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Health perceptions, leisure time physical activity, meal frequency and body mass index in Portuguese male adolescents

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Objective: The aims of this study were (i) to investigate the association of leisure time physical activity (LTPA), meal frequency (MF), and health perception (HP) with weight status and (ii) to analyze how the aggregation of different adverse behaviours is associated with weight status in a sample of Portuguese male adolescents. ***Design:*** The sample comprised 522 boys aged 13 to17 years old from one public secondary school in the North of Portugal. Weight and height were objectively measured. Overweight and obesity were defined according to age-and sex-specific body mass index cut-points. MF, PA and HP were assessed using questionnaires. ***Results:*** 18.4% of the participants were overweight/obese (OV/OB). A logistic regression analysis showed that those who ate fewer than four meals daily were at increased risk for being OV/OB (OR: 2.26; $p<0.05$). Non-active participants (OR: 1.99; $p\leq0.05$) and those with poor HP (OR: 2.61; $p<0.05$) were also more likely to be classified as OV/OB. The odds of being OV/OB increased as the number of aggregated risk factors increased ($p<0.001$). ***Conclusion:*** Our findings suggest that meal frequency, health perception, leisure time physical activity and behavioural aggregation of these risk factors are associated with overweight/obesity (OV/OB) in Portuguese male adolescents. However, the direction of this relation cannot be established due to the cross-sectional nature of our study, and therefore it is also possible that some of these factors could likely be consequences of OV/OB. Future studies in Portuguese adolescents are necessary to better understand the relations between weight status and other health behaviours.

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Key Words: childhood obesity, fitness, physical activity, high-intensity intervention

INTRODUCTION

Overweight and obesity are a growing problem worldwide and have reached epidemic proportions in western countries (1-3) including Portugal (4, 5). Obesity during childhood and adolescence is an important predictor of obesity in adulthood (6). Furthermore, obesity at these ages is related to several risk factors for cardiovascular diseases (7-10), and to a poor quality of life (11, 12). To develop effective strategies for obesity prevention it is critical to determine the relative importance of specific obesity-related risk factors. Adverse health behaviours such as physical inactivity and eating patterns play an important role in weight management and in long-term weight regulation (13). Moreover, active children seem to have a better health-related quality of life compared with inactive ones, irrespective of their weight status (14). Research has found that obese children and adolescents often have psychological distress (7, 15) and suffer social marginalization (16). Thus, psychological well-being and a positive perception of health might be potential factors linked to health-related obesity consequences. For instance, it has been suggested that depressed adolescents are at increased risk for the development and persistence of obesity during adolescence (17).

Although much is known about the health benefits of physical activity (PA) during childhood and adolescence (18), the interaction of PA, meal frequency (MF) and health perceptions (HP) with weight status is less studied. Thus, understanding how weight status is associated with specific health behaviours and HP may inform strategies aimed to promote positive behaviours and reduce obesity risk in adolescents. In this context, the aims of this study

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were (i) to investigate the association of leisure time analyze how the aggregation of different adverse behaviours is associated with weight status in a sample of Portuguese male adolescents.

MATERIAL AND METHODS

Sample

Seven urban public secondary schools in the District of Aveiro in Portugal participated in this study. The potential sample included all of the 554 male students in the 7th through 12th grades registered at the participating schools. The questionnaires were distributed and filled out during physical education classes in the spring of 2006. A response rate of 94.2% was obtained. Thus, the sample of this study comprised 522 boys, ranging from 13 to 17 years old.
The choice of schools was based on district localization and took into consideration that the schools cover different ranges of socio-economic levels as well as different neighbourhood characteristics to provide variability in the sample.
Informed written consent was obtained from the participants and their parents or guardians before the subjects entered into the study. The Portuguese Ministry for Science and Technology provided permission to conduct this study.

Anthropometry

Body height and body weight were determined using standard anthropometrics methods. Height was measured to the nearest mm in bare or stockinged feet with boys standing upright against a Holtain portable stadiometer. Weight was measured to the nearest 0.5 kg, with subjects lightly dressed (underwear and tee-shirt) using a portable digital beam scale (Tanita Inner Scan BC 532).The body mass index (BMI) was estimated from the ratio weight/height^2 (kg/m^2), and the sex- and age-specific cutoff points of Cole et al. PA (LTPA), MF, and HP with weight status and (ii) to were used (19). Due to the low number of obese participants, overweight and obese participants were collapsed into one group (OV/OB).

Leisure Time Physical Activity

LTPA was assessed using a questionnaire developed by Telama et al. (20) that has been previously used with Portuguese adolescents and showed good reliability [ICC: 0.92 to 0.96] (21). The questionnaire has five questions with four response options: 1 - Outside school, do you take part in organized sports?; 2 - Outside school, do you take part in non-organized sports?; 3 - Outside school, how many times a week do you take part in sports or physical activities for at least 20 minutes?; 4 - Outside school hours, how many hours a week do you usually take part in physical activity so much that you get out of breath or sweat? ; 5 - Do you take part in competitive sports? Overall, a maximum of 20 points can be reached. A PA index was obtained that divided the sample into four different activity categories, according to the total sum of the points: the sedentary group [0-5], the low active group [6-10], the moderately active group [11-15] and the vigorously active group [16-20].
Since health-related PA guidelines for youth stress engagement in moderate-to-vigorous PA (18), for statistical analysis the participants were grouped into two categories: the non-active group (NPA), comprising sedentary and low active youth; and the active group (APA), which included the moderately active and vigorously active groups. For this age group (13 to 17 years old), Physical Education is mandatory in the Portuguese Education System (one session per week of 90 minutes plus one session per week of 45 minutes), and all our participants were healthy and attended physical education classes. Therefore, the LTPA questionnaire applied is a useful tool to distinguish between non-active and active participants, as it may work as a proxy measure of total PA.

Table 1. Characteristics of participants according to BMI groups (mean ± standard deviation).

	Normal Weight (n=426, 81.6%)	**Overweight/Obese (n=96, 18.4%)**	**T-Test**	***p* value**
Age	15.08 ± 1.41	14.82 ± 1.31	1.646	0.100
Weight (kg)	55.94 ± 10.01	76.22 ± 13.14		
Height (cm)	168.34 ± 9.80	168.78 ± 8.58	-0.405	0.686
BMI (kg/m2)	19.59 ± 2.05	26.67 ± 3.64		
LTPA	14.50 ± 4.36	12.88 ± 4.24	3.320	<0.001
MF	4.62 ± 1.04	4.10 ± 1.00	4.453	<0.001

BMI – Body Mass Index; LTPA – Leisure Time Physical Activity; MF – Meal Frequency

Table 2. Differences in eating patterns (meal frequency and breakfast skipping), physical activity, health perceptions and number of risk behaviours according to BMI.

	Normal Weight (%)	Overweight/Obese (%)	Chi-Square Test	*p* value
Meal Frequency				
≤ 4	45.77	66.67	13.679	<0.001
≥5	54.23	33.33		
Skipping Breakfast				
No	93.7	88.5	3.043	0.081
Yes	6.3	11.5		
LTPA				
APA	80.75	65.63	10.436	<0.001
NPA	19.25	34.38		
Health Perceptions				
Good	93.90	84.38	9.814	0.002
Poor	6.10	15.63		
Risk Behaviours				
No Risk	42.72	16.67	30.234	<0.001
1 Risk	44.37	54.17		
2 Risks	11.97	25.00		
3 Risks	0.94	4.17		
Mother's Education				
Low	36.85	41.67	1.288	0.525
Middle	49.06	47.92		
High	14.08	10.42		

LTPA – Leisure Time Physical Activity; NPA – Non-active group; APA – Active group

Meal Frequency

Daily MF was assessed by the question: How many meals per day do you consume? Possible answers were 1/2/3/4/5/6. To define a meal, an example was given (i.e., breakfast, lunch, dinner and small snacks such as mid-morning, mid-afternoon and evening). The main meals represented meals that were conventionally served on a plate. For statistical analysis the participants were grouped into two meal frequency categories: four or fewer (≤4) and five or more (≥5) (22).

Breakfast habits were assessed by the question, On a normal day do you eat breakfast? Possible answers were Yes or No. Participants were categorized as having breakfast vs. skipped breakfast.

General Health Perception

Adolescents were asked to assess their general health status by responding to the question, In general, how is your health? This measure was dichotomized into the categories of Good (answers of excellent, very good, and good) and Poor (answers of fair and poor).

Socio-economic Status

The mother's education level was used as a proxy measure of the participants' socio-economic status. Participants were classified with low socio-economic status (≥9 school years—mandatory education level); middle socio-economic status (10-12 school years—secondary education level) and high socio-economic status (college or university degree).

Statistical Procedures

Descriptive statistics included the number and participants' frequencies according to BMI groups. An independent Student T Test was used to analyse differences between BMI groups for continuous variables. The chi-square test (χ^2) was used to determine the differences in LTPA (two categories), MF (two categories) and HP (two categories) variables between BMI groups.

Logistic regression analyses were performed to assess the Odds Ratio (OR) and 95% confidence intervals (CI) for OV/OB. For the first model, all independent variables (LTPA, MF, HP, breakfast skipping and

Table 3. Odds ratios and 95% confidence intervals from logistic regression model predicting overweight/obesity.

	OR	95%CI	p value
Meal Frequency			
≤ 4 (ref.)	1		
≥5	2.26	1.40-3.68	<0.001
Skipping Breakfast			
No (ref.)	1		
Yes	1.52	0.70-3.29	0.288
LTPA			
APA (ref.)	1		
NPA	1.99	1.21-3.31	0.008
Health Perceptions			
Good (ref.)	1		
Poor	2.61	1.28-5.30	0.008
Mother's Education			
High (ref.)	1		
Middle	1.31	0.61-2.79	0.525
Low	1.28	0.59-2.78	0.488

LTPA – Leisure Time Physical Activity; NPA – Non-active group; APA – Active group

mother education level) were tested simultaneously. In the second model, the number of aggregated risk behaviours and mothers' education levels were tested simultaneously.

RESULTS

18.4% of the participants were OV/OB. Differences in participants' characteristics according to BMI status are presented in Table 1. No statistically significant differences were found between non-obese and OV/OB groups for either age or height. OV/OB boys showed lower LTPA levels and had less MF than their normal-weight peers ($p \leq 0.05$).

As shown in Table 2, the proportion of OV/OB boys consuming four or fewer meals a day was significantly higher ($p<0.05$) than those reported for normal weight boys. The proportions of OV/OB boys with NPA and poor HP were also significantly higher than in the normal weight boys ($p<0.05$). OV/OB boys also showed a higher prevalence of behavioural risk factor aggregation compared to normal weight boys ($p<0.001$).

A logistic regression analysis (Table 3) showed that those who ate fewer than four meals were at increased risk for being OV/OB (OR: 2.26; $p<0.001$). Boys with NPA (OR: 1.99; $p<0.05$) and those with poor HP (OR: 2.61; $p<0.05$) were also more likely to be classified as OV/OB. The mother's socioeconomic status was not a significant predictor of OV/OB ($p>0.05$). Additionally, the odds of being OV/OB increased as the number of aggregated risk factors increased ($p<0.001$) (Table 4).

DISCUSSION

This paper describes cross-sectional relationships among overweight/obesity (OV/OB), leisure time physical activity (LTPA), meal frequency (MF), and health perception (HP) among male Portuguese adolescents. The primary finding of this study was that OV/OB in this population was associated with eating fewer meals, having low levels of LTPA and reporting poorer HP, regardless of socio-economic status. This finding is worthy of comment in different ways.

It has been found that eating patterns, especially disordered eating patterns, predicts further weight gain (23, 24). Our data focused on MF. OV/OB students reported eating significantly fewer meals (≤4/day) than their normal-weight peers. Further, regression analysis clearly shows that those with lower MF were 2.26 ($p<0.001$) times more likely to be OV/OB. Thus, our data is in agreement with other studies reporting an influence of MF on BMI (22, 25, 26). The fact that

Table 4. Odds ratios and 95% confidence intervals from logistic regression model predicting overweight/obesity.

	OR	95%CI	*p* value
Risk Behaviours			
No Risk (ref.)	1		
1 Risk	3.15	1.73-5.71	<0.001
2 Risks	5.33	2.63-10.82	<0.001
3 Risks	11.05	2.49-49.05	<0.001
Mother' Education			
High (ref.)	1		
Middle	1.35	0.61-2.88	0.436
Low	1.32	0.63-2.89	0.474

LTPA – Leisure Time Physical Activity; NPA – Non-active group; APA – Active group

eating fewer meals was associated with OV/OB appears counterintuitive. Given the fact that it is generally accepted that excess weight results from greater energy intake versus energy expenditure (27), one might expect eating more meals to lead to greater kcal/intake. Therefore, our findings may suggest that, despite eating fewer meals, participants probably ingest more energy per meal, leading to greater overall kcal intake. Furthermore, it is known that irregularity of meals, such as breakfast skipping, is associated with overweight and obesity (28), as well as with the clustering of less healthy lifestyle factors in childhood and adolescence (29). In our study, a positive, moderate association was found between breakfast skipping and MF (Spearman's correlation for these variables with ordered categories: Rho=0.46; p<0.001 – data not shown), which might explain this apparent contradiction. Nevertheless, our findings require confirmation in future studies. On the other hand, although we have no data showing whether the OV/OB boys in our study were involved in some dieting process or weight control effort, it has been shown that, in girls, overweight status increases the risk for disordered eating (30) and OV/OB youth may be more prompt to use unhealthy or extreme weight control behaviours than their normal-weight peers (31) (32). Thus, our data might be related with a response of OV/OB boys to avoid an increase in energy intake or even linked to negative lifestyle behaviours, which warrants further concern and attention in the school environment.

Although the relation between LTPA and energy intake and its association with obesity has been described (33), an association between PA and an obesity range between low to moderate to some extent depends on the method used to assess activity levels (34). Our data showed that NPA participants were at increased risk (OR: 1.99, p<0.05) of OV/OB, which agrees with other studies showing that obese subjects were significantly less active than their peers (35) and that a low level of PA was a significant risk factor for boys being OV/OB (36). Furthermore, our findings showed that those who reported poor HP were significantly more likely (OR: 2.61; p=0.008) to be OV/OB, which is in accordance with other studies showing that OV/OB youth reported generally poor HP as well as functional limitations (12, 31). Additionally, one study suggested that OV/OB youth were twice as likely to report health concerns than normal weight youth and were also somewhat less likely to engage in health-promoting behaviours (31).

Because of its negative cumulative effect on health, investigating the aggregation of such adverse health-related behaviour is very important (37). Our data showed that 0.9% of adolescents of normal weight and 4.2 of OV/OB adolescents reported having three risk factors (low activity, low MF and poor HP), meaning that 4.2% of our sample displays four risk factors (low activity, low MF, poor HP and OV/OB). Thus, from a public health standpoint our data are important because they show that those with an aggregation of three risk factors are 11.38 times more likely to be OV/OB (p<0.001). Additionally, our findings highlighted that the odds for being OV/OB are lower as the number of risks decreases. These results suggest that some of the behaviours could be interrelated and cumulative in their relation with OV/OB status (25).

Another finding worth noting is the non-significant association between the mother's education level and BMI found in our study, which is not in agreement with other studies. Indeed, some studies have shown negative relations between BMI and socioeconomic status in children and adolescents (38-40). A large body of epidemiological data shows that diet quality also follows a socioeconomic gradient, with the most affluent having better diet quality (41). Despite the

fact that deprivation may increase the odds for obesity in childhood and adolescence, it seem that OV/OB children of low socioeconomic status are more likely to remain OV/OB through early adulthood (42). Apparently, one could speculate that strategies to improve weight status in our sample would produce similar effects in all socioeconomic groups. Although our study is confined to MF (we did not assess diet quality), future studies with Portuguese adolescents may consider assessing diet quality to verify its relation with MF and with BMI.

Some limitations of this study should be pointed out. The results of this study should be interpreted with the understanding that the data are cross-sectional, and therefore, no causal inferences can be drawn. Also the sample size is small and limited to boys, which makes it difficult to generalize the findings. Inherent to all self-report-based approaches to dietary questions, self-reporting bias is likely in this study, since subjects tend to overestimate behaviour considered to be positive and underestimate the negative behaviours. In the absence of further information about actual energy intake, it is difficult to further assess these potential biases, although the information recalled is sufficient to characterize the eating patterns of large groups of youth (25). In this study, obesity was not considered as an objective measure. Although BMI has become a very common way of assessing OV/OB, it does not capture variations in fat and fat-free mass. Nevertheless, recently it was shown that OV/OB assessed by BMI during childhood is a strong predictor of obesity and coronary heart disease risk factors in young adulthood (43), which stresses the importance of our data from a preventive point of view.

CONCLUSION

Our findings suggest that meal frequency (MF), health perception (HP), leisure time physical activity (LTPA) and the behavioural aggregation of these risk factors are associated with OV/OB in Portuguese male adolescents. However, the direction of this relation cannot be established due to the cross-sectional nature of our study, and therefore it is also possible that some of these factors could likely be consequences of OV/OB. Future studies in Portuguese adolescents are necessary to better understand the relations between weight status and other health behaviours.

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