



ORIGINAL ARTICLE

## Prevalence of overweight/obesity and its association with sedentary behavior in children

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### KEYWORDS

Body mass index;  
Risk factors;  
Sedentary lifestyle

### Abstract

**Objective:** The aim of this study was to determine the prevalence of overweight and obesity in children in the northeast region of Portugal, and to examine its association with sedentary behavior.

**Methods:** Data were collected on 1786 children (907 boys, 879 girls) aged 6 to 13 years. Body mass index was calculated from measured height and weight (weight in kg/height in m squared). Overweight and obesity were determined using the International Obesity Task Force cutoff values. Sedentary behavior was assessed based on means of transport to and from school and time spent watching TV and playing video games (TVPC).

**Results:** The prevalence of overweight and obesity was 22.6% and 9.4% respectively. The differences between the sexes for both overweight and obesity were not significant. Most of the children (78.4%) go to school by car. Boys spend more time on TVPC than girls, both on weekdays and on weekends. The logistic regression model indicated a significant effect of 1.5 hours of TVPC by boys during weekdays (OR=0.246; p=0.015). Boys who spent less than 1.5 hours on weekdays on TVPC were 75.4% less likely to be overweight than those who spent more than 1.5 hours.

**Conclusion:** The prevalence of overweight and obesity was 32%. Only 12.2% of the children spend less than 1.5 hours on TVPC. Boys who spend less than 1.5 hours on TVPC are 75.4% less likely to be overweight/obese than those who spend more than 1.5 hours.

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**PALAVRAS-CHAVE**

Índice de massa corporal;  
Fatores de risco;  
Estilo de vida sedentário

## Prevalência de sobrepeso/obesidade em crianças e a sua associação com comportamentos sedentários

**Resumo**

**Objectivo:** determinar a prevalência de sobrepeso/obesidade em crianças da região Nordeste de Portugal, e analisar sua associação com o sedentarismo.

**Métodos:** Os dados foram recolhidos em 1786 crianças (n = 907 meninos, meninas n = 879) com idades entre os 6 e 13 anos, o índice de massa corporal foi calculado a partir da estatura e peso [massa corporal (kg) / Altura (m<sup>2</sup>)] medidos. O sobrepeso/obesidade foram determinados usando os valores de corte da IOTF. O comportamento sedentário foi avaliado tendo em conta: o meio de transporte e tempo gasto a ver televisão/jogar videojogos (TVPC).

**Resultados:** a prevalência de sobrepeso/obesidade foi de 22,6% e 9,4%, respetivamente. As diferenças entre os sexos, tanto para o sobrepeso como para a obesidade, não foram significativas. A maioria das crianças usa o automóvel (78,4%) para ir à escola. Os meninos gastaram mais tempo em TVPC que as meninas, tanto durante a semana como nos fins de semana. O modelo de regressão logística indicou um efeito significativo de 1,5 horas de TVPC para os meninos, durante a semana (OR = 0,246; p = 0,015). Os meninos que gastaram menos de 1,5 horas durante a semana em actividades TVPC foram 75,4% menos propensos a serem obesos do que aqueles que gastaram mais de 1,5 horas.

**Conclusão:** a prevalência de sobrepeso/obesidade atinge 32%. Apenas 12,2% gastam menos de 1,5 horas em TVPC. Os meninos que passam menos de 1,5 horas em TVPC são 75,4% menos propensos a ter sobrepeso/obesidade do que aqueles que gastam mais de 1,5 horas.

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**Introduction**

A majority of western countries and those undergoing economic transition have experienced an increase in the prevalence of childhood obesity.<sup>1</sup> As long ago as 1997, obesity was identified as a public health problem in both adults and youth.<sup>2</sup>

There is a large group of chronic diseases associated with obesity, including cardiovascular disease, diabetes, and hypertension.<sup>3,4</sup> The main causes of obesity are low levels of daily physical activity and excessive intake of high-calorie food,<sup>5</sup> leading to imbalances that increase body fat mass. The problem has several dimensions, including biological, social and psychosocial aspects, and affects all age ranges, genders and socioeconomic levels.<sup>6</sup>

Several studies conducted in Portugal<sup>7-9</sup> in children aged between 3 and 14 reveal the extent of the problem. Apart from the biological and cultural characteristics of the samples, the prevalence of overweight ranged between 13% and 30%, and the prevalence of obesity was 4-14%. These studies also indicated that females - adults and children - are more affected by this epidemic.

Despite this national trend, the situation in the northeast region of Portugal is still unknown. Thus, the main goal of this study was to determine the prevalence of overweight and obesity and its association with sedentary behavior in children of the northeast region of Portugal, as assessed by the type of transportation used between school and home and time spent watching TV and playing video games (TVPC).

**Methods****Population**

The sample consisted of 1786 subjects - 879 female and 907 male - aged between 6 and 13 years. This number corresponds to all children attending public schools in the towns of Bragança and Macedo de Cavaleiros in the northeast of Portugal. Only children who did not attend school on the days of data collection were not included.

The data were collected during the 2008 school year. Each school was chosen from the Executive Board of each school and informed consent was obtained from all children and their parents. The study was approved by local education authorities and the ethics committee of the Polytechnic Institute of Bragança.

**Height and weight assessment**

All individuals were assessed without shoes and with minimal clothing (T-shirt and shorts). A SECA scale, model 885, was used to measure weight, and the value was recorded in kilograms with approximation to hectograms. Height was measured using a wall-mounted stadiometer; the result was recorded in centimeters.

Body mass index (BMI) (weight in kg/height in m squared) was calculated and the International Obesity Task Force (IOTF) cut-off values<sup>12</sup> for overweight and obesity were used.

**Assessment of sedentary behaviors**

All individuals in the sample answered a questionnaire about their travel to and from school (whether they walked or

**Table 1** Mean values and standard deviations of weight (kg), height (cm) and BMI (kg/m<sup>2</sup>) in the study population, by gender and age.

Age (years)	Girls				Boys			
	n	Weight	Height	BMI	n	Weight	Height	BMI
6	98	26.0 ± 5.4	122.0 ± 4.7	17.4 ± 3.0	77	26.1 ± 4.9	122.0 ± 5.3	17.4 ± 2.4
7	137	28.0 ± 5.8	126.7 ± 4.9	17.4 ± 3.0	149	28.0 ± 5.3	127.9 ± 5.6	17.0 ± 2.4
8	127	31.2 ± 5.9	132.1 ± 5.7	17.8 ± 2.7	131	32.4 ± 6.5	133.1 ± 6.3	18.1 ± 2.7
9	135	35.0 ± 8.1	137.7 ± 6.5	18.3 ± 3.3	130	35.2 ± 6.8	137.2 ± 6.1	18.6 ± 2.8
10	125	39.7 ± 8.4	143.7 ± 7.3	19.1 ± 3.1	138	39.7 ± 7.7	142.6 ± 7.7	19.4 ± 3.5
11	137	45.8 ± 10.3	150.3 ± 8.1	20.1 ± 3.6	154	43.2 ± 11.2	148.1 ± 7.4	19.5 ± 4.0
12	79	48.0 ± 9.1	154.0 ± 6.4	20.1 ± 3.0	93	48.8 ± 10.4	154.2 ± 7.1	20.5 ± 3.8
13	40	54.9 ± 12.6	157.7 ± 6.3	21.9 ± 4.1	31	50.1 ± 10.8	160.0 ± 9.0	19.4 ± 3.1

cycled or went by car or bus) and the time they spent, in hours during weekdays and on weekends, watching television and playing video games (TVPC). The children were helped by the research team to complete their questionnaires.

**Statistical analysis**

First, an exploratory data analysis was carried out to identify possible errors in the information input, the presence of outliers and the normality of the distributions.

Descriptive statistics were calculated for weight, height and BMI (mean and standard deviations). A percentage analysis was also carried out on the transportation used and the number of hours of TVPC use.

As the variables did not present normality in their distributions, the Kruskal–Wallis test was used to analyze the differences between age groups and sexes.

To estimate the association of TVPC and transport used with overweight and obesity, logistic regression was used separately for each gender while controlling the age effect to obtain adjusted odd ratios (OR). For this purpose, the TVPC variable was categorized according to the number of hours spent during weekdays and on weekends (up to 1.5; 2.5; 3.5; 4.5; 5.5; 6.5 and 7.5 hours).

The significance level was defined as  $p \leq 0.05$ .

**Results**

Table 1 presents the descriptive statistics (mean and standard deviation) of the population characteristics (weight, height and BMI) by ages and gender.

Figure 1 presents the prevalences of overweight and obesity according to gender and age. The prevalences in the

overall population were respectively 22.6% and 9.4%. In boys, the prevalence of overweight was 23.2% and of obesity was 8.7%. In girls, the prevalence of overweight was 22.1% and of obesity was 10.0% (Figure 1).

Although there were no significant differences between the sexes in overweight and obesity, there was a general tendency in boys to have higher overweight prevalence at all ages, except at the ages of 10, 11 and 13 years. For obesity the converse was seen; girls had higher values than boys at all ages, except at the ages of 10, 11 and 12 years.

No significant differences were observed between ages in overweight and obesity, but there was a lower prevalence of obesity in older subjects. Regarding overweight, the values were very close at all ages.

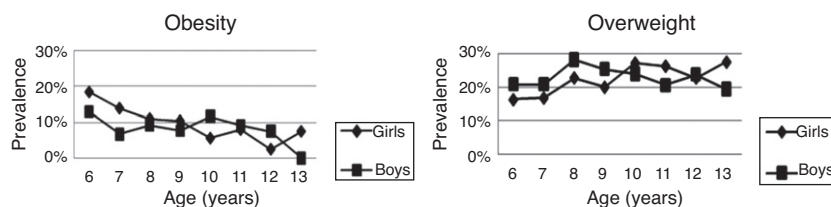
The percentages by gender and age of children who go to and from school by car versus those who walk or cycle are presented in Figure 2.

Car or bus was the means of transport for 78.4%. Only 21.6% of the children walked to and from school. The car was also the most common means of transport in at least one of the daily journeys to school (56.3%). The differences between the sexes were not significant. Walking was less common in both sexes: 10.3% of girls and 11.3% of boys.

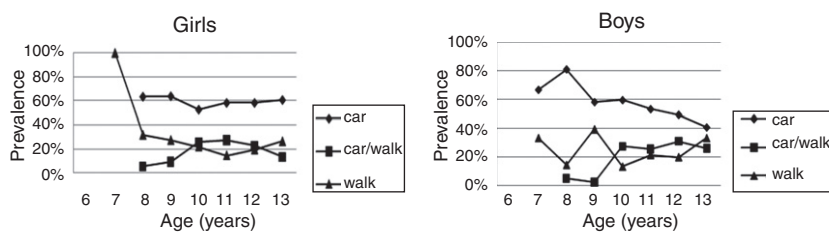
Analysis of the difference between ages in the type of transportation to and from school indicates significant differences between ages only when they use the same type of transportation both to and from school (chi-square<sub>(7)</sub>, Z=14.688; p=0.040). Older children less frequently traveled by car.

Figure 3 presents by age and gender the mean number of hours children spent each weekday and on weekends on TVPC.

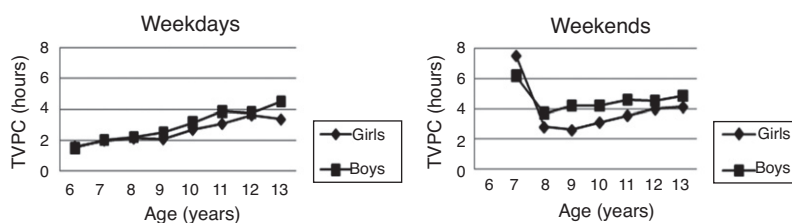
During the week, the mean values were lower, especially for boys (3.06 hours for girls and 3.64 hours for boys), than on the weekend (3.50 hours for girls and 4.44 hours for boys).



**Figure 1** Prevalence of overweight and obesity in the study population, according to the International Obesity Task Force values,<sup>10</sup> by gender and age.



**Figure 2** Percentages of children who go by car (car) or walk (walk) to and from school, or go to school by car and walk home (car/walk), by gender and age.



**Figure 3** Mean number of hours spent watching television and playing video games on weekdays and weekends, by gender and age.

Boys spent significantly more time than girls in sedentary activities (TVPC), both on weekdays (chi-square<sub>(1)</sub>  $Z=11.647$ ;  $p=0.001$ ) and on weekends (chi-square<sub>(1)</sub>  $Z=7.817$ ;  $p=0.005$ ).

Older children spent significantly more time than younger children on TVPC both during weekdays (chi-square<sub>(7)</sub>  $Z=30.740$ ;  $p=0.000$ ) and on weekends (chi-square<sub>(7)</sub>  $Z=25.495$ ;  $p=0.001$ ), with the exception of seven-year-old children on weekends.

Considering the overall population, only 12.2% of children spent less than 1.5 hours on TVPC, whether on weekdays or on weekends.

The logistic regression model did not indicate a significant effect of the "transport" variable; it only indicated a significant effect of 1.5 hours of TVPC by boys on weekdays (OR=0.246;  $p=0.015$ ), which means that boys who spent less than 1.5 hours on weekdays watching television or playing video games were 75.4% less likely to be overweight/obese than those who spent more than 1.5 hours.

## Discussion

The aim of this study was to determine the prevalence of overweight and obesity related to sedentary behavior in children from the northeast region of Portugal, namely the type of transportation to and from school and time spent watching television and playing video games. The prevalence of overweight and obesity was determined through BMI, using the IOTF reference values.<sup>10</sup>

The sample was not random, and no attempt was made to find a representative sample of children in the region; it was intended rather to evaluate all children aged 6 to 13 attending public schools in the towns of Bragança and Macedo de Cavaleiros. Only children who did not attend school on the days of data collection were not included.

The prevalences of overweight and obesity in children in this region of Portugal were 22.6% and 9.4%, respectively. These results are in agreement with those from other studies

carried out in Portugal<sup>11,12</sup> that indicate a prevalence of overweight and obesity of around 30%.

Some studies<sup>13,14</sup> indicate a higher prevalence of overweight and obesity in females than in males. In the present study, girls had a higher prevalence of obesity than boys at almost all ages, but the prevalence of overweight was higher in boys than in girls, although the difference was not significant.

This study analyzed the time spent watching television and playing video games and the means of transport used to and from school. As expected and the children spent more time watching television and playing video games on weekends than on weekdays. Boys spent more time in both cases than girls, and younger children of both sexes spent less time than older ones in these activities.

A sedentary lifestyle as identified in this study corroborates the findings of other studies,<sup>15,16</sup> particularly with regard to the importance of inactivity as a risk factor associated with obesity in children.

An association between excess weight and sedentary activities such as watching television has been reported in numerous studies.<sup>17,18</sup> In fact, screen time competes with physical activity time,<sup>19</sup> leading to reduced levels of exercise in children.<sup>20,21</sup> Besides the association between screen time and overweight/obesity, food intake during this activity can make this association even more significant.<sup>22</sup>

In younger children, overweight/obesity seems to aggregate in families.<sup>23</sup> The daily pattern of parents' physical inactivity and activity can influence their children's behavior. At older ages, as children become more independent, their choices are often more influenced by their peers than by their parents.<sup>24</sup>

Television viewing is frequently used as an indicator of inactivity in epidemiological and intervention studies.<sup>25</sup> This parameter correlates strongly with obesity in childhood.<sup>26,27</sup> In our study, this correlation was also identified in boys. A significant effect of 1.5 hours of TVPC was observed during weekdays, with boys who spend less than 1.5 hours on

weekdays watching television and playing video games being 75.4% less likely to be overweight/obese than those who spend more than 1.5 hours. With girls, no such association was observed.

Two main explanations may be advanced for this result: (1) girls usually spend their leisure time in activities that require lower energy expenditure than boys,<sup>28</sup> contributing to the higher incidence of obesity in girls; and (2) although the main sedentary behaviors cited in the literature were assessed, other habits, possibly more closely related to girls' choices, were not considered in this study. So problems with assessment of total sedentary behaviors may explain why, in this study, girls seem to be less inactive but are more often obese.

Since children spend so much time playing video games, it would be helpful for parents and educators to provide children with interactive games. Although not proven, there seems to be a correlation between the use of video games and obesity, but some authors state that the energy expenditure of playing video games is similar to that of walking and running.<sup>29</sup> Regularly playing active video games may even have positive effects on overall levels of children's physical activity.<sup>30</sup>

Going to school can be physical activity, since some children walk or cycle, but in children in the present study, the car was the most common type of transportation. Younger children walk to school less frequently than older children. At younger ages, parents usually take children to and from school, mostly by car. The common use of mechanical means of transportation to go to school is associated with a lower level of energy expenditure, contributing to increased overweight and obesity in children. However, the results of this study did not show a significant effect of the type of transport on overweight or obesity.

The fact that TVPC and type of transportation used were evaluated through a questionnaire and not by direct observation is a limitation of this study that may influence the results of the association between these variables and overweight/obesity. Children sometimes have difficulty answering questionnaires correctly, as their recall is limited.<sup>31</sup> However, this study would have been virtually impossible to carry out by direct observation.

In conclusion, the prevalence of overweight and obesity in children from 6 to 13 years of age in the Northeast region of Portugal (Bragança and Macedo de Cavaleiros) was 32%. The majority of children go to school by car, and only 12.2% spend less than 1.5 hours watching television and/or playing video games. Boys who spend less than 1.5 hours watching television and/or playing video games are 75.4% less likely to be overweight/obese than those who spend more than 1.5 hours.

## Ethic disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this investigation

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data and that all the patients included in the

study have received sufficient information and have given their informed consent in writing to participate in the study.

**Right to privacy and informed consent.** The authors declare that no patient data appears in this article.

## Conflicts of interest

The authors have no conflicts of interest to declare.

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