BMI-BASED ASSESSMENT OF EXCESS WEIGHT AND ITS ASSOCIATION WITH QUALITY OF LIFE IN YOUNG UNIVERSITY STUDENTS

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Abstract. *Obesity is currently considered by the World Health Organization to be the most serious health problem in the world, as it is the main cause of increased morbidity, disability, mortality rate and deterioration of quality of life in society. Currently, BMI is the most popular measure of overweight and obesity, although it does not distinguish between fat and lean mass, which leads some researchers to question its usefulness as a measure of obesity. The aim of the study is to establish the prevalence of overweight among young students (n=158) and its consequences on quality of life. The evaluation involved anthropometric measurements (BMI, percentage of fat mass and bone density) and assessment of quality of life by applying the European Quality-of-Life Questionnaire-5D (EQ-5D-5L). The results indicated that 25.95% of the participants were overweight. In addition, the findings suggest that obesity classification based exclusively on BMI may overestimate the prevalence of excess adiposity, emphasizing the importance of incorporating complementary body composition assessments for a more accurate evaluation of weight status. Participants with a BMI of 25 or above were considered to have excess weight. It was not substantially associated with major functional and pain-related limitations, but the presence of levels of psychological impairment indicates that the emotional dimension remains a sensitive area in the case of overweight students.*

Keywords*: overweight, obesity, body mass index, fat mass.*

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Introduction

Obesity, this chronic, systemic, progressive and recurrent disease, has reached pandemic proportions worldwide, its prevalence reaching 20% in Europe and already over 30% in some countries (World Health Organization, 2025; Wong et al., 2020). Forecasts are bleak and predict that the proportion will increase further in the future, as a result, it is becoming increasingly clear that obesity is a significant global health problem with far-reaching consequences (Lan & Sulaiman, 2024). At the same time, food policies are increasingly recognized as important tools in

addressing obesity at the population level, especially in diverse economic contexts (Abay et al., 2022).

The causes of obesity are complex and characterized by many factors. Regardless of the root cause of the disease, obesity is accompanied by chronic energy balance disorders related to excessive food consumption compared to the needs of the human body to which is added the low level of physical activity, which is associated with increased abdominal fat (Jakicic et al., 2019). Obesity increases an individual's risk of developing certain diseases, including cancer, heart disease, type 2 diabetes, and so on (Ko et al., 2020).

In 1998, the WHO adopted BMI for the clinical classification of obesity. BMI limit values (25 and 30, respectively) have been implemented for the diagnosis of obesity and the clinical classification of its severity.

The benchmark for the diagnosis of obesity is the body mass index (BMI). It is widely used in epidemiological and physiological research, by multiple health organizations, but also as a guideline for obesity management, in establishing indications for weight loss drugs and monitoring the evolution under specific treatment.

Body mass index continues to be widely used in clinical practice and research, despite current debates about its accuracy as an indicator of actual adiposity. Although BMI is a useful screening tool at the population level, recent literature emphasizes that it does not reflect body composition and cannot differentiate between muscle mass and fat mass (Chamarthi & Daley, 2025). Thus, the exclusive use of BMI in the diagnosis of obesity can lead to erroneous classifications of weight status.

Individuals with elevated BMI values may not necessarily present excess adiposity, particularly in physically active populations with increased lean body mass, while some individuals with normal BMI may still exhibit excess body fat, a phenomenon described as “normal-weight obesity” (Nevill et al., 2022; Weir, 2022). These limitations support the need for complementary body composition assessment when evaluating nutritional status and obesity-related health risks.

Moreover, recent studies on the global obesity situation highlight the fact that the relationship between excess weight and cardio-metabolic risk is complex and influenced by body fat distribution, not just total body mass (Jaacks et al., 2019; Wong et al., 2020). In this context, BMI is increasingly considered an indirect indicator, which needs to be supplemented with measurements of body composition.

Recent literature does not dispute the usefulness of BMI as an epidemiological tool but draws attention to its limitations in individual obesity assessment and health risk assessment (Malik et al., 2020; Kumanyika, 2019). Consequently, it is recommended to interpret it in correlation with indicators of body composition and adiposity distribution.

Obesity significantly influences the quality of life of people with obesity because it negatively affects personal well-being, physical functioning, mental health, and body image, etc. The quality of life of obese people has become an important issue that needs to be included in weight management treatment and research (Kolotkin et al., 2001; Bish et al., 2006). In this context, specialists highlight the major role of physical exercise in maintaining body mass or weight loss

(Bellicha et al., 2021; Leermakers et al., 2000; Hatamoto et al., 2021; Armstrong et al., 2022) and advocate for their introduction into the routine of overweight and obese people.

Starting from these considerations, we set out to evaluate the diagnostic accuracy of BMI in the detection of obesity and to compare the data obtained from the assessment of the nutritional status of the participants in our study with the data reported by international bodies, authorized in this regard, data provided by the specialized literature; establishing the correlation of BMI with body composition measurements and identifying the association of obesity on the quality of life of young students.

Methodology

Aim

To assess the prevalence of excess weight among young university students, to examine the concordance between BMI and adiposity-based classification, and to explore the association between excess weight and quality-of-life indicators.

Research questions

1. To what extent does BMI classification correspond with adiposity-based classification in young university students?
2. What discrepancies exist between BMI-defined excess weight and body fat percentage assessment?
3. Are there sex-based differences in BMI, adiposity indicators, and quality-of-life parameters?
4. Is excess weight associated with quality-of-life indicators among young university students?

Participants

The research participants were 158 students enrolled in the Faculty of Physical Therapy at the National University of Physical Education and Sports (UNEFS) from Bucharest during the 2022-2023 academic year. Inclusion criteria consisted of voluntary participation, signed informed consent, and complete anthropometric and questionnaire data, while exclusion criteria included refusal to participate, incomplete data collection, or the presence of conditions preventing anthropometric assessment.

The investigated population was selected because students in this field are generally regarded as future health professionals and role models regarding body image and physical condition (Elboim-Gabyzon et al., 2020; Black et al., 2012). In addition, previous studies have shown that, the pandemic caused by COVID-19 was a determining factor for the increase in BMI values during

the intra- and post-pandemic periods due to reduced opportunities for physical activity (Bakaloudi et al., 2022; Yang et al., 2020), which coincided with the period of our study. Although all participants were enrolled in a faculty involving practical physical training activities, physical activity level was not objectively quantified and was not used as an inclusion criterion.

Procedure

The evaluation consisted of anthropometric measurements (Cordun, 2009), to which excess weight, respectively weight and body height were reported, based on which BMI and the thickness of 2 skin folds (triceps and subscapular), widely used for the evaluation of body fat, were calculated. The evaluation took place at the "Dr. Alexandru Partheniu" Interdisciplinary Research Center of UNEFS, between December 2022 and January 2023.

The anthropometric measurements based on which we calculated a series of reference indices of excess weight, using the same instruments under the same conditions, were the following:

Body weight (kg) - was measured with participants dressed in light clothing and without shoes, using an Omron scale, model 201801-00273F.

Body height (cm) - was measured between the vertex and the plane of the plants using the U-Grow taliometer model UHM-001, with participants dressed in light clothes and without shoes.

Triceps skinfold (mm), vertical skinfold - was measured with a caliper on the posterior aspect of the arm, halfway between the acromial and olecranon points; subjects was positioned with the hand in supination.

Subscapular skinfold (mm), oblique skinfold downwards and laterally - was measured with a caliper, 1 cm from the lower angle of the scapula, at an angle of 45º from the horizontal.

The thickness of the skin folds was measured on the left side of the body with an accuracy of 0.1 mm, using a Holtain caliper (Holtain Ltd., Crymych, UK). We took 3 successive measurements of the same envelope, within 1 hour, and retained the average value.

We dwelt on these measurements because they are non-invasive, simple, and less expensive than laboratory techniques, and there are also numerous reports on the statistical relationships between body weight, skin fold thickness, BMI, and risk of cardiovascular disease or death.

Based on the anthropometric measurements made, we first calculated BMI and then % of fat mass.

BMI is the most popular measure of overweight and obesity and was calculated according to the formula:

$$BMI = \text{Weight (kg)} / \text{Height}^2 (m^2)$$

To determine the percentage of fat mass, body density was first calculated using anthropometric equations described in kinanthropometric literature (Cordun, 2009), derived from the classical work of Nagamine and Suzuki (1964), as follows:

$$\text{Body density} = 1.074 – 0.0005322 (\Sigma \text{ 2 sachets}) – 0.0009603*BMI$$

The calculation of the percentage of fat mass, based on body density, was carried out with the help of Siri's equation:

$$\% \text{ adipose tissue} = \left(\frac{4.95}{body\ density} - 4.5\right) \times 100$$

These successive calculations allowed us to establish the correspondence between BMI and the real nutritional status of the participants in our study.

The results obtained from the measurements were analyzed intra-groups resulting from successive calculations and compared both intra-groups and with data provided by the reports of international forums or derived from meta-analyses, drawn up based on studies of groups of researchers and/or reports of the WHO (World Health Organization, 2025)

In order to assess the association between excess weight and quality-of-life indicators among the participants in our study, we applied the questionnaire-based survey method. In this regard, we used a standardized and validated questionnaire for our country: European Quality-of-Life-5D (EQ-5D-5L), a research tool developed by a multi-disciplinary team of the EuroQol group and used in multiple studies that have a component of assessing the quality of life in relation to health status (Devlin et al., 2020; Olariu et al., 2023).

The questionnaire was made available to us on request and free of charge, by EuroQol, and was self-administered by the participants. It assesses 5 dimensions of health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 5 levels of operation: *no problems, easy problems, moderate problems, serious problems,* and *extreme problems.* The subject ticks the box next to the statement most appropriate to the health condition, resulting in a one-digit number that corresponds to the perceived level for that size. Finally, the result was a 5-digit number, which represented the subject's state of health, resulting from the combination of the five digits that express the perception of each dimension.

The questionnaire also includes a *vertical visual analog scale* (EQ VAS), through which health was rated from 0 (the worst health imaginable) to 100 (the best health imaginable). Thus, the EQ VAS is used as a quantitative measure of the outcome of health condition.

Statistical Analysis

To process the collected data, we used the descriptive statistics provided by REDCap and the Statistical Package for the Social Sciences (SPSS) program (Patridge & Bardyn, 2018; Gupta et al., 2019).

REDCap (Research Electronic Data Capture) is a secure software platform, created by Vanderbilt University, hosted on the international internet network and designed to facilitate the collection of data necessary for research studies (Harris et al., 2009, 2019). We chose this platform because it is one of those recommended by EuroQol for processing the data collected with the EQ-

5D-5L (EuroQol, 2024). At the same time, this platform is also found in many other studies that address clinical and financial assessment of obesity (Hens et al., 2018).

Descriptive indicators of variability and distribution (standard deviation, skewness, kurtosis and Shapiro-Wilk normality testing) were calculated for the analyzed variables.

Spearman's rho correlation analysis was applied to evaluate the association between BMI, adiposity indicators, and self-perceived health status.

Independent-samples t-tests were applied to evaluate sex-based differences in anthropometric and quality-of-life variables.

Results

From a demographic point of view, the subjects investigated had a mean age of 23.18 years with values between 21 and 50 years. The gender distribution of the investigated group (n = 158) showed a predominance of male students, who accounted for 63.29% of the total, while female students constituted 36.71% of the sample.

The descriptive analysis of somatic parameters (Table 1) highlighted a moderate inter-individual variability and distribution heterogeneity for anthropometric and body composition indicators, supporting the concomitant use of BMI and adiposity-related measurements in the assessment of weight status.

Table 1. *Descriptive statistical indicators for anthropometry*

Variable	N	Mean	Standard deviation	Min	Max	Asymmetry	Kurtosis	Shapiro-Wilk W	Shapiro-Wilk p
Height (m)	158	1.73	0.09	1.5	1.95	-0.11	-0.75	0.983	0.056
Weight (kg)	158	69.64	14.69	43.8	117	0.66	0.2	0.966	<.001
Triceps skinfold (mm)	158	15.85	7.79	2	38	0.4	-0.46	0.971	< .01
Subscapular skinfold (mm)	158	13.61	6.46	3	40	1.71	3.51	0.845	<.001
BMI	158	23.1	3.62	16.24	37.77	0.66	0.96	0.973	< .01
Body density	158	1.04	0.01	1	1.05	-0.96	1.21	0.943	<.001
% Adipose tissue (Siri)	158	0.28	0.04	0.2	0.44	1.03	1.4	0.938	<.001
% Adipose tissue (Brozek)	158	0.27	0.04	0.2	0.42	1.03	1.4	0.938	<.001
Non-fat mass (kg)	158	49.89	8.77	33.95	69.03	0.28	-0.77	0.973	< .01
Fat mass (kg)	158	19.74	6.93	9.82	50.53	1.44	2.9	0.897	<.001

The results obtained showed an average BMI of 23.10 in the group of participants, with a minimum value of 16.24 and a maximum of 37.7 (Figure 1).

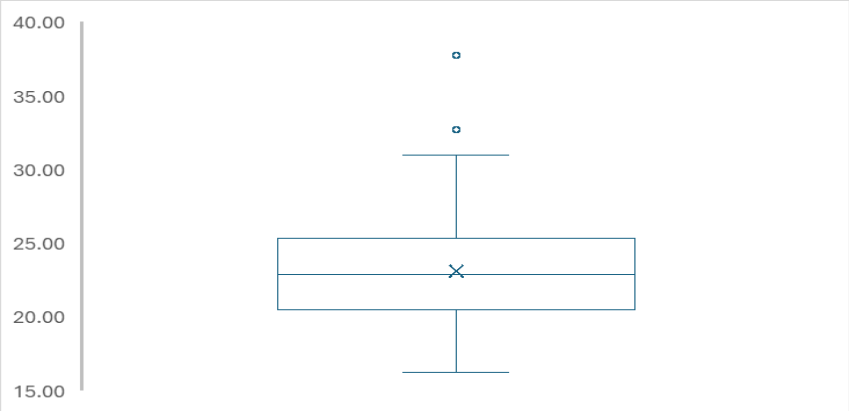

Figure 1. BMI distribution in the study group (n = 158)

Taking as a benchmark the value of 25 established by the WHO as normal for BMI, the group of 158 subjects was divided into two subgroups: one of normal weights, consisting of 117 students, with a BMI below 25 which represented 74.05% of the total participants in the study, and a subgroup consisting of 41 students with a BMI above 25, which represented the subgroup of overweight, respectively 25.95% of the total number of students evaluated in this phase of the research (Table 2).

Table 2. *Prevalence of overweight according to the criterion considered*

Criterion	Values	Number of students (n)	Percent of total (%)
BMI	< 25	117	74.05
	≥ 25	41	25.95
% adipose tissue (Siri)	Under biological threshold *	87	55.06
	Above biological threshold*	71	44.94

** biological threshold: >32% in women and >25% in men (World Health Organization, 2020).*

The analysis of BMI values in the two subgroups highlights differences between normal-weight and overweight students. Thus, in the normal weight group (n = 117), the mean BMI was 21.45, while in the overweight group (n = 41) the mean BMI reached 27.81, with values exceeding 30 in some participants, reflecting a clear separation between the two anthropometric categories (Figure 2).

The gender distribution of students with a BMI ≥ 25 (n = 41) highlights a clear predominance of males within the overweight subgroup. From the total of 41 students in this category, 33 (80.49%) are male and 8 (19.51%) are female. A predominance of male participants was also observed within the overweight subgroup (Figure 3).

The distribution of participants according to the weight category determined by BMI and the gender distribution of these subgroups is summarized in Table 3. and illustrated graphically in Figure 5. Of the 41 students classified as overweight based on a BMI ≥ 25, 38 (92.68%) were confirmed with excess adipose tissue, according to sex-specific biological thresholds. Within this confirmed subgroup, the gender distribution showed a significant male predominance: 86.84% males (n = 33) and 13.16% females (n = 5).

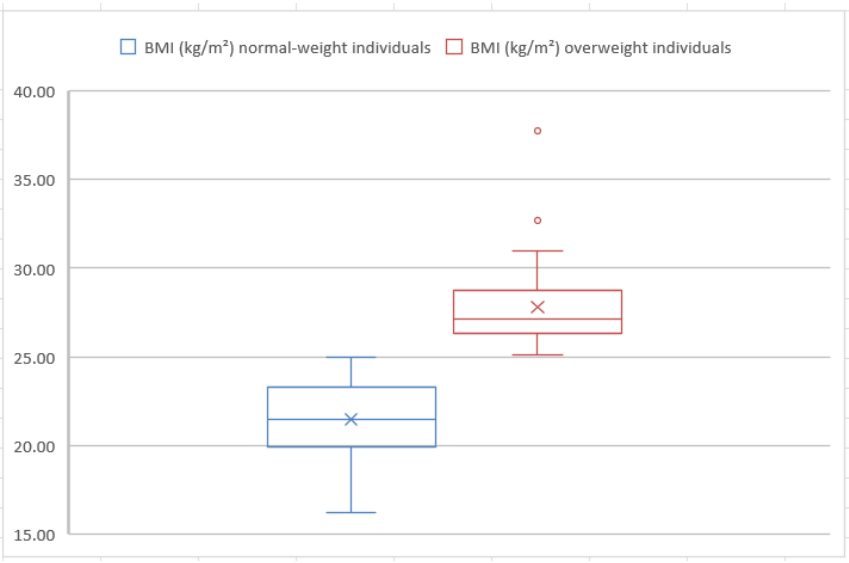

Figure 2. Graphical representation of BMI distribution by weight category

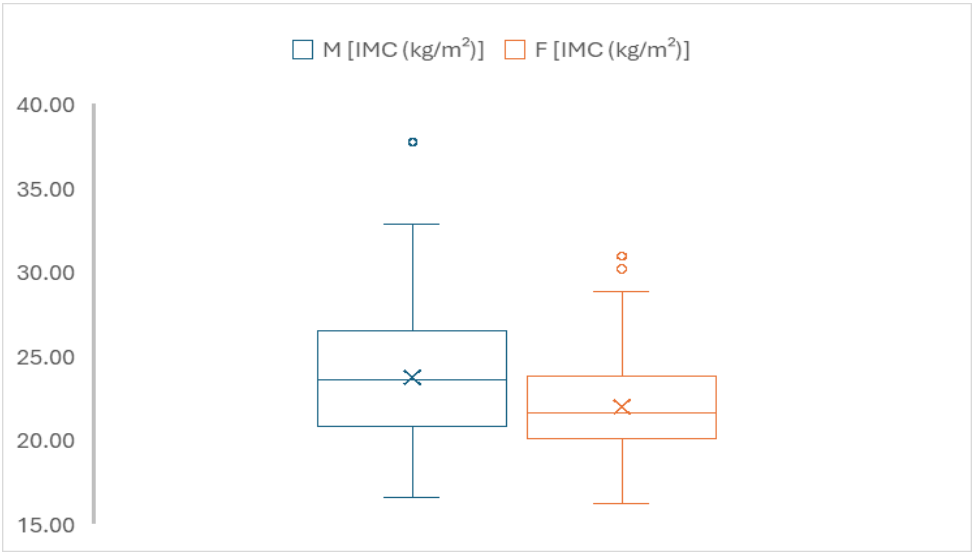

Figure 3. Graphical representation of body mass index by sex

The analysis also highlights that 33 students (20.89% of the total sample), although classified as normal weight based on BMI < 25, had a percentage of adipose tissue above the biological thresholds specific to sex (Table 4).

Cross-tabulation analysis revealed a statistically significant association between BMI-based classification and adiposity-based classification ($\chi^2 = 51.012$, $p < 0.001$). Among the 41 students classified as overweight according to BMI, 38 (92.7%) also presented excess adipose tissue according to sex-specific biological thresholds, while 3 students (7.3%) had adiposity values within normal limits. Conversely, 33 students (28.2%) classified as normal weight according to BMI presented excess adipose tissue, suggesting that BMI alone may underestimate adiposity in a substantial proportion of participants.

Table 3. *Cross-tabulation between BMI-based classification and adiposity-based classification*

BMI classification	Normal adiposity	Excess adiposity	Total
BMI < 25	84 (71.8%)	33 (28.2%)	117
BMI ≥ 25	3 (7.3%)	38 (92.7%)	41
Total	87	71	158

The cross-tabulation presented in Table 3 was further analyzed using Pearson's chi-square test, which indicated a statistically significant association between BMI-based and adiposity-based classification ($\chi^2 = 51.012$, $df = 1$, $p < 0.001$).

Table 4. *Gender distribution of participants by weight category BMI and percentage of adipose tissue*

Categories	Number of students	Women	Men
Overweight with % increased fat mass	38	5	33
Overweight with % normal fat mass	3	3	0
Normal weight with % increased fat mass	33	1	32
Normal weight with % normal fat mass	84	49	35

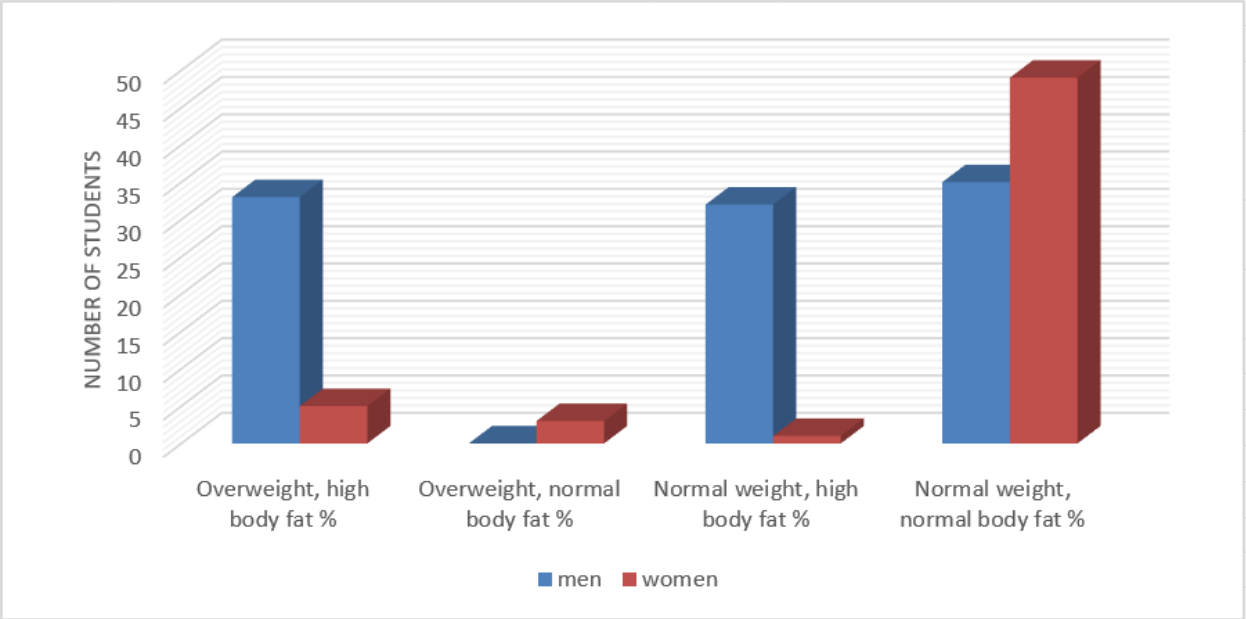

Figure 4. Gender distribution of participants by weight category and percentage of adipose tissue

Out of the 41 students classified as overweight or obese based on a BMI ≥ 25, 3 students (1.90% of the total sample and 7.32% of those initially classified by BMI) did not have a percentage of adipose tissue above the sex-specific biological thresholds (Figure 4).

The results obtained by us were also compared with those reported by the WHO on the prevalence of obesity at European and global level. According to the WHO in 2016, the last report at the time of our study, the average BMI in Romania was 26.9, at the level of the European Union it had a value of 26.4, and at the global level of 24.5 (Figure 5).

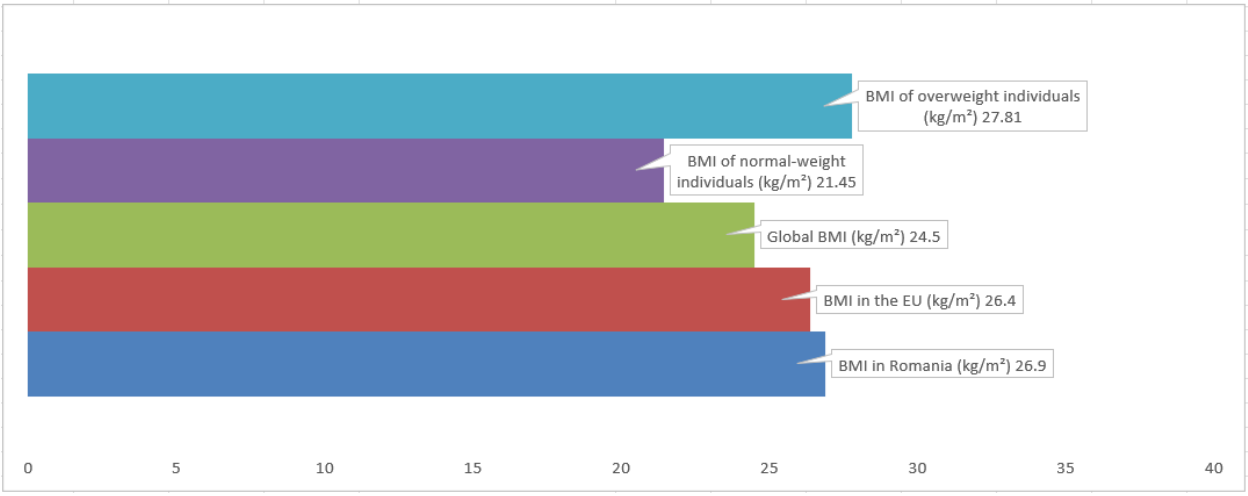

Figure 5. WHO reports on national and international BMI values

The analysis of the distribution of BMI values at the level of the entire sample (n = 158) reveals a moderate positive asymmetry (Skewness = 0.661), which indicates a slightly shifted distribution to the right. This suggests the existence of a relatively small number of students with BMI values higher than the average of the group, but without substantially affecting the overall shape of the distribution. The positive asymmetry is explained by the presence of the group of overweight students, which causes the upper tail of the distribution to expand.

Within the group of 41 students classified as overweight, the percentage of adipose tissue estimated by the Siri equation had an average value of 32.49% (SD = 4.51), with a range of variation between 26.07% and 43.65%. The distribution shows a moderate positive asymmetry (Skewness = 0.76), indicating the presence of high values of fat mass, above the threshold of 40%, which extend the upper tail of the distribution.

The analysis of the skin folds highlights, in the same group, an average thickness of the triceps skinfold of 20.46 mm (SD = 8.88), with values between 4 mm and 38 mm, and for the subscapular fold an average of 19.51 mm (SD = 8.27), with extremes between 9 mm and 40 mm. The relatively high standard deviations for both determinations reflect important inter-individual variability, suggesting a heterogeneous distribution of adipose tissue within the overweight group.

These results underline the fact that, although subjects are classified in the same weight category based on BMI, the fat profile and fat store distribution differ significantly from one individual to another, which justifies the use of body composition indicators in addition to the classical anthropometric assessment.

Fat mass percentage was also assessed in the entire sample of 158 participants. The mean value recorded was 27.77%, and the distribution analysis revealed a positive asymmetry (Skewness = 1.03), which indicates the presence of high values of fat mass within the sample. The values ranged between 20.44% and 43.64%, substantial variability in adipose tissue levels within the investigated sample (Figure 6).

The positive asymmetry reflects the fact that, although most students have values close to the average, a small number of participants with increased percentages of fat mass causes the distribution to expand to higher values.

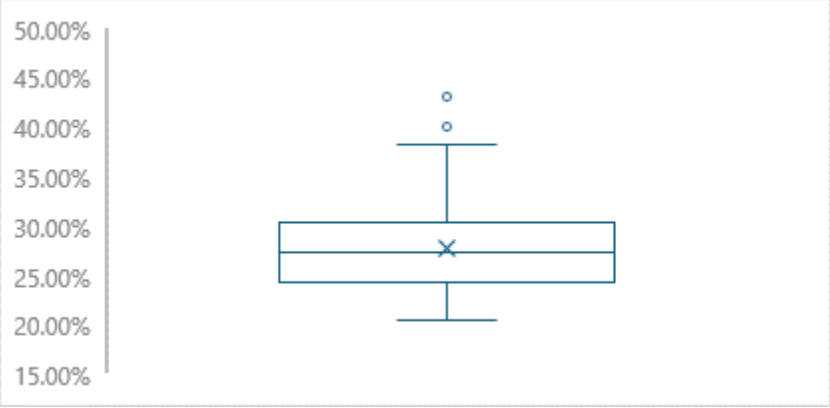

Figure 6. Distribution of the percentage of fat mass at the level of the study group (n = 158)

We mention that the reference to fat mass is very important, as it accurately establishes nutritional status. A BMI can exceed normal values at the expense of increasing muscle mass and non-fat mass, in which case subjects are falsely labeled as overweight; this is the case of some high-performance athletes (Weir, 2022).

Starting from this reasoning, based on BMI index, we extracted from the initial group of students (158) the subgroup of 41 overweight participants, for which we analyzed the results obtained with the calculation of body density and % of fat mass.

After applying the Nagamine & Suzuki equations for estimating body density and the Siri formula for calculating fat percentage, 38 of 41 students classified as overweight according to BMI index also presented adipose tissue values above the sex-specific reference thresholds (>25% in men and >32% in women). Only 3 students (7.32%) showed adiposity values within normal limits, suggesting a limited degree of discrepancy between BMI-based and adiposity-based classification.

The situation of the responses of the 41 overweight students to the EQ-5D-5L questionnaire is summarized in Table 5.

Table 5. *Overweight Student Answers Centralizer to EQ-5D-5L Questionnaire*

Dimension	No problems (No)		Easy problems (easy)		Moderate (moderate) problems		Serious (severe) problems		Extreme problems (incapable)	
	No.of students	Frequency (%)	No.of students	Frequency (%)	No.of students	Frequency (%)	No.of students	Frequency (%)	No.of students	Frequency (%)
Mobility	41	100.00	0	0	0	0	0	0	0	0
Self-care	41	100.00	0	0	0	0	0	0	0	0
Common activities	37	90.24	4	9.76	0	0	0	0	0	0
Pain/ disconfort	35	85.37	6	14.63	0	0	0	0	0	0
Anxiety/ depression	32	78.05	8	19.51	0	0	1	2.44	0	0

Analysis of the distribution of responses indicates a good overall level of self-rated health among this subgroup as well. For the basic functional dimensions - mobility and self-care - all 41 respondents (100%) reported the absence of any problems, suggesting a functional capacity not directly affected by overweight in this age category.

In terms of regular activities, 37 students (90.24%) reported no limitations, while 4 students (9.76%) reported mild problems, indicating a discreet impairment of daily functioning in a small percentage of respondents.

The pain/discomfort dimension highlights that 35 students (85.37%) reported no problems, and 6 students (14.63%) reported mild problems. No moderate or severe levels of impairment were recorded at this size, suggesting a reduced intensity of pain symptomatology in this subgroup.

The anxiety/depression component has a slightly more heterogeneous distribution: 32 students (78.05%) reported no problems, 8 students (19.51%) reported mild problems, and one student (2.44%) indicated a severe level of impairment. Although most respondents fall into the "problem-

free" category, the presence of levels of psychological impairment, even numerically limited, indicates that the emotional dimension remains a sensitive area even in the case of overweight students.

The average self-rated health score on the visual-analogue scale (VAS 0 - 100) among overweight students (n = 41) was 78.83 points, with values ranging from 40 to 100 points. The distribution of the scores indicates an overall favorable perception of one's own health among the overweight participants (Figure 7).

Figure 7. Perceived health status of overweight students (n = 41)

Spearman correlation analysis revealed a strong positive association between BMI and adipose tissue percentage estimated using Siri's equation ($\rho = 0.804$, $p < 0.001$). In contrast, no statistically significant correlations were identified between BMI and self-perceived health status assessed through EQ-VAS ($\rho = -0.010$, $p = 0.904$) or between adipose tissue percentage and EQ-VAS scores ($\rho = -0.031$, $p = 0.701$).

Table 6. *Spearman correlations between BMI, adiposity indicators and self-rated health*

Variables	Spearman's rho (ρ)	p-value
BMI vs. adipose tissue percentage	0.804	<0.001
BMI vs. self-rated health	-0.010	0.904
Adipose tissue percentage vs. self-rated health	-0.031	0.701

As shown in Table 6, a strong positive correlation was identified between BMI and adipose tissue percentage, while no statistically significant correlations were observed between adiposity indicators and self-rated health scores.

Sex-based comparisons revealed significantly higher BMI values in male participants compared to female participants (23.75 vs. 21.99, $p = 0.003$). In contrast, no statistically significant sex differences were identified for adipose tissue percentage estimated using Siri's equation (27.45% vs. 28.35%, $p = 0.215$) or for self-perceived health status assessed by EQ-VAS (78.30 vs. 76.22, $p = 0.532$).

Table 7. *Sex-based comparison of anthropometric and quality-of-life indicators*

Variable	Males (n = 100) Mean ± SD	Females (n = 58) Mean ± SD	Statistical test	p-value
BMI	23.75 ± 3.71	21.99 ± 3.21	Independent samples t-test	0.003
Adipose tissue percentage (%)	27.45 ± 4.47	28.35 ± 4.25	Independent samples t-test	0.215
Self-rated health score	78.30 ± 18.60	76.22 ± 22.45	Independent samples t-test	0.532

Sex-based comparisons are summarized in Table 7. Male participants presented significantly higher BMI values compared to female participants, while no statistically significant sex differences were observed for adipose tissue percentage or self-rated health scores.

Discussions and Conclusion

Our study, which aimed at assessing nutrition status based on BMI, showed that 25.95% of the students evaluated are overweight and confirm the WHO reports, based on BMI, according to which, at national level, excess weight affects over a quarter of the adult population, and globally the percentage is between 20 and 30%. Compared to the national average, but also to the European and world average, the group of overweight students included in our research registers a higher average BMI (27.81), a situation that coincides with the upward trend reported nationally and internationally. We would have expected that these students, who practice physical activities within the curriculum, would present a BMI within normal limits. We believe that the situation could be the consequence of the fact that schooling in the first year of university studies and the reduced number of physical education hours in pre-university education have left their mark on nutritional status. Please note that physical activity level was not objectively quantified.

Studies on the global evolution of obesity indicate that the prevalence of overweight is influenced by socio-structural and behavioral factors, and the interpretation of BMI must be made in the context of these determinants (Malik et al., 2020; Melo et al., 2023).

However, the BMI analysis as a single indicator should be interpreted with caution, as it does not differentiate between fat mass and muscle or bone mass. Therefore, BMI provides a useful screening tool, but it does not allow the precise determination of excess adipose tissue without reference to body composition indicators.

This limitation of BMI is also highlighted in recent literature, which suggests the need to use alternative indicators of body fat distribution (Nevill et al., 2022; Wong et al., 2020). Therefore, the assessment of body composition is a necessary step for a more faithful assessment of excess weight.

The analysis of the body composition of the entire group (n= 158) showed that a number of 71 students (44.94%) exceeded the reference values of the sex-specific biological thresholds, suggesting a higher prevalence of excess fat compared to the classification based solely on BMI. Out of the women, 10.34% exceeded the threshold of 32%, and of men, 65% exceeded the

threshold of 25%. This result highlights the fact that BMI may underestimate the true proportion of excess adipose tissue in the sample, confirming the need for complementary use of body composition indicators in the assessment of weight status.

The analysis then focused on the 41 students classified as overweight or obese based on the BMI criteria ≥ 25. Following the calculation of the percentage of adipose tissue and the application of sex-specific biological thresholds (>32% in women and >25% in men), it was found that only 38 of them exceeded the values considered normal for fat mass, the result highlighting that the diagnosis of obesity based solely on the BMI value can lead to an overestimation of the prevalence of adipose tissue, confirming the need for complementary body composition assessment for a more precise classification of weight status.

As for body density, it is influenced by body composition and has a theoretical average value of 1021.10 g/cm3, with a deviation of 0.985 g/cm3. In obese individuals, body density is generally lower because adipose tissue has a lower density than lean tissue leading to a reduction in total body density. However, body density and adiposity estimation based on anthropometric equations may be influenced by individual differences in body composition and hydration status. Thus, people who are in good physical shape tended to have a higher bone mineral content and, as a result, may have artificially low-fat percentage values when calculated using Siri's equation.

A diagnosis of obesity requires anthropometric assessment of adiposity, and if the indicator is BMI, it should only be included if it is confirmed that a high BMI represents excessive adiposity and a measure of adiposity distribution. Otherwise, BMI can lead to an overestimation of fat mass and the extent of obesity, which is also observed in the analyzed sample.

Although BMI showed a strong association with adiposity indicators, discrepancies between BMI-based and adiposity-based classification support the complementary use of body composition assessment in young adults. BMI-based classification showed both concordant and discordant cases when compared with adiposity-based assessment, supporting the complementary use of body composition indicators in nutritional status evaluation.

Siri’s equation remains a widely used and accessible method for estimating body fat percentage in epidemiological and field-based studies. However, because body density–based equations rely on assumptions regarding fat-free mass composition, their accuracy may be influenced by factors such as sex, hydration status, and physical training level, particularly in physically active populations (Nevill et al., 2022).

A limitation of the present study is related to the use of anthropometric equations for estimating body density and adiposity, as these methods may be influenced by individual differences in body composition and hydration status. Nevertheless, combining BMI assessment with adiposity-related indicators may reduce the risk of incorrect nutritional status classification in young adults.

A misclassification of people with normal levels of fat mass in the overweight category, according to the classification based on BMI, could cause unnecessary suffering and lead to unnecessary and expensive interventions. In addition, such mislabeling has a detrimental effect on public trust in healthcare providers, especially from people in good physical shape with obvious muscle mass.

BMI, despite providing lower sensitivity for assessing body composition and body fat distribution, remains the most widely used index for assessing obesity

In our study, BMI classification was confirmed by body composition analysis in 92.68% of cases, suggesting a high concordance between the two methods within this sample. This concordance was also supported by the cross-tabulation analysis, which revealed a statistically significant association between BMI-based and adiposity-based classifications ($\chi^2 = 51.012$, $p < 0.001$).

The element of originality of our study is represented by the researched population category, consisting of young students involved in physical training activities. In accordance with the literature and WHO reports, which indicate an increased prevalence of overweight among males, a predominance of males was also found in the investigated sample in the category of overweight students confirmed by the percentage of fat mass. Thus, of the 38 subjects who exceeded the sex-specific biological thresholds, 33 (86.84%) were men, while 5 (13.16%) were women. In this context, we believe that further studies on larger samples are needed.

Sex-based analysis also revealed significantly higher BMI values in male participants compared to female participants, while no significant sex differences were identified for adiposity percentage or self-perceived health status.

Regarding the perception of quality of life associated with health status, the analysis of the responses to the EQ-5D-5L questionnaire highlighted that a high percentage of students with confirmed overweight did not report problems in the five dimensions investigated. The proportion of those who declared "no problems" varied between 78.95% and 94.74%, depending on the size assessed. The European Quality-of-Life-5D (EQ-5D-5L) assessment suggests that excess weight was not associated with major functional and pain-related limitations in the investigated sample. Additionally, there are levels of psychological impairment, even numerically limited, which indicates that the emotional dimension remains a sensitive area in the case of overweight students.

Although BMI and adiposity indicators were strongly associated, neither BMI nor adipose tissue percentage showed significant associations with self-perceived health status in this young population. These findings suggest that excess weight and adiposity may not substantially influence subjective health perception at this age, despite the anthropometric differences identified.

The results suggest that, despite the existence of a real excess of adipose tissue, most young participants did not report a less favorable perception of their current health status.

This discrepancy between objective anthropometric status and subjective perception of health may reflect the absence of immediate clinical manifestations of overweight at young ages. In this context, it is necessary to strengthen educational and preventive measures, aimed at raising awareness of long-term risks and adopting behaviors favorable to maintaining an adequate body weight.

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