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Posted Date: 14 November 2023

doi: 10.20944/preprints202311.0908.v1

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A Close Relationship between Weight Status, Health-Related Quality of Life, and Risk Behaviors in a Sample of Italian Late Adolescents

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Abstract: Adolescents experience rapid physical, cognitive, and psychosocial growth with different factors that contribute to health and well-being. In this view, an important role is played by body weight and its perception. The aim of this study was to determine, in a sample of Italian late adolescents, whether health related quality of life (HRQoL) is associated with the different weight status categories (underweight, normal weight, overweight, obese), even considering sex differences. Data were collected from 1826 adolescents (n = 735 males). HRQOL was analyzed using the Italian version of KIDSCREEN-52. Overweight adolescents showed a reduced psychological well-being ($p < 0.05$) and self-perception ($p < 0.05$), then other BMI categories. Subjects with obesity reported an increased bullying victimisation ($p < 0.05$), reduced self-perception and eating disorders ($p < 0.001$), while underweight were characterised by an altered adherence to the Mediterranean diet ($p < 0.001$), eating disorders ($p < 0.001$), and problematic use of social media ($p < 0.05$). No sex differences were found, except for socio-economic status perception, where underweight girls reported a higher economic well-being than boys ($p < 0.05$). Our results may suggest that there is an association between weight status categories and HRQoL, more pronounced in underweight and overweight adolescents. The association between BMI categories and psychosocial dimensions opens the need to define specific domains on which such preventive interventions should focus, always through a personalized perspective.

Keywords: health; bodyweight; well-being; adolescents; HRQoL; school

1. Introduction

Adolescence, the phase of life between childhood and adulthood, is traditionally considered as a healthy stage of life; however, it represents a vulnerable period for psychological, physical, and social outcomes [1]. Adolescents experience rapid physical, cognitive, and psychosocial growth and these neurobiological changes predispose on the one hand to behavioral patterns, related to diet, substance abuse, and lifestyle habits, that can protect their health, but on the other hand, these same behaviours can represent risk factors and, in the medium and long-term future, disease. Generally, numerous variables essentially linked to lifestyle habits or social context protect or undermine adolescents' health. Among the other factors influencing the perception of health and well-being, an important role is played by body weight and its perception, both in the case of underweight and overweight [2,3]. It is well recognized that overweight and obesity in adolescents are associated with an increased risk of psychological diseases, behavioral, social, and emotional problems, with consequent impairment of quality of life [4]. Less evidence is present on the psychosocial effects of being underweight, although it seems to indicate internalizing problems, in particular depression and socially withdrawn behavior [5]. However, underweight girls usually present a greater

 doi:10.20944/preprints202311.0908.v1

perception of well-being. This may contribute to the onset of eating disorders, characterized by altered self-esteem, body image, and social media use [6,7]. The body image (BI) construct, considered in recent years one of the most influential factors affecting psychosocial well-being [8] is associated with body weight perception. This is because body image is composed of different facets, perceptual, affective, cognitive, and behavioural [9]. Moreover, an altered body image is related to unhealthy weight control behaviors, lower levels of physical activity, and reduced social relationships [10]. On the contrary, a proper body image has a protective role towards lifestyle habits and reduces the possibility of suffering from being underweight and overweight [11].

Besides lifestyle habits, traditionally linked to diet and physical activity, the literature has made the effort to find other moderators in the body weight control, referring for instance to classic risk behavior, but the evidence is still fragmentary.

Thus, taking into account these aspects, the present study conducted on a sample of Italian late adolescents, has the following aims: first, we aimed to investigate health-related quality of life (HRQoL) dimensions associated to different BMI categories, both in general population and by sex. We hypothesized that underweight, overweight and obesity would show reduced HRQoL compared to normal weight counterpart. Second, we considered sex differences possibly involved in this relationship.

2. Materials and Methods

Partecipants and Procedures

Data were collected between 2022 and 2023 from the platform of the AVATAR project "A new purpose for promotion and eVAluation of healTh and well-being Among healthy teenageRs" developed by the Institute of Clinical Physiology of the CNR, on a sample of 1908 students [12]. Of the initial population, 82 students were excluded for the following reasons: diagnosed neuropsychiatric or other diseases (n = 9), absence of sign informed consent (n = 48), questionnaires not filled (n = 15), internet connection problems (n = 10). Therefore, the final population consisted of 1826 adolescents. Participants were instructed on how to complete the questionnaires and all tests were performed during school hours. In every school class, all the adolescents filled out the questionnaire, and whether they were not eligible due to exclusion criteria reasons were excluded from the study retrospectively. Participants were previously instructed on how to complete the questionnaires and conduct the tests. One or two project members visited each school to provide the adolescents with verbal and written information about the data collection. All tests were conducted during participants' computer lessons during school time. No incentive was provided to adolescents or parents. A research assistant was available to provide information and technical support to complete questionnaires.

Ethics

All procedures performed in the study were by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The AVATAR project has been accepted by the Regional Pediatric Ethics Committee (Azienda Ospedaliero Universitaria Meyer) (code 166/2018).

Measures

Weight and height were collected in self-assessment. Body mass index (BMI) was calculated as weight (kg)/height (m^2). Adolescents aged <19 were classified into four weight categories: underweight, normal weight, risk of overweight, and obesity, based on the BMI cut-off points for children, approved by the International Obesity Task Force (IOTF) [13]. Adolescents aged >19 were instead classified into four weight categories according to the traditional nomenclature: underweight, normal weight, overweight, and obesity based on the adult BMI cut-off points [14].Data concerning risk factors were collected in self-assessment through a series of questions. In particular, questions were administered with dichotomous "yes/no" answers concerning smoking, cannabis use,

 doi:10.20944/preprints202311.0908.v1

substance use, psychotropic drug use, alcohol consumption, sexual intercourse, and contraceptive use. If the response to the presence of one of these risk behaviors was positive, the frequency with which this behavior was practiced was also asked.

The Italian version of KIDSCREEN-52 was used to assess health-related quality of life (HRQoL) [15,16]. The KIDSCREEN is a self-report questionnaire designed to address health-related quality of life. It aims to monitor and measure the personal experiences of children and adolescents about their perception of health status and well-being. The questionnaire, which describes physical, psychological, mental, social, and functional aspects of well-being, consists of 52 items grouped in 10 dimensions (Physical well-being, Psychological well-being, Moods and emotions, Self-perception, Autonomy, Parent relations, and home life, Social support and peers, School environment, Social acceptance (bullying), Financial re-sources) [15,16]. Some sample items are "In general, how would you say your health is?" for the Physical well-being dimension; "Have you felt satisfied with your life?" for Moods and emotions; "Have you been happy with the way you are?" for Self-perception. Cronbach's alphas are ranging from 0.77 to 0.89 for the dimensions of the 52-item version. Except for the mood and bullying dimensions, higher values of the variables express a better health-related quality of life. KIDSCREEN questionnaires are psychometrically tested using data from a multicenter European study that included a sample of 22.827 children recruited in 13 countries [17].

Dietary habits were evaluated using the Mediterranean Diet Quality Index for children and adolescents (KIDMED) [19]. The KIDMED index was based on principles sustaining Mediterranean dietary patterns as well as those that undermine it (for example, "Every day I eat fruit or freshly squeezed fruit juice", "Regularly once a day would consume fresh and cooked vegetables", "I eat pasta and rice almost every day (5 or more per week)". The index ranged from 0 to 12, and consisted of a self-administered 16-question test. The validity of the KIDMED index is demonstrated by the evidence that a higher score is associated with the expected patterns of food and nutrient intake representative of a good quality diet. (Cronbach's alpha = 0.79, 95% CI: 0.71–0.77). Physical activity levels were assessed using the Physical Activity Questionnaire for Older Children (PAQ-C). The questionnaire provides a general measure of physical activity for 8- to 20-year-olds. The PAQ-C is a self-administrated questionnaire consisting of nine items rated on a five-point scale. (e.g., "In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?", "In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active?", "On the last weekend, how many times did you do sports, dance, or play games in which you were very active?"). The average of the items is used to create the final PAQ summary score, a higher score indicates more active children/adolescents. Previous studies have supported the validity of the PAQ instrument for assessing general levels of physical activity. Validation studies have found the PAQ-C to be highly reliable (Cronbach alphas ranged from 0.72 to 0.88).

Experiences in the use of social media over the past year were evaluated with Bergen Social Media Addiction Scale (BSMAS), containing six items reflecting core addiction elements (i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse) [18]. Eating attitudes and behaviours were assessed using EAT-26 consisting of three subscales: Dieting, eating preoccupation and oral control [19].

Statistical Analysis

Statistical data analysis was performed using SPSS. Data are presented as mean ± SD. Categorical variables were presented as counts and percentages. Differences in BMI and HRQoL by sex were analyzed using Student's unpaired t-test. Two-way analysis of variance (ANOVA) was used to examine differences in KIDSCREEN-52 dimension scores across sex and BMI categories (assuming a linear trend), while also testing for sex*BMI interaction effects. Levene's test was used to assess homogeneity of variances across gender groups and BMI categories, and the Welch test was used in the presence of heteroscedasticity. Sensitivity analyses performed after combining overweight subjects with subjects with obesity yielded similar results. A p-value ≤ 0.05 was considered statistically significant.

 doi:10.20944/preprints202311.0908.v1

3. Results

Socio-demographic characteristics of study population

Table 1 shows the demographic characteristics and BMI categories of the entire cohort of 1826 participants (60% girls) included in the analyses. On average, boys had a higher BMI compared to girls ($p < 0.01$).

When we considered the different BMI categories, expressed as the percentage of boys and girls who were underweight, normal weight, overweight or with obesity, boys were more likely to be overweight or with obesity, while girls were more likely to be underweight ($p < 0.001$).

Table 1. Demographic characteristics and BMI classification of the study population, total and by sex.

VARIABLES	Total (*n* = 1826)	Boys (*n* = 735)	Girls (*n* = 1091)	*p* value
Age, (years)	16.85 ± 1.49	16.92 ± 1.52	16.81 ± 1.46	ns
BMI (kg/m²)	21.33 ± 4.64	21.69 ± 3.23	20.71 ± 2.80	<0.01
Underweight	120(6)	51(7)	69(6)	
Normal weight	1511(83)	576(78)	935(86)	
Overweight	148(8)	76(10)	72(7)	
Obesity	47(3)	32(4)	15(1)	<0.001

Data are expressed as mean ± standard deviation (SD) or number (%). BMI: body mass index, ns: not significant. For BMI categories, p is referred to χ^2 test.

Sex differences on HRQoL and risk behaviors

Descriptive data of health-related quality of life in our population divided by sex are shown in Table 2. Regarding HRQoL, several variables differed significantly according to sex. Compared to girls, boys perceived better physical well-being ($p < 0.001$), emotional status ($p < 0.001$), self-perception ($p < 0.001$), autonomy ($p < 0.001$), relationship with parents ($p < 0.001$), and school environment ($p = 0.01$). Regarding risk behaviors (Table 3), boys reported a more pronounced adherence to the Mediterranean Diet than girls ($p < 0.001$), a normal use of social networks, while the female counterpart showed a problematic use ($p < 0.001$) and no perception of eating disorders as compared to girls ($p < 0.001$).

Table 2. Sex differences in health-related quality of life variables.

VARIABLES	Boys (n = 735)	Girls (n = 1091)	p-value
Physical wellbeing	57.93 ± 17.01	44.23 ± 16.09	<0.001
Psychological wellbeing	36.45 ± 6.5	34.05 ± 6.93	<0.001
Mood/Emotion	43.2 ± 8.98	38.34 ± 9.05	<0.001
Self-perception	45.68 ± 7.84	40.14 ± 8.79	<0.001
Autonomy	42.34 ± 9.76	38.99 ± 8.99	<0.001
Parent relationship	44.55 ± 10.09	42.07 ± 10.66	<0.001
Financial resources	48.56 ± 9.71	48.79 ± 9.61	0.634
Peers	45.88 ± 10.49	45.18 ± 9.81	0.156
School environment	42.31 ± 7.79	41.39 ± 7.03	=0.01
Social acceptance (Bullysm)	49.53 ± 10.87	49.79 ± 9.9	0.608

Data given as mean ± SD (95% CI). Data on the KIDSCREEN-52 dimension are calculated as the mean T-scores according to KIDSCREEN Group. p-values were calculated via Student's unpaired t-test.

 doi:10.20944/preprints202311.0908.v1

Table 3. Sex differences in risk bevaviors.

VARIABLES	Boys (n = 735)	Girls (n = 1091)	p-value
KIDMED	8.06 ± 3.33	7.87 ± 2.62	<0.001
PAQ-C	2.55 ± 0.72	2.14 ± 0.69	0.329
BSMAS	12.95 ± 4.51	15.03 ± 5.22	<0.001
EAT-26	10.62 ± 11.11	13.07 ± 12.13	<0.001

Data given as mean ± SD (95% CI). KIDMED: Mediterranean Diet Quality Index for children and adolescents; PAQ-C: Physical Activity Questionnaire for Older Children; BSMAS: Bergen Social Media Addiction Scale; EAT-26: Eating attitudes and behaviours. p-values were calculated via Student's unpaired t-test.

Relationship between weight status categories and HRQoL in total population and by sex

The results of the analysis of health-related quality of life in the total population and by sex according to BMI categories are shown in Table 4. In our sample, belonging to one of the BMI categories influences the perception of psychological well-being ($p = 0.04$), particularly overweight subjects showed a lower score in this dimension compared to normal weight counterparts. BMI categories are also associated with the self-perception ($p = 0.003$), especially overweight and with obesity adolescents reported lower scores compared to underweight and normal weight subjects. Also, BMI was inversely associated with the perceived quality of financial resources ($p < 0.001$), with underweight and normal weight having a higher score compared to overweight and obese. BMI classification correlated with peer relationships ($p < 0.001$) and bullying behavior ($p = 0.003$); in both categories, underweight and obese adolescents reported lower levels of these variables. For lifestyle habits, physical activity ($p = 0.002$) and Mediterranean diet ($p = 0.001$) correlated with BMI classes; underweight students showed a reduction in these healthy behaviors as compared to the other categories. Examining the impact of gender and BMI categories on HRQoL levels, only the perception of financial resources decreased with increasing BMI, but more in females than in males ($p = 0.001$).

Table 4. BMI categories according to Health-related quality of life dimensions in total population and by sex.

TOTAL POPULATION	Physical wellbeing	Psychological wellbeing	Mood Emotion	Self-perception	Autonomy	Parent relationship	Financial resources	Peers	School environment	Bullysm
Underweight 120(6)	46.1 ± 18.1	34.2 ± 8.3	39.9 ± 11.2	42.2 ± 10	39.1 ± 10.9	42.5 ± 12.2	49.1 ± 10.8	42.8 ± 9.4	41.7 ± 8.7	48.1 ± 10.8
Normal weight 1511(83)	50.2 ± 26.9	35.2 ± 6.5	40.3 ± 9.1	42.6 ± 8.7	40.5 ± 9.1	43.3 ± 10.4	49 ± 9.5	46 ± 9.9	41.8 ± 7.2	50 ± 10.1
Overweight 148(8)	47.4 ± 26.5	33.8 ± 8.5	39.7 ± 10.2	40.7 ± 9.6	39.3 ± 9.7	41.9 ± 10.2	45.9 ± 9.4	43.3 ± 11.3	41.3 ± 7.5	49.3 ± 10.9
Obesity 47(3)	49.1 ± 36.4	34 ± 7.9	40.8 ± 8.5	38.8 ± 6.1	39.8 ± 13.9	41.3 ± 11.4	46.1 ± 9.2	42.9 ± 11.7	41.7 ± 7.8	45.0 ± 11.8
p	0.30	=0.04	0.82	=0.003	0.20	0.29	<0.001	<0.001	0.89	=0.003
BOYS										
Underweight 52(8)	51.5 ± 24.8	36.9 ± 7.7	43.5 ± 11.5	45.8 ± 7.3	40.5 ± 12.3	43.4 ± 11.9	47.4 ± 12	42.7 ± 9.2	42.1 ± 9.9	47.9 ± 10.5
Normal weight 577(78)	44.6 ± 16	36.6 ± 6.1	43.4 ± 8.8	46 ± 7.9	42.7 ± 9.3	45 ± 9.9	49 ± 9.5	46.7 ± 10.4	42.2 ± 7.6	49.8 ± 10.9
Overweight 73(10)	51.9 ± 29.5	35.3 ± 7.8	42.3 ± 8.5	45.2 ± 8.2	41.3 ± 9.8	40.8 ± 11.1	46.5 ± 9.6	43 ± 10.1	42.9 ± 7.3	49.8 ± 10.9
Obesity 33(4)	36.5 ± 8.1	35.1 ± 8.6	42.1 ± 9.2	40.8 ± 5.4	41.8 ± 13	42.9 ± 12.8	46.9 ± 9.2	42.3 ± 12.3	42.3 ± 8.4	46 ± 10.9
GIRLS										
Underweight 69(6)	42.2 ± 9	32.3 ± 8.3	37.3 ± 10.3	39.6 ± 10.9	38 ± 9.7	41.9 ± 12.4	50.3 ± 9.8	42.9 ± 9.7	41.3 ± 7.7	48.2 ± 11.1
Normal weight 935(86)	59.4 ± 36.9	34.4 ± 6.6	38.5 ± 8.8	40.6 ± 8.6	39.2 ± 8.8	42.2 ± 10.5	49 ± 9.6	45.5 ± 9.6	41.5 ± 7	50.1 ± 9.6
Overweight 72(7)	42.7 ± 22.1	32.3 ± 9	37 ± 11.1	36 ± 8.7	37.2 ± 9.3	42.9 ± 9.1	45.2 ± 9.1	43.5 ± 12.4	39.7 ± 7.4	48.7 ± 11
Obesity 15(1)	55.4 ± 43	31.7 ± 5.8	38.1 ± 6.2	34.7 ± 5.6	36 ± 15.2	38.1 ± 7.1	44.5 ± 9.4	44 ± 10.8	40.7 ± 6.4	42.9 ± 13.8
p (BMI trend) adj. for sex	0.25	0.48	0.66	0.33	0.31	0.08	p = 0.001	0.50	0.68	0.08

Data given as mean ± SD or number (%). Data on the KIDSCREEN-52 dimension are calculated as the mean T-scores according to KIDSCREEN Group. In total population p is representative of post-hoc test, by sex p is representative of BMI trend adjusted for sex.

doi:10.20944/preprints202311.0908.v1

 doi:10.20944/preprints202311.0908.v1

Relationship between weight status categories and risk behaviors in total population and by sex

Data of the analysis of risk behaviors in the total population and by sex as a function of BMI categories are shown in Table 5. In our population, belonging to one of the BMI categories influences both adherence to the Mediterranean Diet ($p = 0.001$) and physical activity ($p = 0.002$), in particular both underweight and adolescents with obesity showed a reduced adherence compared to the other categories. Also, BMI categories are associated with social addiction ($p < 0.05$), revealing that normal weigh adolescents had a more altered behavior showing a problematic use of social network than other categories. Moreover, belonging to the different categories of BMI is linked with the perception of eating disorders ($p < 0.05$), especially in underweight subjects and in subjects with obesity. When we assess the impact of sex and BMI categories on risk behaviors, none of the possible risk factors (diet, exercise, social addiction, eating disorders) showed significant differences.

Table 5. BMI categories according to risk behaviors in total population and by sex.

TOTAL POPULATION	KIDMED	PAQ-C	BMAS	EAT-26
Underweight 115(7)	7.2 ± 3.2	2.1 ± 0.7	14.4 ± 5.1	14.9 ± 15.7
Normal weight 1442(83)	8.1 ± 2.9	2.3 ± 0.7	13.2 ± 5.1	11.5 ± 11.3
Over weight 140(8)	7.5 ± 3.1	2.3 ± 0.7	13.5 ± 4.7	14.5 ± 12.3
Obesity 45(2)	7.2 ± 3.3	2.2 ± 0.8	12.6 ± 4.6	15.4 ± 11
p	=0.001	=0.002	<0.05	<0.001
BOYS				
Underweight 52(8)	6.8 ± 0.4	2.3 ± 0.1	11.5 ± 0.7	13.6 ± 1.7
Normal weight 577(78)	8.3 ± 0.1	2.6 ± 0.1	13.3 ± 0.2	10 ± 0.5
Overweight 73(10)	7.5 ± 0.3	2.5 ± 0.1	11.7 ± 0.6	11.8 ± 1.4
Obesity 33(4)	7 ± 0.5	2.3 ± 0.1	11.7 ± 1	13.1 ± 2.2
GIRLS				
Underweight 69(6)	7.4 ± 0.4	2 ± 0.1	14.4 ± 0.6	15.9 ± 1.5
Normal weight 935(86)	7.9 ± 0.1	2.2 ± 0.1	15.1 ± 0.2	12.4 ± 0.4
Overweight 72(7)	7.6 ± 0.4	2 ± 0.1	15.2 ± 0.6	17.3 ± 1.4
Obesity 15(1)	7.6 ± 0.8	1.8 ± 0.2	14.1 ± 1.3	19.5 ± 3
p (BMI trend) adj. for sex	0.48	0.91	0.29	0.25

Data given as mean ± SD (95% CI). KIDMED: Mediterranean Diet Quality Index for children and adolescents; PAQ-C: Physical Activity Questionnaire for Older Children; BSMAS: Bergen Social Media Addiction Scale; EAT-26: Eating attitudes and behaviours. In total population p is representative of post-hoc test, by sex p is representative of BMI trend adjusted for sex.

4. Discussion

This research aimed to determine the effects of belonging to a specific BMI category on health-related quality of life (HRQoL) on a sample of late adolescent students, taking into account sex differences. The main results of this study can be reassumed in the following points: i) the overweight and obesity category is predominantly expressed in the male population, while girls are more represented in the underweight category; ii) boys showed higher values of perceived well-being, better emotional state and self-perception, better family and school relationships, while females reported problematic use of social networks and a greater tendency for eating disorders.

When we consider BMI categories: i) a reduced perception of psychological well-being, self-perception, and fewer social relationships are found in the overweight and obese adolescent categories, while the underweight category is characterized by a better adherence to the Mediterranean diet and better perception of financial resources, especially in girls; ii) normal weight subjects exhibited a problematic use of social network, whereas eating disorders was more pronounced in underweight and obese adolescents.

 doi:10.20944/preprints202311.0908.v1

Consistent with the literature, the present results provide clear evidence that overweight and obesity are more expressed in male population. This prevalence is usually more strong in high income and upper middle-income countries, were obesity is two-fold greater in boys than girls [20]. This sex-difference may be due to biological influences. In fact, biological differences in body composition between sexes, already present during childhood, became more marked in adolescence by the role of sex hormones [21,22]. In fact, females have higher levels of circulating concentrations of leptin, responsible of an increased appetite suppression and promotion of energy utilization [23]. Another possible explanation of sex differences in obesity would seem to be related to brown adipose tissue (BAT) whose decrease is implicated in the development of obesity [24]. Although there is no clear evidence, some studies have found BAT to be predominant in girls than boys [25]. Furthermore, it is important to emphasize that the number of school-aged adolescents with obesity is expecting to rise from 150 million worldwide to over 250 million by 2020, with an increase in the long-term of other related chronic disease, such as type 2 diabetes and cardiovascular disease [20,26]. This growing prevalence of obesity in adolescence globally is of major challenge, not only for the long-term effect, but also for the short health complications, including increased cardiovascular risk, disturbances of sex hormones, hepatic and orthopaedic problems [27]. Although the physiological underlying mechanisms responsible of adolescence obesity rise are not yet fully understood, certainly adolescence is a time of rapid physical, social, and psychological development, and as a result, it offers multiple possibilities for unhealthy and/or risk behaviors. In this frame, psychological/mental health problems which emerge during this period, can often contribute to physical health outputs and persist into adulthood, creating a vulnerability substrate or altering adolescents' well-being and quality of life [28,29]. Independently of body weight, our results show an impairment in HRQoL dimensions, in line with the view in which adolescence is not necessarily the age of highest health, but rather the period of onset of risk factors; this deterioration is more pronounced in girls than boys [6,30,31] (ref).

To try to explain this vulnerability, also in line with previous literature and aforementioned our results, several theories have been formulated [32,33]. Probably this different psychosocial picture by sex is explained by the time of pubertal changes in boys and girls, in which girls enter the state of physiological alteration before boys with associated physical and hormonal variations [34]. This female development is associated with an effect on femininity and thus with psychological outputs such as depressive behaviors, also linked to the time of hormonal maturation.

Within this susceptible framework, it is necessary to highlight that adolescents are more prone to engage in risky behaviour, including an abnormal perception of one's body weight and thus, an alteration of one's image. In this field, our previous data collected in a sample of early adolescents demonstrated that weight status correlated more with the psychological dimension in girls, whereas in boys, a stronger association between weight and physical status was observed [6].

The possible association between body weight control and psychosocial profile creates a vicious circle in which weight stigma may contribute to reinforcing a poor body image, resulting in an increase of stress levels associated with reduced emotion regulation, less rational decision-making, and higher risk behaviors engagement [35,36]. It is not a coincidence that during adolescence, everything to do with the body becomes relevant, with important implications on mental health-related aspects, reinforced by the internalization of the aesthetic model imposed by society through social media [37]. Not surprisingly, the increased stigmatization of overweight/obesity, in the last few years, may be related to more psychological distress and risk behaviors as evidenced by our results, when we analysed health-related quality of life dimensions according to BMI category. In fact, compared to their normal-weight peers, adolescents who are overweight/obese had a reduced perception of psychological well-being, low self-esteem, reduced social relationships with peers and a greater perception of being bullied. In line with our results, these alterations may be amplified in the case of self-perceptions of overweight, considered as predictors of maladaptive coping for stressful events [38]. In fact, evidence have demonstrated that self-perception of overweight was more powerfully linked with a reduced health-related quality of life and risk beahviors [38]. Usually, it is well known that overweight or obese adolescents have an impairment in quality of life,

 doi:10.20944/preprints202311.0908.v1

characterized by elevated symptoms of depression, emotional difficulties, lower self-esteem, and higher school dropout [39,40]. However, little is known about the other side of the coin, i.e., underweight adolescents, although it affects 5% to almost 12% of adolescents, apart from disordered eating, body dissatisfaction, and altered social relationships, as also highlighted in our results [41]. One of the factors linked to body weight, mainly in the underweight category, is body image, and thus body dissatisfaction, considered one of the most influential factors affecting well-being in adolescents [42]. Body dissatisfaction is prevalent among adolescents and recent data shows that 24% of normal-weight girls and 22% of normal-weight boys were dissatisfied with their bodies, while in overweight girls and boys, low-level body satisfaction reached 59% and 48% [43]. The data presented here, which clearly show an impairment of well-being and quality of life, especially in the underweight and obese categories, are, however, perception data and can certainly impair body image. It is not a coincidence that the 'self-perception' dimension is lower in the overweight and obese. Although no sex differences in body image-related dimensions were revealed in our data, usually, underweight girls have been shown to have higher body satisfaction as compared to their normal and overweight counterparts [43]. While previous data demonstrated a sex-effect in this vicious circle, our underweight female population reports a higher perceived economic well-being as compared to boys. There is no clear evidence of this association since few studies have studied the relationship between these dimensions with socio-economic status (SES) or perception of socio-economic status. The few data present are conflicting, showing for example that unhealthy weight control was not limited to upper socioeconomic groups, or in other cases, dietary behavior and attempts to lose weight are more typical of girls of higher SES [44,45]. Certainly, social and economic inequalities cause food and body weight inequalities [46]. In this respect, there is evidence that girls from families of high socio-economic status estimated their weight more correctly than female students of middle and low status, pointing to the 'mother's education' factor as responsible for this association [47].

Not surprisingly, our results suggest that underweight adolescents, regardless of gender, have a problematic use of social networks. Social media platforms, often accompanied by interactive modes such as likes, comments, and stories, are associated with emotional ups and downs with satisfaction and/or inadequacy, particularly in girls [48]. Furthermore, data obtained from principal social media platforms show that altered social media use may induce poor body image, self-perception, and eating disorders, as suggested also by our results [49]. In addition, screen time on social media has been related to an unrealistic view of beauty standards, with subsequent eating disorders and depressive behaviors [50].

The study has some strengths and limitations. The strength of this study is that little is known about the relationship between HRQoL and body weight categories in Italian late adolescents despite the increase in Italy and other industrialized countries of overweight or obesity probably due to a decrease of the Mediterranean nutritional lifestyle [51]. A more precise knowledge of this relationship would allow the implementation of targeted and customized preventive strategies based both on the psychosocial profile of the adolescent, also considering a parameter as simple as BMI, considered a potential predictor of health-related quality of life in adolescents, as reported in our previous study [52].

One of the limitations of the study may be represented by the calculation of BMI because it does not distinguish between lean and fat mass and does not identify the type of obesity. In addition, the use of self-reports for psychological evaluation it could also be a limitation. Moreover, perceptions of well-being and health status may vary from day to day, especially in adolescence when is related to the different emotional backgrounds; thus the results must not be considered in an absolute way, but limited to a specific time window. Finally, the different number of subjects in the different BMI categories, in particular the reduced number of adolescents with obesity, may not show certain significant differences, visible on a larger sample.

5. Conclusion

In conclusion, this study suggests that there is an association between weight status categories and some dimensions of HRQoL, and that this association is more pronounced in overweight and obese adolescents, irrespective of sex. Also, it is interesting that BMI categories, in overweight and obese conditions, correlates with a reduced psychological well-being, self-perception, and bullying. Another very important result, in our opinion, is that underweight adolescents showed a higher economic wellbeing, eating disorders, and problematic use of social media. Our data suggest the importance and the need of implementing weight control strategies that take into account not only metabolic parameters, but also psychological dimensions. These factors should be taken into consideration when designing programs for adolescents with weight related problems, although the variety of psychological problems associated with overweight and underweight is so wide that there is a risk of the intervention not being too specific and focused on the real problem. This opens up the need for the scientific community to define, if possible, specific domains on which such interventions should focus and which may be most beneficial, always through a personalized perspective [53].

Author Contributions: FM: MFLL, AP, designed the study; FM, MFLL, PP, analysed the data. All authors critically reviewed the manuscript, contributed to interpretation and approved the submitted version. The author (s) read and approved the final manuscript.

Funding: No financial support for the research, authorship, and/or publication of this article.

Institutional Review Board Statement: This study was approved by the Regional Pediatric Ethics Committee (Azienda Ospedaliero Universitaria Meyer) (code 166/2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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