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Factors Affecting the Body Mass Index in Adolescents in Portuguese Schools

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Summary

The prevalence of overweight and obesity among children is increasing; hence, it was aimed to assess the Body Mass Index (BMI) in school children aged from 10 to 18 years for girls and to 17 for boys, as well as to identify the factors influencing BMI. This study included 742 students who answered a questionnaire previously approved for application in schools. The results showed some sociodemographic factors associated with BMI classes: age, school year, practicing high competition sport, being federate in a sport or having a vegetarian diet. The educational factors associated with BMI classes included only seminars given at school by a nutritionist. Behavioural factors significantly associated with BMI included: learning in classes, playing in the open air, reading books or use of internet. As conclusion, the results demonstrated that several factors affect BMI, and hence some actions could be taken in order to change them so as to reduce the prevalence of overweight, namely reinforcing the role of school and a more active participation of nutritionists in the education of the adolescents.

Keywords: Adolescents, Body Mass Index, Nutrition education, Healthy eating.

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Introduction

The problem of obesity is nowadays a worldwide concern and many studies are being conducted on children so as to know the present situation and eventually prevent further expansion of this problem (Batscheider et al., 2014; Cornwell et al., 2014).

The Body Mass Index (BMI) is defined as the weight in kilograms divided by the square of the height in metres. It allows to easily classifying the individuals according to their status. The World Health Organization presented a 4 class classification valid for adults of both genders: underweight (BMI<18.50 kg/m²), normal (18.50≤BMI≤24.99 kg/m²), overweight (25.00≤BMI≤29.99 kg/m²), obese (BMI≥30.00 kg/m²) (WHO Expert Committee, 1995). For school-aged children and adolescents the WHO developed curves that accord with the WHO Child Growth Standards for preschool children and the body mass index (BMI) cutoffs for adults (de Onis et al., 2007)i.e. the Box-Cox power exponential (BCPE. According to the CDC BMI-for-Age Growth Charts for ages between 2 and 20, the BMI cutoffs are: overweight (percentile ≥ 95th), risk of overweight (85th to < 95th percentile), normal weight (5th to < 85th percentile) and underweight (< 5th percentile) (Ogden et al., 2008, 2010). Although these last are more precise and distinguish among ages and genders, its applicability sometimes is more difficult and the results are less easily classifiable.

In Portugal, 52.8% of adults over 18 years are overweight, from which 31,1% are obese, being the incidence more preoccupying among people aged from 45 to 74 years, and among women when compared to men (17.5% and 15.1%, respectively for women and men). The underweight people represent 2.5% (Mendes, 2015). With respect to adolescents, 31% of boys and 18% of girls are overweight, and at the age of 15 years obesity reaches 24% and 17%, for both genders, respectively (WHO, 2013).

Many factors contribute for the weight of the population in general, and adolescents in particular, such as genetics, family environment, education, food habits, fast food, sports, physical activity, or sedentarism (television, computers, mobile phones, etc.) (Campbell et al., 2010). It has been observed that individuals do not respond uniformly to overfeeding or dietary/physical activity interventions, being assumed that these differences have a significant genetic background (Zlatohlavek et al., 2013).

Parents help shape their children's eating and physical activity behaviours (Campbell et al., 2010). However, nowadays, that is complemented with education provided in schools. Many factors contribute for children and adolescents to substantial increase their daily energy supply, such as the consumption of high-energy and low-nutrient dense foods, the increase in portion sizes, or the decrease in physical activity. Still, the overweight is far from being the only problem associated to weight in adolescents. In fact, in the last decades the prevalence of eating disorders has increased leading to unhealthy dietary behaviours aimed at losing weight due to social pressures to be thin and distorted body image perceptions (Vignerová et al., 2007).

The aims of the present study were on one hand to evaluate the BMI of adolescents attending the 2nd and 3rd cycles of the Portuguese Basic Education in schools in the dis-

trict of Viseu, Portugal, and on the other hand to assess the factors that are related to the BMI. The research hypothesis was to verify if the sociodemographic, behavioural and educational factors have some influence on the BMI of the adolescents.

Subjects and Methods

Data Collection

This survey was undertaken by a questionnaire, which was developed for this study and previously submitted to the approval of the competent authority (The Service of Educational Projects of the Portuguese General Direction of Education) for application in school context. The questionnaire, which can be obtained from the authors upon request, was structured into three sections: the first aiming to collect data on sociodemographic variables; the second aiming to evaluate the knowledge of the young respondents relating to healthy eating; and the third aiming to assess their habits regarding eating and food.

Sampling and Procedure

A multistage stratified sampling method was used in the selection of schools. From all the public schools in Viseu four were randomly selected for the study. The sample was exclusively constituted by students attending the 2nd and 3rd cycles of basic education in Portugal (5th to 9th grades). The sample was selected among all classes of the years considered in the schools included in the study. There was a random selection of classes in each school and the questionnaires were delivered to the corresponding directors of class so they could distribute them during their lessons. The participation of the respondents was voluntary and proceeded by written authorization from their parents. In the end, 742 consented valid questionnaires were obtained.

Data Analysis

In the data analysis basic descriptive statistics was used. Also some hypothesis tests were used to access the influence of some variables on the BMI, namely the cross tabulation with chi-squared test and in all cases the level of significance considered was 5%. For all data analysis software SPSS, from IBM Inc. (version 21) was used.

Sample Description

The sample was constituted by 742 students, from which 49.7% were female and 50.3% were male, thus representing evenly both genders. The ages of the enquired varied from 10 to 18 years, with a mean of 12.5±1.6 years. The age distribution can be seen in Table 1. The student's distribution by school year was: 20.1% in the 5th grade, 22.6% in the 6th grade, 21.2 in the 7th grade, 16.0 in the 8th grade and 20.1 in the 9th grade.

Table 1. *Age distribution of the enquired, according to gender (n = 742).*

| Age (years)	Female		Male		Total	
	N	%	N	%	N	%
10	43	11.7	44	11.8	87	11.7
11	63	17.1	75	20.1	138	18.6
12	85	23.0	65	17.4	150	20.2
13	67	18.2	65	17.4	132	17.8
14	78	21.1	71	19.0	149	20.1
15	28	7.6	36	9.7	64	8.6
16	4	1.1	14	3.8	18	2.4
17	0	0.0	3	0.8	3	0.4
18	1	0.3	0	0.0	1	0.1
Total	369	100.0	373	100.0	742	100.0

Results

Characterization of the Sample in Sociodemografic, Educational and Behavioural Terms

The analysis of the sociodemographic data of the adolescents studied revealed some differences among genders and according to age (Table 2). As expected, on average, the weight and height increased with age for both genders. Comparing the girls with the boys it was also observed that the boys were in general heavier than girls, although this difference was only visible from the age of 12 onwards. Also for the height a similar trend was observed with boys being taller than girls after the age of 13 years.

Table 2. *Mean values and standard deviation of weight, height and BMI according to gender and age.*

Age (years)	Weight (kg)		Height (m)		BMI[1] (kg/m^2)	
	Female	Male	Female	Male	Female	Male
10	38.0±5.9	37.45±5.1	1.5±0.1	1.4±0.1	17.5±2.2	18.3±3.1
11	40.4±9.2	40.4±7.6	1.5±0.1	1.5±0.1	18.0±3.3	17.9±2.6
12	43.6±7.6	46.3±10.9	1.5±0.1	1.6±0.1	18.2±2.5	19.1±3.6
13	50.0±9.4	52.0±9.6	1.6±0.1	1.6±0.1	19.8±3.0	19.7±3.0
14	53.0±8.6	60.0±10.8	1.6±0.1	1.7±0.1	20.2±3.1	20.8±2.9
15	54.2±7.5	60.1±9.4	1.6±0.1	1.7±0.1	21.0±2.5	20.6±2.7
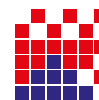
16	53.3±5.6	63.8±9.8	1.6±0.1	1.7±0.1	20.8±2.2	21.4±3.1
17	n.a.[2]	68.3±10.4	n.a.[2]	1.8±0.1	n.a.[2]	22.2±2.2
18	65.0±0.0	n.a.[2]	1.7±0.0	n.a.[2]	21.5±0.0	n.a.[2]
Global	46.5±10.0	49.8±12.8	1.6±0.1	1.6±0.1	19.1±3.1	19.4±3.2

[1]BMI = Body mass index
[2]n.a. = not applicable due to zero observations

Some aspects considered in this study related to the practice of sports and physical activity as shown in Table 3. The results indicated that boys practiced more sports than girls, and vw this difference was particularly evident for federate and high competition sports, for which the percentage of male practitioners (42.1% and 27.3%) was almost double and triple than girls (25.2% and 10.0%), respectively. Also the health problems or food restrictions were considered in the study, because these may have an important influence on the eating habits and, consequently on the BMI (Table 3). The results obtained indicated that only about 20% have health problems (20.9% in girls and 19.8% in boys), less than 10% have food allergies (6.0 and 8.0, respectively for boys and girls) and a minority of about 1% are vegetarians, being this result again similar among genders.

Table 3. *Practice of exercise, physical condition and diet restrictions of the adolescents at study.*

	Female		Male	
	Yes (%)	**No (%)**	**Yes (%)**	**No (%)**
Practices school sports	33.3	66.7	37.3	62.7
Is federate in any sports	25.2	74.8	42.1	57.9
Practices high competition sports	10.0	90.0	27.3	72.7
Has a health problem	20.9	79.1	19.8	80.2
Is allergic to any food or food component	6.0	94.0	8.0	92.0
Is vegetarian	1.1	98.9	1.3	98.7

The students were asked to indicate what were their sources of information about healthy eating, on a scale from 1 (never used) to 5(always used). The sources considered were school, television, friends, books, family, internet and classes, and the results are displayed in Table 4. The results indicated that the more relevant sources of information were family (4.0±1.0), followed by school (3.7±1.0) and classes (3.6±1.0).

Table 4. *Mean score obtained for the sources of information about healthy eating (scale from 1 = never, 5 = always, describing the frequency of use).*

Mean score (value±standard deviation)						
School	**Television**	**Friends**	**Books**	**Family**	**Internet**	**Classes**
3.7±1.0	3.1±1.0	2.1±1.0	2.9±1.2	4.0±0.9	2.7±1.2	3.6±1.0

One other aspect investigated was the role of school in transmitting information about healthy eating, either in regular classes of certain subjects or by inviting a nutritionist to speak about topics related to eating habits and nutrition. The results showed that 96.4% of the students indicated that teachers talked about healthy eating in classes, particularly in the 5th and 6th grades. Regarding the seminars with a nutritionist, only 13.7% of the students had this possibility at school, and the school years were the same (5th and 6th).

The adolescents were further asked to do a self-evaluation about the degree of information they considered to have about healthy eating, on a scale from 1 (nothing informed) to 5 (totally informed). The average score obtained was 4.0±0.8, thus indicating a very good degree of knowledge. For the girls the value was 4.1±0.7 and for the boys 3.9±0.8, revealing that the girls considered themselves just slightly more informed than boys.

The Food Wheel is a representation created in Portugal which aims at helping to choose and combine the foods to obtain a healthy daily diet. It was created in 1997, and reformulated in 2003, due to evolution in the scientific knowledge. It is composed of 7 groups of foods, plus the water in the centre, and for each it advises the daily portions and percentages recommended for a healthy diet (Rodrigues et al., 2006) (Figure 1).

The image of the correct Food Wheel was mixed with four other images of incorrect or old Food Wheels for the students to identify which was the correct. 94.3% correctly identified the current Portuguese Food Wheel. Those who did not correctly identified it were only 42 adolescents, equally dis-

tributed among genders, mainly in the 6th grade, not practising sports, not with health problems and not vegetarian.

Figure 1. *The Portuguese Food Wheel.*

The students were further asked about attitudes and the role of different factors to promote a healthy eating. A scale from 1 (never) to 5(always) was used to measure the agreement with the statements and the results are shown in Table 5, according to gender, indicating that family was considered by the adolescents of both genders as having a great concern about preparing healthy meals. Furthermore, the school canteen and classes greatly contributed for their information about healthy eating. As to the other situations, they were in general positively scored by the girls (with mean scores ranging from 2.4 to 2.6) but not by the boys (with mean scores ranging from 2.1 to 2.4).

Table 5. *Mean score obtained for the different factors promoting a healthy eating (scale from 1 = never to 5 = always, measuring the agreement).*

Statement	Mean score (value±st. deviation)
	Female
In the school canteen there is information posted about healthy eating habits	3.4±1.4
I regularly see TV programs that encourage me to practice a more balanced diet	2.6±1.1
I talk to my friends about what to eat, because I care about my physical appearance	2.6±1.2
I love to read books that help me choose what to eat, for a more healthy diet	2.4±1.2
My parents/family are concerned to prepare balanced meals for me to eat	0.8±0.7
I look up on the internet about health problems caused by a poor diet	2.6±1.2
When the subject of the lesson is food, I try to ask many questions to stay informed	3.2±1.2

Regarding the number of meals taken per day, it was found to be on average 3.7±1.0, with 41% having 5 meals a day and 29% having 4. Also the eating out habits were addressed, and in particular those relating to fast food restaurants (results in Table 6). This sample of 742 adolescents appeared to have quite healthy habits considering that the visits to the fast food restaurants are very rare, in all cases less than once a week. Still, although the great majority never or very rarely goes to this kind of restaurants, there are some few concerning cases of adolescents that in a week visit 12 times the McDonalds and the same for telepizza.

Table 6. *Number of times the adolescents eat in fast-food restaurants during one week*

Restaurant	Frequency[1]	Restaurant	Frequency[1]
McDonalds	0.46±1.09 (0 − 12)	*Pizza Hut*	0.19±0.67 (0 − 10)
Vitamins	0.12±0.51 (0 − 5)	*Telepizza*	0.23±0.76 (0 − 12)
H3	0.06±0.59 (0 − 10)	*Subway*	0.04±0.25 (0 − 3)
Pans & Company	0.06±0.36 (0 − 7)	*Piantella*	0.03±0.21 (0 − 2)
Soups house	0.10±0.44 (0 − 5)	*Times Fish*	0.01±0.10 (0 − 1)

[1]*Values given represent: mean ± standard deviation (minimum – maximum)*

Also the activities that the students practiced in their spare time were evaluated in this study. 47.4% played in the open air against 52.6% that usually did not. 68.6% watched TV and only 31.4 did not regularly do it. Practising sports
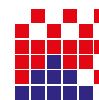
was an activity for 48.5% of the adolescents, while surfing on the internet was a way of using the spare time for 48.9% of the adolescents and playing on the computer got 35.8% positive answers. Reading books got 29.1%, being a less chosen option for using the spare time. Among other activities cited by the adolescents stood riding a bicycle, walking, PlayStation and console games, dancing, drawing, cinema, listen to music or playing music.

Sociodemographic Factors Affecting BMI

The BMI percentile cut-offs were determined separately for girls and boys and according to age, following the 2000 CDC Growth Charts (Kuczmarski et al., 2002). The obtained cut-offs are reported in Table 7 for girls and for boys, according to age.

Table 7. *BMI (Body Mass Index) cut points by age for teenage boys and girls.*

BMI percentile Cut-points	Age of BOYS (years)								
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
95th	22.0	23.3	24.2	25.1	26.0	26.8	27.5	28.3	29.0
85th	19.5	20.2	21.0	21.8	22.6	23.5	24.1	25.0	25.6
5th	14.2	14.5	15.0	15.5	16.0	16.5	17.0	17.7	18.2
BMI percentile Cut-points	Age of GIRLS (years)								
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
95th	23.0	24.0	25.2	26.1	27.2	28.0	28.9	29.5	33.0
85th	20.0	20.7	21.7	22.5	23.4	24.0	24.6	25.1	25.6
5th	14.0	14.4	14.8	15.4	15.8	16.4	16.8	17.2	17.5

Table 8 shows the incidence of each of the four classes of BMI among girls and boys, considering the CDC BMI-for-Age cut-offs (Ogden et al., 2008, 2010). In the sample at study the great majority of the individuals of both genders showed to have a normal body weight, 84.3% of the adolescent girls and 71.8% of the boys. The results also showed that in the sample at study the incidence of overweight was very low (eleven girls and twenty boys, representing 3.0% and 5.4%, respectively), thus contradicting some actual tendency worldwide.

Table 8. *Distribution of the adolescent girls and boys among the classes of BMI.*

Classes of BMI	Percentile	Frequencies (%)	
		Female	**Male**
Overweight	≥ 95th	3.0	5.4
Risk of over-weight	85th to 95th	8.6	17.4
Normal weight	5th to 85th	84.3	71.8
Underweight	< 5th	4.1	5.4

Although the incidence of overweight was low, it is still important to notice the incidence of the risk of overweight, which represented 8.6% in girls and a higher percentage, 17.4%, for boys. Finally, in this work was found a very low incidence of underweight (4.1% and 5.4%, respectively for girls and boys). The overweight individuals were characterized by being between 10 and 14 years, being eleven girls and 20 boys. Eight of them (26%) were federate in a sport and 13 (42%) practiced school sports, but only 6 (20%) practiced high com-

petition sports. Ten had health problems; only two could not identify correctly the Food Wheel and in general they considered themselves well informed about healthy eating. Finally, their habits of eating fast food were rare, eating only once a week in some of the fast food restaurants indicated in the survey: McDonalds (29%), Pizza Hut (13%), Telepizza (7%), Vitamins (7%), Soups house (3%), Subway (3%), Times Fish (3%).

On the other extreme stand the underweight individuals, which were between 10 and 16 years, 15 girls and 20 boys. Most of them (66%) did not practice school sports, weren't federate in any sport (60%) and did not practice high competition sports (77%). The underweight adolescents were mainly healthy with only 20% having health problems. As to correctly identifying the Food Wheel, 97% succeeded. Finally, these adolescents frequent fast food restaurants with some regularity, and particularly McDonalds (17% go once a week, 6% go twice and 6% go three times per week), Pizza Hut (11% go once a week and 3% go three times per week) or Telepizza (14% go once a week and 3% go three times).

It was aimed at evaluating if there was an association between the BMI classes and some sociodemographic factors, such as age, gender or school year. For this a cross tabulation analysis with chi-squared test was undertaken. The results obtained indicated that there was no association between BMI and gender (p=0.391; chi-square test), but there was a highly significant association between BMI and age (p<0.001; chi-square test) and also between BMI and school year (p<0.001; chi-square test).

Also the same kind of analysis was made to assess the associations between BMI and sports. No association was found between BMI and school sports (p=0.065; chi-square test), but a significant association was found between BMI and prac-

ticing high competition sport (p=0.046; chi-square test) and a highly significant association was also found between BMI and being federate in a sport (p=0.001; chi-square test).

The results also indicated that there was no association between BMI and health problems (p=0.320; chi-square test). However, there was a highly significant association between BMI and vegetarian diet (p<0.001; chi-square test).

Educational Factors Affecting BMI

The association between BMI classes and some aspects related to education for a healthy eating were evaluated. Regarding the correct identification of the Food Wheel, no association was found with BMI (p=0.915; chi-square test). Those who did not know the Food Wheel were aged between 10 and 16 years and attending all school years, although the majority were in the 5th (45.2%) and 8th (23.8%) grades. Most of them did not practice school sports (59.5%), weren't federate in any sport (66.7%) and did not practice high competition sports (81.0%). However, these adolescents admit that teachers speak about healthy eating in class (97.6%) and evaluate themselves as well (19.0%) and very well informed (57.1%) about healthy eating.

The association between BMI and the teaching of topics related to healthy eating in school was investigated, by means of cross tabulation analysis. No association was found between BMI and the teaching about healthy diet (p=0.803; chi-square test). However, a very significant association was found between BMI and the seminars given by a nutritionist (p=0.006; chi-square test).

Finally an association was sought between BMI and the self-evaluation of the degree of knowledge about a healthy diet, but the results indicated that no such association existed (p=0.895; chi-square test).

Behavioural Factors Affecting BMI

A cross tabulation with chi-square test analysis was performed to assess the associations between BMI classes and those aspects about attitudes and the role of different factors in promoting a healthy eating that were previously identified as more relevant: care of the family in preparing healthy meals, look for information in the school canteen and search for knowledge transmitted in classes. A very significant association was found between BMI and the learning in classes (p=0.008; chi-square test). However, no association was found between BMI and the information in the school canteen (p=0.736; chi-square test) and also no association was found between BMI and care of the family in preparing healthy meals (p=0.255; chi-square test).

The BMI was also found not associated with the number of meals that the adolescents make per day (p=0.930; chi-square test). The associations between eating fast food and BMC were also investigated, particularly for those restaurants that were previously identified as being more frequently used: McDonalds, Telepizza and Pizza Hut. No association was found between BMI and eating at McDonalds (p=0.999; chi-square test), or Telepizza (p=0.659; chi-square test) or Pizza Hut (p=0.892; chi-square test).

Finally the associations between spare time activities and BMI were also checked. A highly significant association was found between BMI and playing in the open air (p<0.001;

chi-square test) and also between BMI and reading books (p<0.001; chi-square test). A very significant association was found between BMI and the use of internet in the spare time (p=0.004; chi-square test). However, no association was found between BMI and playing computers (p=0.642) or between BMI and watching television (p=0.210; chi-square test) or even between BMI and practising physical activity as a hobby (p=0.185; chi-square test).

Discussion

The adolescents who participated in this study believe to be well informed about healthy eating habits, and this is reflected on their body weight. The governmental institutions, like health centres, hospitals and schools have been used as vehicles to channel information that could influence the younger generations towards healthier behaviours and choices (Guiné and Fernandes, 2016).

The role of family and society are fundamental in the development of the lifestyle patterns in children and adolescents that will determine their future behaviours. The dietary patterns in Portugal have long been determined by the Mediterranean influences, and this diet has been recognized as having many potential health benefits (Mancini et al., 2016). Habits such as eating soup on a daily basis or eating salads and fruits regularly are deeply rooted into the habits of the Portuguese, so much that there is a new trend to have convenience restaurants with these healthier alternatives. Pedersen et al. (2015)a survey was completed by 757 adolescent-parent dyads. Our theoretical framework builds on social cognitive theory and the focus theory of normative conduct, and data are analysed by means of confirmatory factor analysis and structural equation modelling. The study reveals that when it comes to adolescents' fruit and vegetable intake, parents remain the main influencer, with what they do (descriptive norms studied the influence of family and friends in adolescent healthy eating. Their study revealed that parents remain the main influencer when it comes to the intake of fruits and vegetables, and their attitudes and example are more important than what they say. Also Monge-Rojas et al. (2010) examined parental feeding styles as a means to encourage healthy eating habits among Costa Rican adolescents, and their results showed that the verbal encouragement of healthy eating behaviours' did not produce results on dietary intake.

Petranovic et al. (2014) presented results of several cross-sectional surveys conducted in the adolescent population of Zagreb (Croatia) and evaluated possible influence on BMI of socioeconomic deterioration associated with the Croatian War of Independence (between 1991 and 1995). Their findings indicate that adolescent's body size was closely linked to socio-economic and political changes, being this, however, different according to gender.

Implications and Limitations

There are some limitations of this study, namely the fact that it was undertaken on a limited geographical area, a province in the centre of Portugal, and therefore it would be important in the future to extend this study to other regions of Portugal, and most specially the bigger metropolitan areas like Lisbon and Porto. Other important limitations are the questionnaire
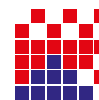
itself since it was not validated and the use of self-reported instead of measured body weight and body height.

Conclusions

The present research allowed concluding that the adolescents showed a very low prevalence of overweight and obesity. The adolescents considered themselves well informed about healthy eating and recognised the role of family and school in providing accurate information about the diet.

Some sociodemographic factors were found to be associated with BMI, namely age, practicing high competition sport, being federate in a sport or vegetarian diet. Also BMI was associated with some educational factors, such as the seminars given at school by a nutritionist and the knowledge transmitted in schools. Finally BMI was further associated to some behavioural factors, like learning in classes, playing in the open air, reading books and use of internet.

These results reinforce the role of family and school in providing the right information to help adolescents making correct food choices towards a healthy diet.

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