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# The Rural Health Advantage: Lower Obesity Rates Among Students in Portugal's Countryside

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**Abstract:** Dietary habits significantly influence students' health status, with overweight and obesity posing serious global challenges linked to chronic diseases like type 2 diabetes and cardiovascular conditions. Our cross-sectional study assessed overweight and obesity prevalence among students in Guarda, Portugal, analysing the nutritional and lifestyle habits of 2,083 students aged 6 to 58 years. The sample included 1,762 school children and 321 higher education adults, grouped into age intervals: 5–12, 13–19, 20–39, and 40–59 years. BMI analysis revealed obesity rates of 9.1% in children and 9.7% in adults, with younger children, particularly males, showing higher rates compared to older children. Increased physical activity and reduced sedentary time were correlated with a lower BMI. The observed obesity rates suggest that factors such as physical activity levels, traditional dietary patterns, and access to fresh foods in this region of Portugal may contribute to better health outcomes among students.

**Keywords:** overweight and obesity: body mass index; student health status; eating behaviours; epidemiology

## 1. Introduction

The dietary and lifestyle habits of students play a fundamental role in their overall health and development [1]. There has been a marked decrease in physical activity levels among children and adolescents, partly due to increased screen time and sedentary behaviours [2,3]. Lifestyle changes among students need to be understood, in order to promote early interventions to prevent obesity and reduce the risk of having chronic diseases later in life [4].

Obesity and overweight are among the most significant public health challenges facing the modern world [5,6]. Defined by the World Health Organization (WHO) as an abnormal or excessive fat accumulation that may impair health, obesity is linked to numerous non-communicable diseases (NCDs), including type 2 diabetes, cardiovascular diseases, hypertension, and certain types of cancer [5,7]. The global burden of NCDs linked to obesity continues to increase, with recent forecasts predicting that, if trends persist, over 1.31 billion people worldwide will have diabetes by 2050 [8,9]. Type 2 diabetes has been increasing among children and adolescents and can lead to severe complications such as atherosclerotic cardiovascular disease, stroke, myocardial infarction, renal insufficiency, neuropathy, vasculopathy, or retinopathy leading to blindness [10,11]. Cardiovascular diseases, including heart disease and stroke, are also more prevalent among obese individuals,

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contributing to higher mortality rates [12]. The incidence of cardiovascular events is expected to more than double in the next decade in some countries [13,14]. The number of obesity-related cancer cases is projected to exceed 2 million globally by 2070 [15]. Obesity is also linked to various musculoskeletal disorders, including osteoarthritis, which can cause chronic pain and disability [16]. Additionally, obesity can lead to psychological problems, such as depression, anxiety, and low self-esteem, particularly among children and adolescents [17]. Body Mass Index (BMI) is a widely recognized tool used to classify individuals' weight categories and assess potential health risks associated with body weight. It is a simple measure derived from a person's weight relative to their height and it is typically used to categorize weight status, identifying if someone is underweight, normal weight, overweight, or obese [18]. Overall, BMI is an essential tool in public health for monitoring population weight trends and it serves as a valuable indicator for healthcare professionals to initiate discussions about nutrition, physical activity, and lifestyle choices that contribute to overall well-being [19].

The commonness of obesity has reached alarming levels globally. According to the WHO, the prevalence of obesity has more than doubled since 1990. In 2022, more than 2.5 billion adults were overweight, and of these, over 890 million were obese. Similarly, in the same year, 37 million children under the age of five were overweight or obese [5]. In 2019, in Portugal, 17% of adults was classified as obese, a proportion slightly above the EU average of 16% [20]. According to the Childhood Obesity Surveillance Initiative (COSI) conducted in Portugal, although there has been a reversing trend in the prevalence of childhood obesity and overweight (-8.3% between 2008 and 2019), one in every three children is still overweight, and 10.6% are obese [21]. These trends indicate a public health crisis that requires urgent and comprehensive intervention.

To our knowledge, our study is the first to analyse the health of students in a rural area of Portugal (Guarda). The findings will provide valuable insights into the current state of student health, specifically assessing obesity rates, physical activity levels, and dietary habits in a less urbanized region of the country.

## 2. Materials and Methods

To assess the nutrition and associated behaviours among students from various educational levels (1st to 12th grade and higher education), a cross-sectional study (Figure 1) was conducted from January to July of 2024. A cross-sectional design was chosen to facilitate the identification of trends and associations between lifestyle factors and health outcomes in a large sample, given the logistical limitations of conducting long-term follow-ups in a student population. The study focused on two groups of schools, namely, (1) Agrupamento de Escolas Afonso de Albuquerque and (2) Agrupamento de Escolas da Sé, and one higher education institution, (3) Instituto Politécnico da Guarda, located in Guarda, Portugal. A comprehensive survey based on national surveys performed by other universities was developed [22], which included questions related to demographics, physical activity, sleep, sedentarism, dietary habits, substance consumption and health status (Supplementary Figure S1). Ethical approval was obtained from the Ethical Commission of Instituto Politécnico da Guarda (Document no. 8/2024) on 21 May 2024.

A total of 3,599 surveys were distributed to all the students in the two school groups, with the collaboration of the teachers. The surveys were provided in both paper and online formats, with a prior request for parental permission to participate. For younger children, parents assisted in completing the surveys at home to ensure accuracy and comprehension. Out of the 3,599 distributed surveys, 1,696 responses were received. A meticulous validation process was conducted, including a thorough double-check of each survey individually. After this process, 1,441 responses were deemed valid, resulting in a response rate of 40%, since the remaining participants did not have authorization from the parents to participate or did not complete the survey in its entirety. Regarding the higher education, a survey link was shared with 2,483 students, through the mailing list of the institution. From this cohort, 320 students completed the survey, with a response rate of 13%. All responses to the survey were collected anonymously and kept confidential to ensure privacy of the participants and encourage honest and accurate reporting.

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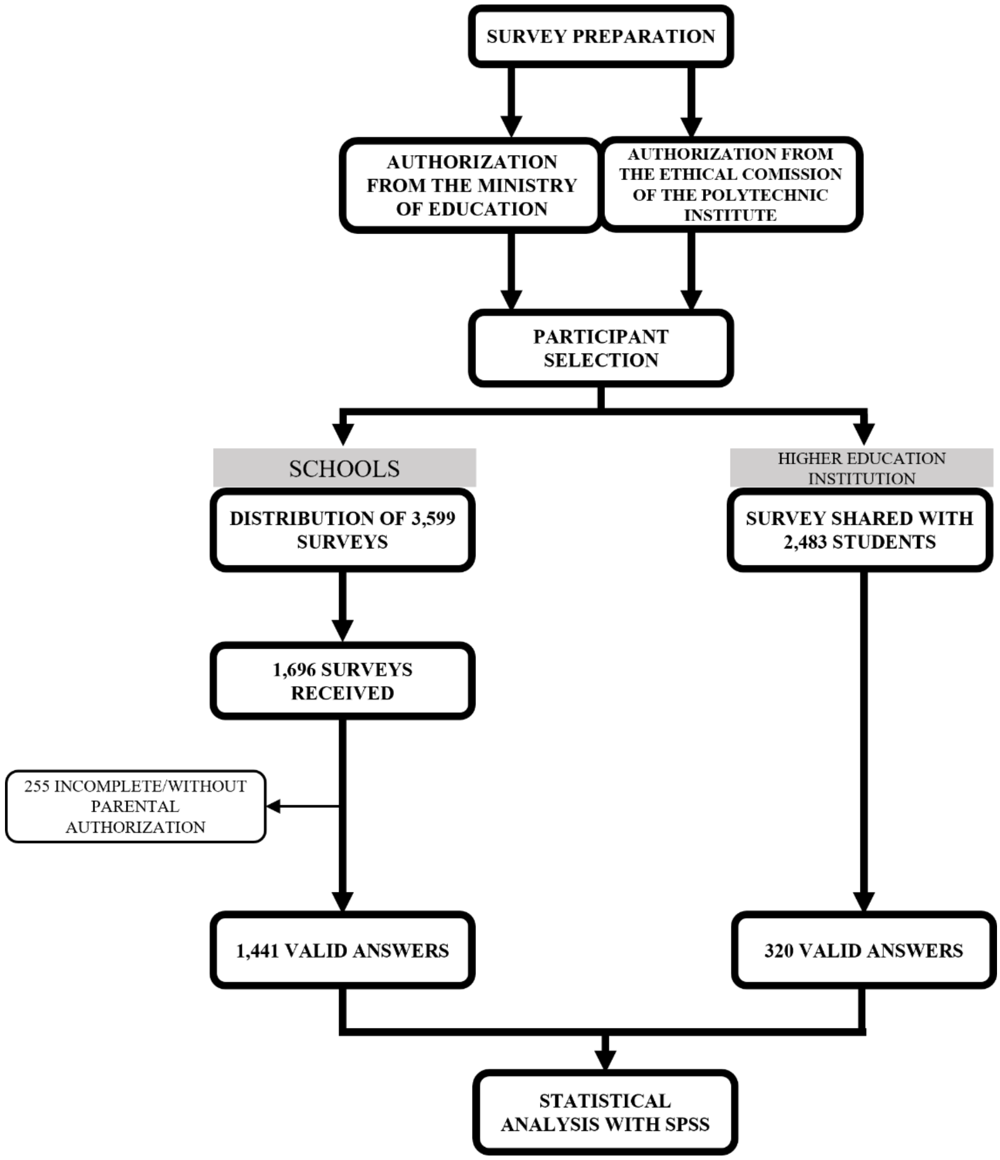


**Figure 1.** Cross-sectional study design.

The collected data was separated in the following age groups: children and adolescents (from 6 to 19 years old) and adults (over 19 years old) [5]. The study was stratified by life stages in age intervals (5-12 years, 13-19 years, 20-39 years, 40-59 years), based on commonly used classifications in public health and epidemiological research, including WHO and CDC guidelines for childhood, adolescent, and adult health assessments [23–25], although there is no universal definition of exact age groups. We defined overweight and obesity using the Body Mass Index (BMI) for each participant, which was calculated based on the self-reported height and weight, using the following formula:

$$\mathrm{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2} \quad [26]$$

BMI categories for adults were defined as: underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9), and obese (≥30, with further classes for obesity) (Table 1). For children and adolescents, BMI is age- and sex-specific, following WHO guidelines that use percentiles: healthy weight (15th–85th percentile), overweight (85th–97th percentile), obese (>97th percentile), and thinness (<15th percentile) [27,28]. This approach accounts for varying growth patterns and maturity rates.

**Table 1.** WHO weight classification according to BMI values [29].

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| BMI | Weight classification | |
|---|---|---|
| < 18.5 | Underweight | |
| 18.5 – 24.9 | Normal weight | |
| 25.0 – 29.9 | Overweight | |
| 30.0 – 34.9 | Obesity class I | Obese |
| 35.0 – 39.9 | Obesity class II | |
| ≥ 40 | Obesity class III (morbid) | |

As for the frequency of physical activity practice, it was classified as low if the individual exercises less than twice per week, as moderate if three to four times per week and heavy if more than five times per week, since the WHO recommends practising vigorous-intensity physical activity at least 3 days per week [30].

*Statistical Analysis*

Data collected from the surveys was organized and analysed using IBM SPSS Statistics version 29.0.0.0 for Windows. An exploratory analysis of the data was performed using frequency distributions, graphical representations, box plots and descriptive measures (mean, median, quartiles, standard deviation, minimum, maximum). The statistical analysis included the Fisher's exact test, chi-square tests and Independent Samples t-test to examine associations between BMI, demographic factors, dietary habits and physical activity. When appropriate, the Relative Risk (RR) was used to quantify the probability of an event occurring in the exposed group compared to its probability in the non-exposed group. Mann-Whitney U test and the Spearman's Coefficient (SC) were applied for non-parametric and correlation analyses, respectively. Lastly, binary logistic regression was used to identify factors associated with BMI categories. The 95% Confidence Intervals (CI) was carried out in situations where it was considered relevant to the study. In the statistical analysis of the results, a significance level of 5% was considered.

## 3. Results and Discussion

*3.1. Demographic Data*

Regarding children and adolescents, the results included 1545 individuals, of which 43.4% are male and 56.6% are female. This group includes 63.6% of children aged from 6 to 12 years old and 36.4% adolescents from 13 to 19 years old. 41.4% of answers are from the first cycle of education (1st to 4th grade), 17.4% belong to the second cycle (5th to 6th grade) and 18.1% to the third cycle (7th to 9th grade). 16.3% of the students are currently in high school (10th to 12th grade) and a percentage of 6.7% is enrolled in higher education.

We obtained data from a group of 217 adult students, from a higher education institution, that included 35% males and 65% females. From the participants, 93.5% belong to the age interval of 20 to 39 and 6.5% are 40 to 59 years old.

*3.2. Prevalence of Overweight and Obesity Among Students*

After the calculation of the BMI, we found that the prevalence of overweight among the children and adolescents is 17%, while 9.1% are obese (Figure 2a). A high percentage of students has a normal weight (70.1%). In Portugal, according to the COSI study, in 2021/2022, the prevalence of excess weight for children was 31.9%, from which 13.5% were obese [21]. Data from the COSI study in 33 countries from the European Region reveals a 29% prevalence of obesity in children aged 7 to 9 years old [31].

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According to the collected data, 17.5% adults are overweight, while 8.3% suffer from class I obesity, 0.9% are class II obese and 0.5% have morbid obesity. It was observed that 68.7% of adult students fell within the normal weight range (Figure 2b). According to the WHO European obesity report from 2022, obesity affects almost 60% of adults [23].

These findings suggest that students in Guarda, Portugal, show lower rates of obesity and overweight compared to national and European averages, indicating a potential health advantage in this region. A study has shown that children from rural areas and small cities practise more physical exercise than children from urban environments [32] which could help explain this difference.

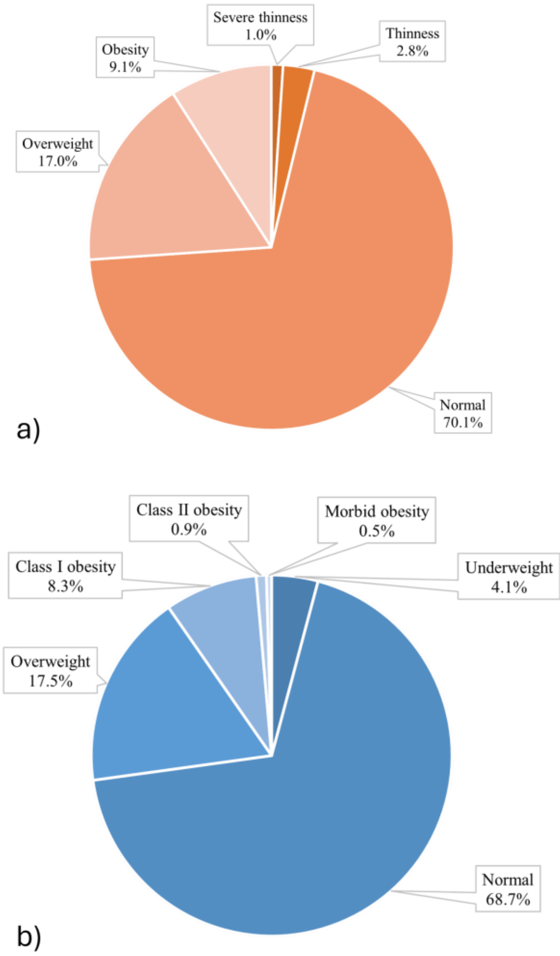


**Figure 2.** Weight status of child (a) and adult (b) students.

*3.3. Weight Status According to Sociodemographic Characteristics and Life Habits of the Students*

A dependency was found between sex and the weight classification ($P < 0.001$), according to Fisher's exact test. Following this information, Table 2 represents the prevalence of some characteristics and life habits in females and males aged from 6 to 19 years old, in relation to their weight status, according to the BMI. In male children and adolescents, variations in BMI classification are observed across different age groups, showing a statistically significant relationship between BMI and age. Boys aged 6 to 12 show a higher prevalence of overweight and obesity, at 33.4%, compared to boys aged 13 to 19, who show a prevalence of 25.8% ($P = 0.05$). A similar trend is seen among female children, where 27.4% of girls aged 6 to 12 are overweight or obese, whereas this prevalence decreases to 15.0% in girls aged 13 to 19 ($P < 0.001$). Furthermore, an Independent Samples t Test confirmed that overweight/obese children tend to be younger in both male ($P < 0.001$; $t(472.223) = 2.732$) and female students ($P < 0.001$; $t(376.01) = 5.171$). Accordingly, data from the WHO in Europe 2022 reveals that one in three school-aged children are overweight or obese, while in 10-19 years the prevalence decreases to one in four [23]. These findings suggest that younger children are more susceptible to

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higher BMI, which is worrying, potentially due to variations in physical activity levels [33]. Younger children may not be as involved in structured physical activity as adolescents, who possibly participate in school sports and extracurricular activities more often. In fact, we found a statistically significant positive and weak relationship between age and frequency of physical activity for both sexes (female: SC=0.095, $P = 0.005$; male: SC=0.340, $P < 0.001$), this indicates that adolescents practice more exercise than younger children.

The frequency of weekly physical activity also shows a correlation with BMI classification (male: $P = 0.031$; female: $P = 0.002$). The Mann-Whitney Test confirmed that males with low physical activity have a higher prevalence of overweight/obesity (34.3%) compared to those with moderate (32.3%) and heavy physical activity (22.4%) ($U = 42\ 954.5$; $P = 0.024$). Similarly, females with low physical activity had a 26.3% prevalence of overweight/obesity, while those with moderate and heavy physical activity had 19.3% and 11.9% respectively ($U = 57\ 423.5$; $P = 0.002$). This suggests that higher physical activity levels are associated with lower rates of overweight and obesity in both sexes, which is in accordance with previous studies. A systematic review of longitudinal studies found that individuals with higher physical activity levels had a significantly reduced risk of developing obesity compared to those with lower activity levels, with a lower risk of developing coronary heart disease or diabetes [34]. The Rotterdam Study, a large-scale study involving middle-aged and elderly adults, found that higher levels of physical activity significantly reduce the risk of cardiovascular disease associated with overweight and obesity [35]. The results suggest that female children that are overweight/obese spend more time sitting down during the week, (SC= 0.067, $P = 0.049$), which is consistent with what was mentioned above, since spending more time sitting down logically implies less physical activity. However, among the individuals who have a low frequency of physical activity, a substantial proportion maintains a healthy weight. We need to consider the interaction with other factors, such as genetic predisposition or metabolic rates.

Regarding disease incidence, there is an association between the weight status and having been diagnosed with diseases in males ($P = 0.035$). According to our following tests, the incidence of health conditions among overweight or obese boys is 1.27 times higher than the incidence of health conditions among boys with a normal weight (RR = 1.27; 95% CI: 1.0 – 1.6). A relationship between obesity and health complications has been intensively described before. Studies show that obese children are more likely to be diagnosed with diseases such as mental disorders, gastrointestinal disorders, metabolic syndrome, insulin resistance and non-alcoholic fatty liver disease [36–38]. Another study showed that children who are morbidly obese have even higher prevalence of diabetes/prediabetes and use more medications for asthma than obese children [39].

Lastly, we found an association between the consumption of food supplements and the weight status in male children ($P = 0.036$). Further tests determined that the incidence of overweight/obesity among boys who consume supplements is 1.4 times higher than the incidence of overweight/obesity among those who do not consume supplements (RR = 1.4; 95% CI: 1.1 – 1.9). A possible explanation could be the inappropriate usage of these products, coming from the parents' erroneous assumption that the children need to take supplements to boost their growth, when in fact they don't need them. Inappropriate usage of supplements may increase a child's calorie consumption without making up for real nutritional needs, which might result in weight gain. However, since the numbers found do not imply a direct cause-and-effect relationship, it is also possible that obese or overweight students are taking supplements to aid in weight loss, which could explain the higher incidence [40].

For other variables, there were no relations with the weight status of the children. Therefore, there was no significant relationship between the sleep and the weight status of children. However, the descriptive data analysis suggests that the people that sleep less tend to be overweight, with 44.4% of the males who sleep less than 6 hours per day being overweight or obese, compared to 30.5% who sleep 6 hours or more. For females, the percentages were, respectively, 25.0% and 22.2%. A study analysed data from the National Health Interview Survey in the US and stated that individuals who sleep less than the recommended 7-8 hours per night have significantly higher odds of being overweight or obese, increasing in the past years. Short sleepers (5-6 hours per night) had a 57%

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greater risk of obesity, while very short sleepers (less than 5 hours per night) were twice as likely to be obese compared to those who get adequate sleep [41]. Although no significant relationship was found between sleep duration and the weight, it is important to consider that we did not evaluate directly the sleep quality. Research suggests that the quality of sleep plays a significant role in weight management, disrupting the metabolism and increasing appetite which might lead to weight gain and obesity [42].

**Table 2.** Characteristics and habits of children and adolescent students, categorized by weight status and separated by sex.

| | | **Male BMI classification (n=670)** | | | | | **Female BMI classification (n=875)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Underweight/Normal weight** | | **Overweight/Obesity** | | **P-value** | **Underweight/Normal weight** | | **Overweight/Obesity** | | **P-Value** |
| | | **n** | **% (CI)** | **n** | **% (CI)** | | **n** | **% (CI)** | **n** | **% (CI)** | |
| **Age in years** | 6 - 12 | 299 | 66.6(62.1-70.8) | 150 | 33.4(29.2-37.9) | 0.050 | 387 | 72.6(68.7-76.3) | 146 | 27.4(23.7-31.3) | <0.001 |
| | 13 - 19 | 164 | 74.2(68.2-79.6) | 57 | 25.8(20.4-31.8) | | 292 | 85.4(81.3-88.8) | 50 | 14.6(11.2-18.7) | |
| **Frequency of weekly physical activity** | Low | 188 | 65.7(60.1-71.1) | 98 | 34.3(28.9-39.9) | 0.031 | 368 | 73.7(69.8-77.5) | 131 | 26.3(22.5-30.2) | 0.002 |
| | Moderate | 157 | 67.7(61.5-73.4) | 75 | 32.3(26.6-38.5) | | 222 | 80.7(75.8-85.1) | 53 | 19.3(14.9-24.2) | |
| | Heavy | 118 | 77.6(70.5-83.7) | 34 | 22.4(16.3-29.5) | | 89 | 88.1(80.8-93.3) | 12 | 11.9(6.7-19.2) | |
| **Hours of sleep per day** | < 6 | 10 | 55.6(33.2-76.3) | 8 | 44.4(23.7-66.8) | 0.207 | 36 | 75.0(61.5-85.5) | 12 | 25.0(14.5-38.5) | 0.721 |
| | ≥ 6 | 453 | 69.5(65.9-72.9) | 199 | 30.5(27.17-34.1) | | 643 | 77.8(74.8-80.5) | 184 | 22.2(19.5-25.2) | |
| **Hours spent sitting down, daily during the week** | < 6 | 150 | 70.1(63.7-75.9) | 64 | 29.9(24.1-36.3) | 0.721 | 181 | 73.3(67.5-78.5) | 66 | 26.7(21.5-32.5) | 0.059 |
| | ≥ 6 | 313 | 68,6(64.3-72.8) | 143 | 31.4(27.2-35.7) | | 498 | 79.3(76.0-82.3) | 130 | 20.7(17.7-24.0) | |
| **Hours spent sitting down, daily during the weekend** | < 6 | 322 | 70.5(66.2-74.5) | 135 | 29.5(25.5-33.8) | 0.282 | 461 | 78.1(74.5-81.2) | 130 | 22.0(18-8-25.5) | 0.729 |
| | ≥ 6 | 141 | 66.2(59.7-72.3) | 72 | 33.8(27.7-40.3) | | 218 | 76.8(71.6-81.4) | 66 | 23.2(18.6-28.4) | |
| **Number of daily meals** | ≤ 3 | 50 | 64.9(53.9-74.9) | 27 | 35.1(25.1-46.1) | 0.432 | 95 | 81.2(73.4-87.5) | 22 | 18.8(12.5-26.6) | 0.343 |
| | > 3 | 413 | 69.6(65.9-73.2) | 180 | 30.4(26.8-34.1) | | 584 | 77.0(74.0-79.9) | 174 | 23.0(20.1-26.0) | |
| **Diagnosed with disease(s)** | Yes | 148 | 63.8(57.5-69.8) | 84 | 36.2(30.2-42.5) | 0.035 | 229 | 78.2(73.2-82.6) | 64 | 21.8(17.4-26.8) | 0.797 |
| | No | 315 | 71.9(67.5-76.0) | 123 | 28.1(24.0-32.4) | | 450 | 77.3(73.8-80.6) | 132 | 22.7(19.4-26.2) | |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Medication** | Yes | 66 | 70.2(60.5-78.7) | 28 | 29.8(21.3-39.5) | 0.904 | 90 | 79.6(71.5-86.3) | 23 | 20.4(13.7-28.5) | 0.630 |
| | No | 397 | 68.9(65.1-72.6) | 179 | 31.1(27.4-34.9) | | 589 | 77.3(74.2-80.2) | 173 | 22.7(19.8-25.8) | |
| **Dietary supplementation** | Yes | 45 | 58.4(47.3-69.0) | 32 | 41.6(31.0-52.7) | 0.036 | 66 | 77.6(68.1-85.5) | 19 | 22.4(14.5-32.0) | 1.000 |
| | No | 418 | 70.5(66.7-74.1) | 175 | 29.5(25.9-33.3) | | 613 | 77.6(74.6-80.4) | 177 | 22.4(19.6-25.4) | |

The characteristics of adult students were categorized similarly (Table 3). Among males aged 20-39, 30.0% were overweight/obese, compared to 24.1% of females in the same age group. The sample size for the 40-59 years old group was not relevant.

A relationship between smoking and weight was found in women (P = 0.002). The incidence of obese woman is much higher in the smoking group (48.1%) than in the no smokers' group (18.4%). The relative risk of being obese/overweight in the group of women who smoke is 2.6 times the risk in the group of non-smokers (RR = 2.6; 95% CI: 1.5 – 4.5). Studies suggest that the relationship between smoking and obesity may vary with age and smoking intensity. Younger or heavy smokers tend to show higher rates of obesity, while older or light smokers are more likely to exhibit lower BMIs, often attributed to the appetite-suppressing effects of nicotine [43,44]. However, given the small sample size of the smoking group in our study (only 27 smokers out of 141 women), this estimate lacks precision, and no definitive conclusions can be drawn. Larger studies are needed to clarify these results.

Alcohol consumption was significantly associated with the weight status among adult males, with 46.9% of those who consumed alcohol being overweight/obese compared to 22.7% of non-drinkers (P = 0.047). This association suggests that alcohol consumption may be a significant risk factor for overweight and obesity. However, previous research seems to lack consensus on this relationship. A review about alcohol and obesity stated that moderate alcohol consumption does not appear to be a significant risk factor for obesity, while heavy drinking and changes in alcohol consumption patterns can possibly contribute to weight gain and obesity. However, long-term effects and gender-specific responses are not yet well understood [45]. In another study of the Irish population, the individuals who drank heavily were more likely to be obese (high BMI and large waist circumference (WC)), but binge drinkers were more likely to have a larger WC and frequent alcohol consumers were less likely to be obese, suggesting a complex relationship between alcohol use and body weight [46].

The last variable that showed a significant relationship with the weight status was the consumption of supplements for memory enhancement in males. Among male students who use this kind of supplementation, 61.5% are overweight or obese (P = 0.024). However, even though the difference seems to be large, the small number of participants using memory aid supplements (13 men and 26 women) does not allow us to draw conclusions about this relationship.

**Table 3.** Characteristics and habits of adult students, categorized by weight status and separated by sex.

| | | Male BMI classification (n=76) | | | | | Female BMI classification (n=141) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Underweight/Normal weight | | Overweight/Obesity | | P-value | Underweight/Normal weight | | Overweight/Obesity | | P-Value |
| | | n | % (C.I.) | n | % (C.I.) | | n | % (C.I.) | n | % (C.I.) | |
| **Age in years** | 20 - 39 | 49 | 70.0(58.6-79.8) | 21 | 30.0(20.2-41.4) | 0.087 | 101 | 75.9(68.2-82.6) | 32 | 24.1(17.4-31.8) | 1.000 |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40 - 58 | 2 | 33.3(7.70-71.4) | 4 | 66.7(28.6-92.3) | | 6 | 75.0(40.8-94.4) | 2 | 25.0(5.6-59.2) | |
| **Frequency of weekly physical activity** | Low | 29 | 64.4(49.9-77.2) | 16 | 35.6(22.8-50.1) | 0.647 | 68 | 74.7(65.1-82.8) | 23 | 25.3(17.2-34.9) | 0.894 |
| | Moderate | 13 | 76.5(53.3-91.5) | 4 | 23.5(8.5-46.7) | | 20 | 76.9(58.5-89.7) | 6 | 23.1(10.3-41.5) | |
| | Heavy | 9 | 64.3(38.5-84.9) | 5 | 35.7(15.1-61.5) | | 19 | 79.2(60.2-91.6) | 5 | 20.8(8.4-39.8) | |
| **Hours of sleep per day** | < 6 | 11 | 64.7(41.1-83.7) | 6 | 35.3(16.3-58.9) | 1.000 | 19 | 82.6(63.8-93.8) | 4 | 17.4(6.2-36.2) | 0.595 |
| | ≥ 6 | 40 | 67.8(55.2-78.6) | 19 | 32.2(21.4-44.8) | | 88 | 74.6(66.2-81.8) | 30 | 25.4(18.2-33.8) | |
| **Hours spent sitting down, daily, during the week** | < 6 | 24 | 68.6(52.2-82.0) | 11 | 31.4(18.0-47.8) | 1.000 | 42 | 77.8(65.4-87.2) | 12 | 22.2(18.2-34.6) | 0.840 |
| | ≥ 6 | 27 | 65.9(50.7-78.9) | 14 | 34.1(21.1-49.3) | | 65 | 74.7(64.9-82.9) | 22 | 25.3(17.1-35.1) | |
| **Hours spent sitting down, daily, during the weekend** | < 6 | 36 | 67.9(54.7-79.3) | 17 | 32.1(20.7-45.3) | 1.000 | 65 | 77.4(67.6-85.3) | 19 | 22.6(14.7-32.4) | 0.690 |
| | ≥ 6 | 15 | 65.2(44.9-82.0) | 8 | 34.8(18.0-55.1) | | 42 | 73.7(61.3-83.7) | 15 | 26.3(16.3-38.7) | |
| **Number of daily meals** | ≤ 3 | 24 | 68.6(52.2-82.0) | 11 | 31.4(18.0-47.8) | 1.000 | 35 | 67.3(53.9-78.9) | 17 | 32.7(21.1-46.1) | 0.102 |
| | > 3 | 27 | 65.9(50.7-78.9) | 14 | 34.1(21.1-49.3) | | 72 | 80.9(71.8-88.0) | 17 | 19.1(12.0-28.2) | |
| **Smoking** | Yes | 13 | 76.5(53.3-91.5) | 4 | 23.5(8.5-46.7) | 0.398 | 14 | 51.9(33.6-69.7) | 13 | 48.1(30.3-66.4) | 0.002 |
| | No | 38 | 64.4(51.7-75.7) | 21 | 35.6(24.3-48.3) | | 93 | 81.6(73.7-87.9) | 21 | 18.4(12.1-26.3) | |
| **Alcohol consumption** | Yes | 17 | 53.1(36.2-69.5) | 15 | 46.9(30.5-63.8) | 0.047 | 15 | 65.2(44.9-82.0) | 8 | 34.8(18.0-55.1) | 0.194 |
| | No | 34 | 77.3(63.4-87.7) | 10 | 22.7(12.3-36.6) | | 92 | 78.0(69.9-84.7) | 26 | 22.0(15.3-30.1) | |
| **Opioids consumption** | Yes | 3 | 75.0(28.4-97.2) | 1 | 25.0(2.8-71.6) | 1.000 | 0 | 0 | 0 | 0 | 1.000 |
| | No | 48 | 66.7(55.3-76.7) | 24 | 33.3(23.3-44.7) | | 107 | 75.9(68.3-82.4) | 34 | 24.1(17.6-31.7) | |
| **Diagnosed with disease(s)** | Yes | 23 | 65.7(49.2-79.7) | 12 | 34.3(20.3-50.8) | 1.000 | 65 | 75.6(65.8-83.7) | 21 | 24.4(16.3-34.2) | 1.000 |
| | No | 28 | 68.3(53.2-80.9) | 13 | 31.7(19.1-46.8) | | 42 | 76.4(64.6-86.1) | 13 | 23.6(13.9-36.0) | |
| **Medication** | Yes | 4 | 50.0(19.9-80.1) | 4 | 50.0(19.9-80.1) | 0.427 | 35 | 71.4(57.8-82.6) | 14 | 28.6(17.4-42.2) | 0.411 |
| | No | 47 | 69.1(57.5-79.1) | 21 | 30.9(20.9-42.5) | | 72 | 78.3(69.0-85.7) | 20 | 21.7(14.3-31.0) | |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dietary supplementation** | Yes | 10 | 76.9(50.3-93.0) | 3 | 23.1(7.0-49.7) | 0.526 | 23 | 79.3(62.2-90.9) | 6 | 20.7(9.1-37.8) | 0.808 |
| | No | 41 | 65.1(52.8-76.0) | 22 | 34.9(24.0-47.2) | | 84 | 75.0(66.4-82.3) | 28 | 25.0(17.7-33.6) | |
| **Memory enhancement supplementation** | Yes | 5 | 38.5(16.5-65.0) | 8 | 61.5(35.0-83.5) | 0.024 | 16 | 61.5(42.4-78.2) | 10 | 38.5(21.8-57.6) | 0.075 |
| | No | 46 | 73.0(61.2-82.8) | 17 | 27.0(17.2-38.8) | | 91 | 79.1(71.0-85.8) | 24 | 20.9(14.2-29.0) | |

The findings highlight critical relationships between weight status and several factors, such as age, physical activity, and lifestyle habits. Younger children, especially boys, demonstrate higher rates of overweight and obesity. Physical activity is strongly associated with healthier BMI in both male and female children, reinforcing the need for an active lifestyle. Although correlations with supplement intake, smoking, and alcohol consumption were observed, the limited sample sizes in some categories limit the conclusions.

Other factors should be considered when evaluating a population's habits and health outcomes. The socioeconomic status, for example, is one of the factors that can influence dietary habits (for example, higher consumption of more affordable energy dense foods) and access to physical activity resources, possibly influencing behaviours and, consequently, the prevalence of obesity and overweight [47]. Furthermore, psychological variables like academic stress (which can lead to depression and anxiety) may have an indirect impact on weight, by influencing certain behaviours like the practise of regular exercise or affecting sleep [48].

It is important to sensitise parents, in an educational way, about the importance of balanced diets and regular physical activity for their children. Schools should implement programs that encourage active play and provide nutritious meals, promoting healthier habits from a young age. Furthermore, community-based programs that provide access to nutritious foods and exercise opportunities could enhance children's health outcomes and support the fight against the rising incidence of childhood obesity.

### *3.4. Food Habits of the Student Community*

We then analysed the frequency of food consumption among children and adults, identifying notable trends. Regarding children (Figure 3a), in the cereal, sugar and sweets category, the preferred foods are white bread, breakfast cereals and cookies, with a median consumption of about 2 to 4 days per week. The consumption of bread shows a wide distribution among children. Whole wheat bread is less consumed than white bread, with a lower distribution, showing that a higher percentage of children does not consume this type of bread. In western diets, it is an often practice to consume bread in breakfast, sandwiches, snacks, and other. However, whole wheat bread should be chosen over white bread for its content in whole grains, which have been associated with lower BMI [49].

Whole grains, being a source of fibres, vitamins, minerals, phenolic compounds and other important components, have been related to health benefits and improvement of insulin sensitivity [50]. Cakes and salted snacks are consumed moderately by most children, with a median of 1 to 3 days per month. Perhaps they are associated with special occasions, and they are considered unhealthy foods, leading to a limited consumption. Salted snacks show a few outliers with more frequent consumption, which could be of concern regarding unhealthy eating habits. Honey has the lower frequency (median at less than once per month), suggesting it might not be such a common ingredient in children's diets.

Regarding fruit and vegetables, fruits and soups are being consumed regularly, up to 2 times in the same day. Some outliers can be noticed in the fruit category, showing that some children still do not include fruits in their diets. Natural fruit juices are consumed less often by children, which could possibly reflect the growing awareness among parents of the higher sugar content of these fruit

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products or due to the increased time and effort that the preparation of these juices requires. The World Health Organization recommends a daily intake of at least 400 g (5 portions) of fruit and vegetables, in order to prevent noncommunicable diseases (NCDs), such as diabetes, cancer, heart disease and stroke [29,51].

In the meat section, it is noticeable that the consumption of red and white meat is consistent, given the median of about 2 to 4 times per week, but 50% of the participants eat each one less/more than 2 to 4 times per week. This could mean that the meals include a balance between the two types of meat, however, there is a wider distribution for the red meat, with more children consuming less but also more often. Given the health risks associated with the higher levels of saturated fats in these products, consumption of red meat needs to be moderated, having been linked to a higher risk of cardiovascular disease development [52]. The more consistent consumption pattern of white meats, may reflect an inclination of the parents towards healthier and leaner proteins, recommended by nutritional guidelines [53]. Processed meats have a slightly lower consumption with 50% of participants doing so between one to three days per month, and 1 day per week (median), which is positive, given the known health risks associated with processed meats, such as their high sodium and saturated fat content and the presence of preservatives like nitrates, which have been linked to increased risk of breast, colorectal, colon, rectal and lung cancers [54]. Consuming less than 500 g of red meat per week and no to little processed meat is advised by the World Cancer Research Fund (WCRF) [55]. The UK Scientific Advisory Committee on Nutrition (SACN)'s advised for the consumption of red and processed meat fewer than 70 g per day [56].

While fish seems to be present in the diets of children, it is not consumed as frequently as meat. Clearly, there is a general tendency to prioritize meat consumption over fish. Fatty and lean fish are consumed in a median of once per week, with 50% of participants doing so less than once per week. Both types of fish should be included in the diets of children, particularly, fatty fish, including salmon and mackerel. These fishes are rich in omega-3 fatty acids, essential for brain development and health [57,58]. Shellfish has the lowest consumption frequency, with most children consuming it less than once per month, possibly due to the high costs of this type of food, availability questions or even the distinctive and strong taste that might not be too appealing for younger palates.

Eggs are generally consumed around 2 to 4 days of the week by most children, with a narrow distribution, which is in accordance with European recommendations for moderate egg consumption by children [59].

Milk and yogurt stand out as the most frequently consumed dairy products. Milk has a median consumption of once per day, having a significant role in children's diets. Daily intake is recommended by European guidelines for a healthy diet [60] as a source of calcium and protein. The consumption of cheeses is far less frequent, and soy alternatives show almost no consumption. Plant-based dairy alternatives are not yet widely adopted by children, most likely being consumed more often in households with specific restrictions.

While sugary sodas and juices are present in children's diets, their consumption is moderate, with a median of 1 to 3 days per month, which suggests an awareness of their health impacts. Outliers indicate that a small part of the community can be consuming these drinks as often as in a daily dose, which is concerning due to their sugar content. Given the extensively studied relationship between free sugars intake and obesity and dental caries. The WHO recommends a reduction of the consumption of these sugars, to less than 10% of the total energy intake, if possible, under 5% of the total energy intake, for children and adults [61]. The consumption of light juices and sodas is even less frequent, with some outliers that could indicate the presence of some concerns and awareness about sugar intake.

The total distribution of tea and infusions consumption, which ranges from once a month to every day, suggests that they occasionally drink them, maybe as a result of their health benefits. Coffee and coffee substitutes show no significant consumption among children, as expected and recommended. Caffeine is not advised for children consumption, since their potential negative effects in younger populations are yet unknown [62].

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Fast-food showed a relatively low median, with consumption frequency of one to three times per month, with 50% of participants doing so less times, indicating that it is viewed as occasional treat instead of a regular meal option. However, some outliers are concerning, with some children possibly consuming fast food on a daily basis. Fast-food meals have a higher content of solid fat (23.9% of total energy) than foods from retail stores (17.6%) or schools (20.9%) [63]. Also, the consumption of these foods is also often associated with consumption of sweetened beverages and lower intake of vegetables, fruit and milk, increasing total energy intake and leading to a poor-quality diet [64,65]. Some families may rely on this type of meals due to their convenience, accessibility and socioeconomic factors [66].

The trends for adults are very similar, with a few exceptions (Figure 3b). Regarding the first food group, the adults eat breakfast cereal, cookies and other sweets slightly less frequently than children's students. Given that these products are frequently more closely linked to children and are widely promoted to younger audiences, this outcome is to be expected. Adults may also avoid these snacks, since they can be more conscious of their dietary choices.

Regarding vegetables and fruits, adult students seem to consume all the categories (fruit, soup, fruit natural juices and cooked vegetables) slightly less often than the children. Adults might be more likely to choose quicker and less nutritious options due to time constraints, while children may have more balanced meals with more structured mealtimes at school or home. Additionally, schools and parents tend to promote the consumption of fruits and vegetables as part of healthy eating habits for children, while adults may not receive the same external encouragement or monitoring. Socioeconomic factors could also play a role, limiting the access to fresh produce for some adult students.

Adults consume eggs at a more varied frequency than children, ranging from daily intake to no consumption, perhaps due to some dietary restrictions. The median frequency of consumption of light sodas and juices is slightly higher in adults, who may choose these beverages as an effort to manage weight or reduce sugar intake, which typically is not often a concern of children.

The consumption of coffee among adults is frequent, with a median of 4 to 6 days per week. The frequency has a high diversity, with 75% students drinking from zero to one time per day. However, coffee is a regular part of the daily routine of adults, with 25% of the students drinking coffee every day, from one to two or more times per day. Coffee, as a major source of caffeine, is well-known for its stimulating effects that help with concentration, fatigue management and alertness, which are particularly important for students in their demanding studying schedules. Coffee also has a role in adults' social and work environments, often being a central part of routine and social gatherings, which is a particularly common practice in Portugal. Improving of attentiveness and the taste of caffeine products are the main reasons for their consumption in the country [67]. Adding to the energy related benefits of coffee, moderate consumption as health benefits giving its content in antioxidants, which has been linked with a reduced risk of diseases such as Parkinson and Alzheimer [68]. However, high caffeine intake has been associated in students with negative health effects, such as depression, anxiety and sleep issues [69].

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**Figure 3.** Consumption frequency of different groups of food by children (a) and adults (b). 1 – never; 2 – less than once per month; 3 – one to three days per month; 4 – one day per week; 5 – two to four days per week; 6 – four to six days per month; 7 – once per day; 8 – twice or more per day.

Statistically, we did not find any relevant associations between the consumption of certain groups of food and the weight status of the students (Supplementary Figures S2 and S3). Cooked vegetables show a P-value of 0.029 for children and 0.016 for adults. Adding cooked vegetables to meals may significantly increase the daily vegetable intake of the individuals, beyond other vegetable sources such as soup. Vegetables are a good source of essential vitamins, minerals, and fibre, which promote satiety and help regulate caloric intake, which can help maintaining a healthy body weight [70]. However, other foods within these two food groups did not show significant differences between the weight groups, indicating the absence of a consistent trend across them. We also found a significance for coffee (P = 0.003) and for tea and infusions (P = 0.034) in the case of children,

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however, these beverages are not often consumed by them, particularly coffee, which limits the relevance of this finding. For the adults, we also found a significance for coffee consumption (P < 0.001). An association between a higher BMI and the consumption frequency of coffee (Spearman's correlation coefficient = 0.260; P < 0.001) has been observed. The literature did not provide any evidence of an association between caffeine consumption and weight changes. We should consider examining whether individuals drink their coffee with sugar or not, as this could lead to an increase in daily caloric intake, which can be a possible explanation for weight gain related to coffee consumption. A study about coffee intake inversely associated an increase in intake of unsweetened caffeinated and decaffeinated coffee with weight gain [71].

Lastly, there is significance for the adults in the soy alternatives (P = 0.030), but the consumption of these foods is not significant for this group. While these few values show significance, they are not enough to suggest meaningful associations between food consumption and the weight status of the students.

While no strong statistical associations were found between specific food groups and weight status, the consumption patterns observed in both children and adults suggest overall healthy dietary habits in this region. For example, processed and fast-food consumption appears to be relatively moderate, with most students consuming these foods occasionally. This suggests that, compared to more urbanized areas where fast-food is more accessible and frequently consumed, students in Guarda may follow more traditional dietary habits, which could contribute to the lower obesity rates observed in this study. Similarly, the relatively low intake of sugary sodas and juices suggests a degree of awareness and regulation in sugar consumption. Additionally, the higher prevalence of home-cooked meals, including regular consumption of soups and vegetables, aligns with traditional Mediterranean diet patterns, which are associated with better health outcomes [72,73]. This could reflect the influence of a more rural environment, where access to fresh, local produce may be more common than in more populated cities, where processed and convenience foods dominate [74]. Moreover, lower dependence on processed meats and moderate red meat consumption indicates that families in this region may prioritize fresh, unprocessed protein sources, which is an important factor in preventing diet-related diseases [75].

### *3.5. Disease Incidence in the Student Community*

Lastly, we analysed the incidence of diseases in the student community, through questioning the students if they have ever been diagnosed with any disease. Firstly, we found that 66% of the children have never been diagnosed with health problems before, and 34% have been diagnosed with at least one (Table 4). These results are a positive indicator of general health in the community. The most prevalent diseases found among the community of children and adolescent students were allergic (18.1%), pulmonary (8.2%), skin (7.9%), gastrointestinal (3.4%) and mental diseases (2.4%). Furthermore, we found no significant association between the diagnosis of any of the diseases and the weight status (Supplementary Figures S4-S8). An association between the age and the diagnosis of diseases was observed, with older children having a higher disease incidence than younger ones (U = 201381.5; Z = -8.019; P <0.001).

Regarding adult students, 55.8% has been diagnosed with one or more diseases before, while 44.2% has not. The most common diseases among this group, similarly to the children, are allergic (32.7%), pulmonary (11.1%), skin (10.1%), mental (9.2%) and gastrointestinal diseases (7.8%). In this case, we found a significant relationship between the weight status and the diagnosis of pulmonary diseases (P = 0.03) (Supplementary Figures S9-S13). When we calculate the relative risk, we can observe that the incidence of pulmonary diseases in the overweight/obese group is 2.3 higher than the underweight/normal group. A higher BMI is associated with reduced lung volume, which can manifest as a restrictive ventilatory pattern on spirometry, including reductions in expiratory reserve volume and functional residual capacity. Obese individuals may also experience decreased vital capacity, total lung capacity, and altered expiratory flow rates due to increased residual volume and

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airway resistance. Clinically, these patients tend to have a higher respiratory rate, leading to increased oxygen consumption [76].

An allergy epidemic has been blooming, with increased prevalence of atopic diseases such as allergic rhinitis, asthma, food allergies, conjunctivitis and atopic dermatitis, attributed to factors like diet, the hygiene hypothesis (reduced exposure to microbes early in life), air pollution, climate change and urbanization [77]. A cross-sectional study from primary schools in Belgium 2019 describes a prevalence of allergic rhinitis of 29.3%, with asthma being the most significant related comorbidity [78]. According to Asher M. et al. (2020), asthma is the most frequent chronic disease among children, worldwide. A systematic review from 2023 describes that prenatal and early-life exposure to traffic-related air pollution can significantly increase the risk of allergic rhinitis in children [79]. Although Guarda is not a highly urbanized area, environmental pollutants may still play a role, particularly considering exposure to allergens, seasonal changes, and dietary factors.

With 66% of children and 44.2% of adults reporting no previous diagnosis of disease, the overall health status of the student community appears relatively positive.

**Table 4.** Incidence of diseases in children and adult students.

| | | Children | | Adults | |
|---|---|---|---|---|---|
| | | **Number of students** | **Percentage** | **Number of students** | **Percentage** |
| **Diagnosed with diseases(s)** | Yes | 525 | 34.0% | 121 | 55.8% |
| | No | 1020 | 66.0% | 96 | 44.2% |
| **Diagnosis** | Allergic diseases | 279 | 18.1% | 71 | 32.7% |
| | Pulmonary diseases | 126 | 8.2% | 24 | 11.1% |
| | Skin diseases | 122 | 7.9% | 22 | 10.1% |
| | Gastrointestinal diseases | 52 | 3.4% | 17 | 7.8% |
| | Mental diseases | 37 | 2.4% | 20 | 9.2% |
| | Heart diseases | 29 | 1.9% | 6 | 2.8% |
| | Blood diseases | 26 | 1.7% | 5 | 2.3% |
| | Kidney diseases | 23 | 1.5% | 8 | 3.7% |
| | Bone diseases | 21 | 1.4% | 5 | 2.3% |
| | Metabolic diseases | 15 | 1.0% | 7 | 3.2% |
| | Hypertension | 11 | 0.7% | 11 | 5.1% |
| | Type 1 Diabetes | 5 | 0.3% | 1 | 0.5% |
| | Dyslipidaemia | 5 | 0.3% | 3 | 1.4% |
| | Cancer | 1 | 0.1% | 1 | 0.5% |
| | Stroke | 1 | 0.1% | 2 | 0.9% |
| | Type 2 Diabetes | 0 | 0.0% | 0 | 0.0% |

### *3.6. Logistic Regression Model*

Lastly, we performed a binary logistic regression model to analyse all the variables in our study in relation to the BMI, separately for children and adults. The pre-requisites for performing the model were verified in both cases, and no multicollinearity was found between the independent variables, meaning that the variables used in the model are not highly correlated. Additionally, no outliers were

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identified in the model and there is a sufficient number of records per variable. The model performed 5 steps for the children's data and 6 for adults.

The analysis used the Forward method, revealing low $R^2$ values (Table S1), which indicates moderate predictive capacity. In our case, this may not be critical, as our primary objective is to identify associations between dependent and independent variables rather than to make precise predictions.

The Hosmer-Lemeshow test indicated that the model is adequate, in both cases, with a significance value of 0.267 for children and 0.365 for adults, which is higher than the significance level of 0.05. This suggests that the model satisfactorily explains the dependent variable (obesity/overweight) with the independent variables.

In line with our previous analysis, the model presented some significant relationships. Regarding children (Table 5), the likelihood of overweight/obesity decreases with age (B = -0.137) indicating 12.8% of reduction in the odds if obesity per year (Exp(B) = 0.872). The amount of sleep was associated with a lower probability of obesity (B = -0.561). Sleeping more hours reduces the likelihood of obesity by 42.9% (Exp(B) = 0.571). A positive coefficient (B = 0.288) suggests that more time sitting down during the weekend increases the probability of obesity, with a 33.4% increase in the likelihood of obesity for more sitting hours during the weekend (Exp(B) = 1.334).

Lastly, females have a 43.8% reduction in the odds of being obese, compared to males (B = -0.576; Exp(B) = 0.562). In the past, data from Poland revealed a greater prevalence of obesity in boys than girls [80]. Another study with national Canadian data observed a higher prevalence of obesity in boys compared with girls aged 3–19 [81]. According to Shah et al., some biological variations in the body of girls and boys could explain this difference: girls tend to have greater fat mass and lower fat-free mass (e.g., muscle), which affects energy requirements, with girls requiring fewer calories than boys, thus reducing the risk of excess weight gain; girls have higher levels of leptin, a hormone that suppresses appetite and promotes energy utilization, while boys have higher levels of androgens, which suppress leptin production, leading to potentially higher appetite; some studies suggest that brown adipose tissue, which helps burn calories, is more prevalent in females [82].

In the case of adults, the significance found for soy alternatives and coffee substitutes (Table 5) does not seem relevant, as previously we observed a low consumption of these products. A positive coefficient (B = 0.329) suggests that consuming light sodas increases the likelihood of obesity by 39% (Exp(B) = 1.390). Although these beverages contain less sugar, their consumption could potentially be associated with other unhealthy habits, such as the consumption of fast-foods or regularly alternating between sugary and light beverages. For coffee, we found that a higher consumption increases the likelihood of obesity by 29.5% (B = 0.258; Exp(B) = 1.295). In the case of tea and infusions, their consumption is associated with a 35.9% increase in the likelihood of obesity (B = 0.307; Exp(B) = 1.359). As we previously suggested, these associations could be related to the addition of sugar to these beverages, which needs to be further analysed.

**Table 5.** Logistic regression results for significant variables in Step 5 and Step 6, for children's and adults' data, respectively.

| | | B | S.E. | Wald | df | Sig. | Exp(B) | 9.5% C.I. for EXP(B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | **Lower** | **Upper** |
| | | | | **Children** | | | | | |
| Step 5 | **Age** | -0.137 | 0.026 | 27.127 | 1 | <0.001 | 0.872 | 0.829 | 0.918 |
| | **Time of sleep per day** | -0.561 | 0.144 | 15.071 | 1 | <0.001 | 0.571 | 0.430 | 0.758 |
| | **Hours spent sitting down,** | 0.288 | 0.090 | 10.369 | 1 | 0.001 | 1.334 | 1.119 | 1.590 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **daily, during the weekend** | | | | | | | | |
| | **Cookies** | -0.168 | 0.050 | 11.264 | 1 | <0.001 | 0.845 | 0.767 | 0.933 |
| | **Sex*** | -0.576 | 0.160 | 12.907 | 1 | <0.001 | 0.562 | 0.410 | 0.770 |
| | **Constant** | 2.704 | 0.736 | 13.489 | 1 | <0.001 | 14.934 | | |
| | | | | | **Adults** | | | | |
| Step 6 | **Cookies** | 0.307 | 0.128 | 5.703 | 1 | 0.017 | 1.359 | 1.057 | 1.748 |
| | **Soy alternatives** | -0.840 | 0.329 | 6.534 | 1 | 0.011 | 0.432 | 0.227 | 0.822 |
| | **Light sodas** | 0.329 | 0.136 | 5.850 | 1 | 0.016 | 1.390 | 1.064 | 1.815 |
| | **Tea and infusions** | 0.307 | 0.115 | 7.094 | 1 | 0.008 | 1.359 | 1.084 | 1.702 |
| | **Coffee** | 0.258 | 0.082 | 9.867 | 1 | 0.002 | 1.295 | 1.102 | 1.521 |
| | **Coffee substitutes** | -0.320 | 0.131 | 5.981 | 1 | 0.014 | 0.726 | 0.562 | 0.938 |
| | **Constant** | -3.894 | 0.991 | 15.443 | 1 | <0.001 | 0.020 | | |

*1=Male;2=Female. B = regression coefficient; S.E. = standard error; Wald = Wald chi-square test; df = degrees of freedom; Sig. = significance level; Exp(B) = odds ratio; C.I. = confidence interval.

## 4. Limitations and Future Perspectives

Although our study provides valuable insights into the health and nutritional status of a group of students, it is important to acknowledge some limitations. First, the cross-sectional design limits our ability to establish causality between nutritional and lifestyle habits and obesity. Since the data is collected at a single point in time, we cannot analyse changes over time or determine the direction of relationships. Additionally, the use of self-reported data introduces potential biases, since participants might overestimate or underestimate their responses due to social constraint or inaccurate memory, which can affect the validity of our findings. Some participants may feel uncomfortable disclosing information about sensitive topics, such as weight, dietary habits and consumption of substances, especially the younger individuals. Furthermore, using a single measure like BMI does not allow us to fully evaluate the health status of the participants, since it does not account for body fat and muscle and, in the case of adults, for sex and age.

While the initial number of surveys was high, the rate of response was not ideal (40% for schools and 13% for high education), which may affect the results. Those who responded might have a greater interest in health-related topics or different lifestyle habits compared to non-respondents. Additionally, it is possible that students with overweight or obesity may have been less willing to participate in the survey due to discomfort or self-consciousness about sharing weight-related information. As a result, this could lead to an underrepresentation of students with higher BMI values, potentially influencing the estimates toward lower obesity rates. Moreover, among school students, the requirement for parental consent may have influenced participation, leading to an underrepresentation of students from households with lower parental involvement. This could result in a bias toward families that are more health-conscious or engaged in their children's education.

The fact that a part of the surveys was delivered in paper also complicates the process, since it is impossible to make the answers mandatory similarly to the online version, leading to a lack of some information and to incomplete data. Also, our study is geographically focused on students from the city of Guarda, Portugal, which may limit the applicability of our findings to other regions with different socioeconomic, cultural, and environmental contexts.

As the next steps, performing longitudinal studies could be a good approach to try to establish a relationship between nutritional and lifestyle habits and obesity, identifying trends and changes over time. The accuracy of the data can be improved by using equipment like accelerometers to measure physical activity [83], and therefore obtain more objective measurements. Other geographic areas with different socioeconomic and cultural aspects should also be studied and compared. Incorporating new technologies, such as mobile health apps and online platforms can be helpful for monitoring behaviours.

## 5. Conclusions

The findings of our study indicate a complex relationship between BMI and several factors, such as age, physical activity, sex and dietary habits among the students. According to our survey, the younger students, particularly boys, have a higher rate of overweight and obesity, which highlights the need for an early intervention. Higher physical activity and reduced sedentary behaviours were associated to a healthier BMI, which emphasizes the need for promoting a more active lifestyle in schools. Despite its limitations, our study provides valuable insights into the health status of students in a non-metropolitan region, where traditional dietary habits and potentially more active lifestyles may contribute to lower obesity rates compared to national and European averages.

**Supplementary Materials:** The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Figure S1: Survey for the student community; Figure S2: Comparison of consumption of different food groups by weight status of children using Mann-Whitney U test; Figure S3: Comparison of consumption of different food groups by weight status of adults using Mann-Whitney U test; Figure S4: Chi-Square test results for the association between allergic diseases and BMI in children; Figure S5: Chi-Square test results for the association between pulmonary diseases and BMI in children; Figure S6: Chi-Square test results for the association between skin diseases and BMI in children; Figure S7: Chi-Square test results for the association between gastrointestinal diseases and BMI in children; Figure S8: Chi-Square test results for the association between mental diseases and BMI in children; Figure S9: Chi-Square test results for the association between allergic diseases and BMI in adults; Figure S10: Chi-Square test results for the association between pulmonary diseases and BMI in adults; Figure S11: Chi-Square test results for the association between gastrointestinal diseases and BMI in adults; Figure S12: Chi-Square test results for the association between mental diseases and BMI in adults; Figure S13: Chi-Square test results for the association between skin diseases and BMI in adults; Table S1: Model summary for the logistic regression of the children and adults' data.

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**Data Availability Statement:** The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

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