohen's d = 0.22) in girls of 11 years old, normal weight and overweight ($p = 0.047$, Cohen's d = 0.20) in female of 13 years old.
Regarding results obtained from Kruskal-Wallis's test in SRH, we observe a statistically significant difference in general and in all categories of age ($p < 0.001$). Effect sizes were very low in all categories: 11-years old, (Boys) $\varepsilon 2 = 0.077$, (Girls) $\varepsilon 2 = 0.016$, 13-years old, (Boys) $\varepsilon 2 = 0.024$, (Girls) $\varepsilon 2 = 0.017$, 15-years old, (Boys) $\varepsilon 2 = 0.020$, (Girls) $\varepsilon 2 = 0.019$, Total, (Boys) $\varepsilon 2 = 0.031$, (Girls) $\varepsilon 2 = 0.007$, Total, $\varepsilon 2 = 0.013$). The Bonferroni's test showed the existence of significant differences between: underweight and overweight ($p < 0.001$, Cohen's d = 0.29), normal weight and overweight ($p < 0.001$, Cohen's d = 0.22) in boys of 11 years old, underweight and overweight ($p = 0.008$, Cohen's d = 0.29), normal weight and overweight ($p = 0.029$, Cohen's d = 0.22) in boys of 13 years old, normal weight and overweight ($p = 0.030$, Cohen's d = 0.22) in girls of 13 years old, normal weight and overweight ($p = 0.004$, Cohen's d = 0.22) in boys of 15 years old, normal weight and overweight ($p = 0.006$, Cohen's d = 0.22) in girls of 15 years old, underweight and overweight ($p < 0.001$, Cohen's d = 0.29), normal weight and overweight ($p < 0.001$, Cohen's d = 0.22) in boys, underweight and overweight ($p = 0.044$, Cohen's d = 0.29), normal weight and overweight ($p = 0.006$, Cohen's d = 0.22) in girls, underweight and overweight ($p < 0.001$, Cohen's d = 0.29), normal weight and overweight ($p < 0.001$, Cohen's d = 0.22) in general group.
Regarding the effect of the interaction, no analysis was performed for SRH, because non-parametric methods did not permit this type of test.
Regarding LS, when effect of the interaction was studied by means of a multivariate ANOVA, we have found significant interaction between age category and weight status, age category and gender. No interaction was found between gender and nutritional status.

Discussion

The aim of the study was to investigate the relationship between nutritional status, SRH, and LS as mediators of the association between obesity and impaired psychological well-being in Tuscany adolescents.
Our data showed that there is a statistically significant relationship between gender and BMI in general and in all age categories in the current sample ($p < 0.001$); furthermore, Student's t-test results show that there was a statistically significant difference between boys and girls in general and in age category 13 years-old and 15 years-old in the mean LS; in addition, boys have higher LS than girls in general and in 13 and 15 year age groups, as well as higher levels of SRH than their female peers.
Comparing LS and SRH by nutritional status class, we observe for both constructs a significant difference between boys and girls in 13 years-old and 15 years-old; in general, we observe a significant difference in underweight class. These findings are in agreement with other studies reporting differences between obese and normal-weight adolescents [10, 11, 18].
In general, obese subjects are exposed to prejudice and discrimination impairing their quality of life and causing numerous consequences for their psychological and physical health. It has been estimated that obesity prejudice has increased by 66% over the past decade in the USA and Europe [28].
The high prevalence of childhood obesity is recognized as a global public health priority. It is estimated that obesity affects > 107 million children worldwide, with the prevalence of pediatric obesity in high-income countries exceeding 20% [29]. This represents a two- or threefold increase of obesity rates among children at the country-specific level within the past 40 years [29]. The effects of obesity on health can also be lifelong and lead to an increasing in the risk of developing chronic diseases and early mortality [30].
Immediate and long-term psychosocial health consequences, such as reduced self-esteem and depression, also arise in children with ponderal excess [31, 32]. Of note, mental health concerns are the most commonly reported health risk among children with severe obesity [33], emphasizing the importance of incorporating psychological interventions into other aspects of obesity care. Weight stigma has a considerable impact on children that can affect their physical, mental and psychological health [32, 34-36].
Weight stigma may be particularly damaging when experienced during childhood and adolescence, whose internalization can result in a chronic stress response in addition to adverse medical consequences [28, 37, 38]. Weight stigmatization strengthens unhealthy lifestyle behaviours that contribute to obesity and is an unlikely method to induce successful weight lost. In adults it has

been recognized as an important risk factor for depression, low self-esteem, and body dissatisfaction [28].
It is useful to raise public awareness regarding obesity as a risk factor, that obesity increase the risk of life-threatening diseases and chronic conditions. In order to transform public awareness regarding obesity it is necessary to focus on advocacy and calls to action, *e.g.* on childhood obesity and life perspectives, combined with a new approach to public education campaigns supported by structural interventions. Furthermore, it is crucial to improve obesity-related health literacy at the local level.
While obesity increases the risk of developing life-threatening diseases and chronic conditions, which negatively impacts people and families, it also puts a heavy burden on public health expense, which has a negative impact on the society [39, 40].
Studies on childhood obesity and parental health literacy indicate that 'health literacy is a potentially undetected determinant of obesity, due to its influence on parents' opinions about their child's weight loss strategies and health information-seeking preferences, as well as health awareness in general' [41]. Furthermore, low levels of health literacy are associated with several determinants of health in adolescence, including body weight [42]. Health literacy is also associated with lower levels of cardiovascular diseases risk factors such as high BMI, metabolic syndrome in women and fatty liver disease [43].
The lack of success on standard obesity control measures reveals the need to develop a new, non-stigmatising approach to public policy, guided by multi-professional teams. Tackling obesity requires the involvement of general practitioners and experts such as endocrinologists, nutritionists, psychologists, behavioural counsellors, and physical fitness specialists; these figures, as well as teachers, and school staff, can play a key role towards this objective.
Stakeholder coordination between health professionals and policy makers through multi-professional teamwork, is crucial to assessing the burden of disease as well as confronting barriers in seeking treatment and performing screening [44].
In 2020, the European Commission formally established obesity as a chronic disease and has committed to assigning high priority to obesity as a major non communicable disease (NCD). Furthermore, measures have been implemented that will effectively deal with obesity as a chronic disease, including policy interventions that go beyond primary prevention and guarantee long-term and lifelong management [5]. Since 2021, the Model European Parliaments' (MEP) Informal Interest Group on Obesity and Resilient Health Systems has focused on the promotion of obesity as an NCD [5]. Conducting regular and continuous surveillance will have the potential to support policies and action plans to better monitor and assess the impact of diseases, and to measure the effectiveness of health policy interventions [45]. The groups' aspiration is to guarantee that obesity is accepted as a chronic disease based on its own definition, scope, and the way it is treated above and beyond primary prevention within policy instruments. The group also looks forward and considers resilient health systems and ecosystems in a more comprehensive sense beyond obesity.
Limitations of the study include the cross-sectional nature of the study, in this kind of study it is not possible to identify the temporal link between the outcome and the exposure because both are examined at the same time, and self-reported nature of the data, although under the supervision of teachers. Even more, the use of BMI as the sole measure to define overweight and obesity has its limitations, adding to the fact that the criteria for assessing obesity can change significantly depending on the references we consider. Therefore, could be important to harmonize these international standards for the categorization of childhood obesity.

Conclusions

More attention and care must be given regarding the psychosocial problems related to being overweight in adolescence; this is a very complex and delicate phase of development crucial to assure healthy development.
Future work is also required to better comprehend environmental influences on obesity. In addition to individual factors, work needs to better understand how other elements could influence risk of obesity. To this regard it could be useful to investigate why overweight boys have a higher LS than girls. Digital environments are another key factor in influencing health, and greater efforts needs to limit advertising unhealthy products online, especially for children and adolescence.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

GL: Conceptualization. AP: methodology and formal analysis. DL, VM, RS, LZ, GL: investigation. DL, AP, GL: data curation. CMT, DL, GL: writing - original draft preparation. DM, IM, TG: writing - review and editing; DL, AP, GL. visualization. GL: supervision and project administration. All authors have read and agreed to the published version of the manuscript.

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