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Clinical Study

Psychosocial Factors of Different Health Behaviour Patterns in Adolescents: Association with Overweight and Weight Control Behaviours

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Physical activity, nutrition, and sedentary behaviour combine to influence the risk of overweight among adolescents. This paper aims to identify psychosocial factors of different health behaviour patterns in adolescents and its association with overweight and weight control behaviours. The 3069 adolescents of both genders (average of 14.8 years old) from the 2010 Portuguese survey of Health Behaviour School-Aged Children (HBSC) answered the 2010 HBSC self-reported questionnaire. It used the cluster k-means (nonhierarchy method), qui-square, one-way ANOVA, and logistic regression. Three clusters with different behavioural patterns (physical activity, sedentary, and eating) composed the results obtained. The sedentary group (34%) had lower self-regulation, body satisfaction, health and wellness, family and classmates relationships, communication with the father than the other two groups. The active gamers (25%) had a smaller BMI but used more unhealthy weight control strategies than the other two groups. The healthy group (41%) was more motivated and more satisfied with school but was not different than the active gamers in most psychosocial variables. Differences were found between clusters for weight control behaviours and psychosocial variables. Different strategies for different patterns were necessary in order to promote obesity prevention and, simultaneously, target healthy lifestyle and wellbeing in adolescents.

1. Introduction

The potential synergistic effect of multiple dietary and inactivity behaviours on the risk of chronic conditions, as obesity, and other health outcomes is a key issue for public health. Many adolescents fail to meet a wide diet, physical activity, and sedentary behaviour recommendations, highlighting the need to achieve multiple health behaviour change in adolescent boys and girls [1].

The prevalence and clustering patterns of multiple health behaviours among adolescents ($N = 176$; 12–16 years old; 49% boys) showed that boys were more active than girls ($P < .001$), and younger teenagers were more active than older ones ($P < .01$) [2]. Regarding eating behaviour, boys ate breakfast on more days per week than girls ($P < .01$), and older adolescents ate more fruit and vegetables than younger ones ($P < .001$). Only 6% of adolescents achieved all three of the recommendations (60 minutes of moderate-to-vigorous physical activity/day; 5 portions of fruit and vegetable per day; eating breakfast 5 days per week), while almost 54% had multiple risk behaviours, and girls had significantly more risk factors than boys. When adolescents accumulated two risk behaviours, the most prevalent cluster was "not meeting the physical activity and fruit and vegetable recommendations." Future research should investigate the best way to achieve multiple health behaviour

change in adolescents, in order to meet recommendations [2].

Effective strategies may focus on determinants of healthful and sustainable behaviour patterns, rather than focus on any single aspect of these patterns. Considering the combination of both active and sedentary behaviour in order to encourage adolescents to adopt overall healthy lifestyles was probably a more effective strategy than considering only one of them [3, 4]. In fact, some studies showed that sedentary behaviour might moderate the relationship between physical activity and overweight [5].

Recent reviews of the effectiveness of obesity treatments consider psychosocial determinants to identify moderators and mediators of the interventions to produce enduring changes in health behaviours [6, 7]. An important review on these psychosocial determinants recommend strategies to reduce obesity prevalence based on protective and risk factors identified [8]. Protective factors against obesity were considered to be regular physical activity and a high intake of dietary nonstarch polysaccharides/fiber (both convincing); supportive home and school environments for children and breastfeeding (both probable). Risk factors for obesity were considered to be sedentary lifestyles and a high intake of energy-dense, micronutrient-poor foods (both convincing); heavy marketing of energy-dense foods and fast food outlets; sugar-sweetened soft drinks and fruit juices; adverse social and economic conditions-developed countries, especially in women (all three probable).

These results show the importance of family and school contexts (interpersonal variables) to obesity prevention. Intrapersonal variables, such as motivation for weight management [9] or psychological health in general, also seem relevant [10]. The proportion of obese and overweight adolescents who have an accurate perception of weight, intend to lose weight, and have taken recent action to lose weight suggests that this group is highly motivated and engaged in weight-related behaviour change [11]. Nevertheless, the discrepancy between these proportions and the rising prevalence of overweight subjects implies that adolescents are taking actions which are not effective [11].

However, it appears that many students are already taking appropriate steps to reduce their weight [12]. Unhealthy weight control behaviours and specific weight loss plans were not associated with weight loss in teenagers ($N = 130$), but adolescents who lost weight (in the past year; $N = 62$) were more likely to report using healthful control behaviours such as increasing exercise, spending less time watching TV, consuming diets high in protein, drinking less soda and self-weighing compared to overweight adolescents who had not lost weight in the past year ($N = 68$) [13]. In overweight/obese adolescents from New Zealand (who are trying to lose weight), an inverse relationship between BMI and consumption of high-fat/high-sugar foods and a positive relationship between BMI and eating 5 or more fruits and vegetables a day (all significant after controlling for age, gender, and ethnicity) were found [12]. Unexpectedly, the lowest BMI was found in students who drank most soft drinks or ate fruit and vegetables infrequently. In most cases, among students not trying to change their weight, expected relationships were observed; among students trying to lose weight, unexpected or no relationships were observed [12]. Adolescents are concerned about the weight and carry out efforts to change, so it is important to identify which are the most effective strategies and prevent ineffective ones.

Despite the weak scientific evidence to prove what works best in the management of adolescent overweight, recent reviews show that combined behavioural lifestyle intervention can produce a significant and clinically meaningful reduction in overweight [6, 14, 15]. Changes in psychosocial variables were also recommended [16], given its role as moderators and mediators of interventions that could produce sustainable change [6].

Studies that tried to understand mediators of behaviour change and maintenance have been supporting autonomous self-regulations or motivation and psychological basic needs (competence, autonomy, and relatedness), conceptualized by Self-Determination Theory (SDT) [17, 18] as key components of long-term adherence to healthy lifestyles [17]. In the context of health behaviour change, it is maximizing the chances of the person to experience autonomy, competence, and positive relationship, that self-regulation of health behaviours is more likely to be internalized and behaviour change is maintained [19], such as greater intake of fruits and vegetables or more physical activity. Thus, this theory is concerned with social-contextual conditions which facilitate versus prevent the natural processes of self-motivation and healthy psychological development [20].

The present study seeks to identify patterns of health behaviour (physical activity, inactivity, and nutrition) in adolescents based on age, gender, weight status, and psychosocial variables and, also, analyse the psychosocial predictors (intrapersonal and interpersonal) of those patterns and the prevalence of weight control behaviours (unhealthy and healthy) within each pattern. In order to bring implications to healthy lifestyles promotions and unhealthy weight control prevention, this research hopes to clarify some protective or risk behaviour patterns related to overweight in adolescents and to understand their association with the weight control strategies.

2. Method

2.1. Subjects and Procedures. The present study used the data from the 2010 Portuguese sample of the Health Behaviour in School-Aged Children (HBSC) [21]. This is the 2010 international investigation that took place in 44 countries, and the main objectives consist in studying and monitoring the lifestyles of adolescents and their behaviours in their distinct social contexts.

The Portuguese HBSC 2010 sample was composed by 5050 individuals of 139 schools randomly selected from a national list stratified by region. It is a representative sample of students from 6th, 8th, and 10th grades of Portuguese public schools. Girls were 52.3% (2643) and boys were 47.7% (2407) with an average age of 13.98 years old (SD ± 1.85), varying between 10–21 years old.

The study participants represent 60.8% ($N = 3069$) of total sample selected from the 8th and 10th grade. Exclusion criteria were applied for age (subjects under 12.9 years old and older than 16.9 years old) to exclude subjects who could contaminate the analysis according to age and school grade and for BMI (subjects with BMI below 13 and above 50) to exclude values that, according to clinical criteria, are not possible. They were 45.9% (1408) boys and 54.1% (1661) girls, with an average age of 14.8 years old (SD ± 1.1), varying between 13–16.9 years old. The average BMI was 20.88 (SD ± 3.42; range from 13.01 to 47.57).

2.2. Measures. All measures were obtained from the 2010 Health Behaviour School-Age Children self-reported questionnaire [21, 22]. The participating countries in the HBSC study included all the mandatory items on the questionnaire, which focus on distinct health aspects: at a demographic, behaviour, and psychosocial level. All the questions followed the protocol format [21, 22]. The variables selected for this study are as follows.

Health Behaviours. The physical activity (PA) was measured by the number of week days (1–7) performing 60 minutes of moderate-to-vigorous intensity PA (days of 60′ PA); intense exercise out of school (sport or leisure) was measured by frequency (never, less than once a month, once a month, once a week, 2-3 times a week, 4–6 times a week, every day) and by hours a week (about 7 hours or more, about 4–6 hours, about 2-3 hours, about 1 hour, about 1/2 hour, none), and a factory analysis showed only one factor (KMO = .50) and 81.3% of explained variance ($\alpha = .76$); all sedentary variables of screen time/week as TV watching, playing video games/computer, and computer use for internet/homework were measured by an average of hours/week; weekly consumption of fruits, vegetables, soft drinks, and sweets was measured by a seven-point scale (never, less than once a week, once a week, 2–4 days a week, 5-6 days a week, once daily, more than once daily).

Dieting behaviour to lose weight was assessed by one question (*currently, are you on a diet or doing something else to lose weight?*) whose response options were "No" or "Yes."

Weight control behaviour was measured by yes/no answers to one question (*which of the following things did you do to control your weight over the past 12 months?*) with nine items (*more exercise or sport, more active transport by walk or bike, drink more water, eat smaller portions, eat less fat food, follow a nutrition plan with professional supervision, skip meals, fasting, induce vomiting, using diuretics or laxatives, other*). The factor analysis (KMO = .75) showed two factors which explained 51.8% of variance: unhealthy weight control behaviours ($\alpha = .73$) (*included skip meals, fasting, induce vomiting, using diuretics*) and healthy control behaviours ($\alpha = .68$) (included other items, but excluded *follow a nutrition plan with professional supervision*).

Health and Wellbeing Variables. The perceived health was measured by a four-point scale (poor/fair/good/excellent); the life satisfaction was measured by a ten-point scale (0 = worst possible life; 10 = best possible life); the happiness was measured by a four-point scale (feeling very unhappy, feeling little happy, feeling happy, feeling very happy); the psychological symptoms (such as feeling low, irritability or bad temper, feeling nervous, difficulties in sleeping and fear) and the physical symptoms (as headaches, backache, stomachache, neck and shoulders aches, feeling dizzy, exhaustion) were measured by the weighted sum of symptoms evaluated in 0–4 point scale (rarely or never, about every month, about every week, more than once a week, about every day). These two variables were obtained by factor analysis, and the reliability was .76 and .73, respectively.

Intrapersonal Variables. The self-regulation was measured by three items (*e.g., when I am sad, I usually start to do something that makes me feel better; if something does not go as planned, I can change my behaviour to try to reach my goal; I can resist doing something when I know I do not*) by a five-point scale (never true, sometimes true, neither true nor false, often true, always true); a factor analysis (KMO = .61) found one factor which explained 59.7% of variance ($\alpha = .65$); the body satisfaction was measured by the weighted sum of symptoms evaluated in 1–5-point scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree) with six items (*e.g., I am frustrated with my physical appearance; I am satisfied with my appearance; I like my looks, despite its imperfections*) three of them recoded; a factor analysis (KMO = .84) found one factor which explained 62.5% of variance ($\alpha = 88$); motivation was measured with one item, when I cannot do things first, I insist and keep trying until I get it by a five-point scale (never, rarely, sometimes, many times, always).

Family Variables. Family relationship was measured by a ten-point scale (0 = very poor relationship; 10 = very good relationship); communication with father and mother was measured by a five-point scale (do not have or see, very difficult, difficult, easy, very easy).

Peers Variables. Relationship with colleagues/classmates was measured with three items (e.g., *my classmates like being together; my classmates accept me as I am*) evaluated in 1–5-point scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree); Talk with friends was measured with three items (e.g., *how do you feel comfortable to talk about issues that concern you with. . .best friend, friends of the same sex, friends of opposite sex*) by a 5-point scale (very difficult, difficult, easy, very easy). These two variables were confirmed by factor analysis (KMO = .642 and .662), explained variance of 65.3% and 62.5%, $\alpha = .70$ and .73, respectively.

School Variables. Liking school was measured with one item and by a 4-point scale (not at all, not very much, like a bit, like a lot); academic achievement was measured with one question (*in your opinion, what teachers think about your school capacity compared with that of your classmates?*) by a 4-point scale (below average, average, good, very good).

Table 1: Gender, school grades, and weight status prevalence within clusters.

	Active gamers (N = 678): Cluster 1		Healthy group (N = 1140): Cluster 2		Sedentary group (N = 952): Cluster 3	
Variables	N	%	N	%	N	%
Boys	443	35.8*	522	42.2	273	22.1*
Girls	235	15.3*	618	40.3	679	44.3*
8th grade	377	29.8*	518	40.9	371	29.3*
10th grade	301	20.0*	622	41.4	581	38.6*
Normal weight	575	25.0	944	41.0	784	34.0
Overweight	83	21.2	164	41.9	144	36.8
Obese	20	26.3	32	42.1	24	31.6

$P < .001$, based on chi-square test for categorical variables,
*Adjusted residual $R^2Aj \geq |1.9|$.

Finally, BMI was calculated based on self-reported weight/height relations (kg/m^2) [23]. *Weight status* (obese, overweight, and normal weight) was defined using international definitions for children and adolescents [24].

2.3. Statistics. The classification of subjects was performed with a nonhierarchical clusters analysis with the *k-means* method [25] using the Euclidean distance between centroids and each subject as a measure of dissimilarity between subjects. It was decided to retain three clusters with lifestyles variables (physical activity and exercise, screen time behaviour, eating behaviour) theoretically interpretable. To identify which variables are most important in the clusters retained, the analysis of one-way ANOVA F statistic of the cluster as described in Maroco (2009) was performed. Chi-squared test (χ^2) was performed to analyse the relationship between clusters, genders and school grade. A better test for the significance of clusters cells is given by inspection of the Adjusted Residuals when these are clearly above the value |1.9|. One-way ANOVA was performed for comparison between clusters for continuous variables. All analyses were performed with SPSS (v. 19, SPSS Inc, Chicago, IL).

3. Results

The clusters analysis of the health behaviours variables (physical activity and exercise, dieting, and screen time) shows three patterns. The procedure for refinement of the classification by *k-means* revealed intense exercise out of school variable as the best that allows differentiating the clusters (F = 998.6), followed by playing video games (F = 813.5) and by 60′ PA (F = 595.9). On the contrary, sweets consuming (F = 129.4) was the variable that less distinguishes the clusters.

Cluster 1. Active gamers—25% (N = 678) adolescents with high amount of daily physical activity, but more intense exercise out of school, with higher screen time behaviour (especially due to the time spent playing video games), with poor eating behaviour, low fruit and vegetable consuming and higher sweets and soft drinks consuming.

Cluster 2. Healthy group—41% (N = 1140) adolescents with higher amount of physical activity, lowest sedentary behaviour, and also a healthy diet (high fruit and vegetable consuming and low sweets and soft drinks consuming).

Cluster 3. Sedentary group—34% (N = 952) adolescents with lower scores related with physical activity, low sedentary behaviour, except TV watching on average, and low fruit and vegetables consuming, but a sweet and soft drinks on average.

3.1. Differences between Clusters. Different prevalence was found within groups for genders [$\chi^2(2) = 216.3$; $P = .0001$] and school grades [$\chi^2(2) = 44.2$; $P = .0001$], but not for weight status (see Table 1).

The results showed that *Active gamers* was mostly boys (N = 443; Adj Res = 12.4) and students from the 8th grade (N = 377, Adj Res = 6.0); *Sedentary group* was mostly girls (N = 679; Adj Res = 12.3) and students from the 10th grade (N = 581; Adj Res = 5.1), while the *Healthy group* did not show a significant difference prevalence. The prevalence of weight status in total sample (N = 2270) was 83.1% (N = 2303) of normal weight, 14.1% of overweight (N = 391), and 2.7% of obesity (N = 76).

Differences between groups for age, BMI, and psychosocial variables (wellness and health, interpersonal variables relating to family, peers and teachers, and relating with school) are presented in Table 2.

Only motivation ($F(2, 2546) = 28.7$; P = .000) and liking school ($F(2, 768) = 37.5$; P = .000) distinguish the three groups. The healthy group is the most motivated and satisfied with school, than the other two groups with very low scores or even negative.

The sedentary group includes older adolescents ($F(2, 2769) = 16.8$; P = .000) with the worst significant values: poorer self-regulation ($F(2, 2650) = 33.6$; P = .000) and body satisfaction ($F(2, 2484) = 11.1$; P = .000); an unfavourable health ($F(2, 2744 = 40.6$; P = .000) and happiness ($F(2, 2654) = 10.0$; $P = .000$) and life satisfaction ($F(2, 2731) = 28.1$; $P = .000$); worst satisfaction with family relationships ($F(2, 2624) = 12.4$; $P = .000$), communication with father ($F(2, 2720) = 23.9$; P = .000); a poorer

Table 2: Differences between clusters for each psychosocial variable.

	Cluster center					
	Active gamers[a]	Healthy group[b]	Sedentary group[c]			
Variables	*M*	*M*	*M*	*df*	*F*	
Age	14.7[a]	14.8[b]	15.0[c]	2	16.8***	a < c; b < c
BMI	20.5[a]	21.0[b]	20.9[c]	2	4.8**	a < b; a < c
Self-regulation	0.06[a]	0.13[b]	−0.22[c]	2	33.6***	a > c; b > c
Motivation	0.02[a]	0.17[b]	−0.15[c]	2	28.7***	b > a > c
Body satisfaction	0.07[a]	0.07[b]	−0.13[c]	2	11.1***	a > c; b > c
Unhealthy weight cont.	0.09[a]	−0.08[b]	−0.07[c]	2	4.4*	a > b
Healthy weight control	−0.10[a]	0.16[b]	−0.14[c]	2	33.0***	a < b; b > c
Life satisfaction	7.28[a]	7.44[b]	6.88[c]	2	28.1***	a > c; b > c
Happiness	0.05[a]	0.07[b]	−0.11[c]	2	10.0***	a > c; b > c
Psychological symptoms	0.84[a]	0.83[b]	1.07[c]	2	21.5***	a < c; b < c
Physical symptoms	0.84[a]	0.87[b]	1.03[c]	2	13.8***	a < c; b < c
Health perception	0.15[a]	0.11[b]	−0.22[c]	2	40.6***	a > c; b > c
Communication father	0.42[a]	0.13[b]	−0.17[c]	2	23.9***	a > c; b > c
Communication mother	−0.03[a]	0.08[b]	−0.06[c]	2	5.6**	b > c
Family relation feelings	0.05[a]	0.11[b]	−0.10[c]	2	12.4***	a > c; b > c
Relation with classmates	0.09[a]	0.03[b]	−0.15[c]	2	9.7***	a > c; b > c
Liking school	−0.20[a]	0.20[b]	−0.02[c]	2	37.5***	b > c > a
Academic achievement	−0.06[a]	0.20[b]	−0.09[c]	2	27.4***	a < b; b > c

$P < .05$; $^{**}P < .001$; $^{***}P < 0.0001$; a, b, c and <> signals represent the significant differences between groups for $P < 0.05$ through Tukey post hoc test; communications with friends and autonomy support by teachers (n.s.).

Table 3: Psychosocial predictors of each pair of groups.

	Active gamers versus Healthy group (1)	Healthy group versus Sedentary group (1)	Active gamers versus Sedentary group (1)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age	1.01 [0.915, 1.124]	1.20 [1.089, 1.313]***	1.26 [1.126, 1.404]***
Gender (boys = 1)	0.39 [0.309, 0.497]***	0.53 [0.428, 0.665]***	0.21 [0.162, 0.270]***
BMI	1.06 [1.018, 1.099]**	0.99 [0.957, 1.021]	1.05 [1.006, 1.099]*
Self-regulation	1.05 [0.925, 1.195]	0.86 [0.768, 0.971]*	0.87 [0.762, 1.004]
Motivations	1.11 [0.982, 1.260]	0.78 [0.694, 0.874]***	0.88 [0.774, 1.008]
Body satisfaction	0.99 [0.875 1.129]	0.98 [0.876, 1.094]	1.00 [0.871, 1.142]
Communication with father	1.21 [1.063, 1.379]**	0.85 [0.756, 0.964]*	1.02[0.889, 1.179]
Communication with mother	1.0 [0.881, 1.132]	1.01 [0.895, 1.131]	1.02 [0.894, 1.172]
Family relationships	1.02 [0.889, 1.164]	0.96 [0.853, 1.075]	0.98 [0.859, 1.128]
Liking school	1.47 [1.312, 1.657]***	0.84 [0.748, 0.938]**	1.20 [1.063, 1.360]**
Relationship classmates	0.88 [0.779, 0.987]*	0.93 [0.843, 1.032]	0.85 [0.746, 0.963]*

OR (1 < OR < 1); 95% CI (1 < CI < 1); $^{*}P < .05$; $^{**}P < .001$; $^{***}P < .0001$.

relationship with classmates ($F(2, 2752) = 9.7$; $P = .000$). There is no significant difference between the other two groups for those variables. The sedentary group had also worst values without significant differences with active gamers in healthy weight control strategies ($F(2, 2548) = 33.0$; $P = .000$) and academic achievement ($F(2, 2763) = 27.4$; $P = .000$). The active gamers had the smaller BMI ($F(2, 2769) = 4.8$; $P = .008$) but use significantly more unhealthy weight control strategies ($F(2, 2548) = 4.4$; $P = .013$), than the healthy group, although there are no significant differences between sedentary adolescents and these other two groups for those variables. The communication with mother ($F(2, 2693) = 5.6$; $P = .004$) was worst in sedentary group and significantly better for healthy group, but active gamers do not differ from those two.

3.2. Psychosocial Predictors of Each Cluster. To examine psychosocial predictors of each group logistic regressions were performed including intrapersonal, interpersonal variables and controlling age, gender, and BMI (see Table 3 with all three logistic regressions).

Table 4: Prevalence of dieting and weight control behaviours within groups.

		Total sample ($N = 3069$)		Active gamer $N = 678$ Cluster 1		Healthy group $N = 1140$ Cluster 2		Sedentary group $N = 952$ Cluster 3			
Dieting		%		N	%	N	%	N	%	df	χ^2
Yes		10.6		57	8.4*	154	13.5*	83	8.7*	2	17.05***
No		89.4		618	91.6*	984	86.5*	867	91.3*		
Weight control behaviours (Yes/No)											
Healthy weight control	More exercise	66.3		481	75.3*	828	76.9*	418	47.1*	2	223.1***
	Walking/biking	54.8		351	55.9	629	59.0*	434	49.0*	2	19.8***
	More water	63.5		386	61.2	731	68.1*	528	59.5	2	17.4***
	Smaller portions	40.3		223	35.5*	442	41.2	377	42.5	2	8.1*
	Less fat food	51.2		263	41.9*	612	57.1*	447	50.5	2	36.8***
	Nutrition plan with a professional	15.0		112	17.9*	187	17.5*	89	10.1*	2	30.0***
Unhealthy weight control	Skip meals	17.2		114	18.2	154	14.4*	176	19.8*	2	10.9**
	Fasting	6.7		55	8.8*	60	5.6*	58	6.5	2	6.4*
	Induce vomiting	4.7		37	5.9	46	4.3	38	4.3	2	2.8
	Diuretics/laxatives	4.0		36	5.8*	38	3.5	30	3.4	2	6.4*

* Adjusted residual $\geq |1.9|$; all data represent the "yes" answers; * $P < .05$; ** $P < .01$; *** $P < .001$.

Active Gamers versus Healthy Group. The results showed that BMI, communication with father, and liking school were more associated with healthy group than with active gamers, when healthy group was the reference, but gender (boys) and relationship with classmates were more associated with active gamers.

Healthy Group versus Sedentary Group. When sedentary group was the reference, self-regulation, motivation, communication with father, and liking school were more associated with healthy group; on the other hand, age (older) and gender (girls) were more associated with sedentary group.

Active Gamers versus Sedentary Group. Active gamers were also more associated with gender (boys) and relationship with classmates than the sedentary, which were more associated with age (older), BMI, and liking school.

3.3. Prevalence of Weight Control Behaviour. The prevalence of weight control behaviour and dieting were significant within groups for all variables except weight control by induce vomiting (see Table 4). Regarding dieting behaviour there was significant differences prevalence between groups [$\chi^2(2) = 17{,}05$; $P = .001$]; the healthy group was characterized by high dieting behaviour than the other two groups; the sedentary group had more dieting behaviour than active gamers.

Regarding weight control behaviours or strategies, the healthy group used "more exercise" [$\chi^2(2) = 223.10$; $P = .001$] significantly oftener than the two other groups and used "walking/biking" [$\chi^2(2) = 19.82$; $P = .001$] more than the sedentary group, which used "more exercise" significantly less than the active gamers, who do not use "walking/biking" significantly. Only the healthy group used "drink more water" significantly [$\chi^2(2) = 17.43$; $P = .001$] and used "less fat food" more times than the active gamers, while the sedentary group does not use that strategy significantly [$\chi^2(2) = 36.80$; $P = .001$]. "Smaller portions" was only significant regarding the group active gamer [$\chi^2(2) = 8.14$; $P = .017$]. "Follow a nutrition plan supervised by a professional," even low values in each group, was used firstly by the active gamers, than by the healthy group and significantly less by the sedentary group [$\chi^2(2) = 25.94$; $P = .001$].

In the negative weight control behaviours, the sedentary group "skip more meals" [$\chi^2(2) = 10.86$; $P = .004$] than the healthy group. The active gamers, who do not "skip meals" significantly, used more "fasting" behaviour [$\chi^2(2) = 6.39$; $P = .041$] than the healthy group and was also the only one that used "diuretics or laxatives" significantly [$\chi^2(2) = 6.40$; $P = .041$] (see Table 4).

4. Discussion

This study tried to identify patterns of health behaviour (physical activity, nutrition, and sedentary behaviour) in adolescents and analyse their differences based on age, gender, weight status, and psychosocial variables. Another purpose was to analyse the psychosocial predictors (intrapersonal and interpersonal) of those patterns and the prevalence of weight control behaviours (unhealthy and healthy) within each pattern. Understanding these data is an important public health issue to develop preventive interventions in certain risk groups [26].

The demographic differences between clusters showed that there exist a majority of adolescents with healthy behaviours (healthy group), a short proportion of young people very active, mostly boys of the 8th grade, with a poor diet who spend too much time playing video games

(active gamers); there is another significant proportion, mostly girls in the 10th grade, who are very sedentary, with a low consumption of vegetables and fruit (sedentary group). These results were consistent with population's studies that find this age and gender pattern regarding physical activity and inactivity [2, 27, 28]. Regarding the eating behaviour, an association was observed between screen time, especially TV, and poor nutrition, which was also found in other studies [12, 29].

The psychosocial differences between groups highlighted the healthy group with a more favourable pattern (except for BMI). However, it seems that psychosocial factors do not distinguish these adolescents from active gamers (with intermediate scores), as distinguishing them from the sedentary group (with the worst values). Probably, the exercise was a protective factor regarding the active gamers, which did not happen with the sedentary group, who had a poorer wellness and health perception, low self-regulation, motivation, and body satisfaction, as well as worst relationships with family and classmates. This protective effect of physical activity is widely described by their psychological benefits in wellness and mood, body image, self-efficacy, self-esteem, and coping [30, 31]. Being the only factor of distinction between groups of adolescents with healthy and unhealthy behaviours, studies showed that the decrease in physical activity is related to regaining weight across all experimental and control groups [32].

The unhealthy psychosocial pattern of the sedentary group was expected, since girls mainly composed it, and the literature showed them as more sedentary and worse in psychological variables [21, 27, 28, 33]. On the other hand, active gamers who had the worst eating pattern of all the three groups, despite a significant lower BMI than the other two groups, had more unhealthy weight control behaviours, which may expose them to eating disorders. In fact, recent studies have shown a relationship between the high screen time behaviour and a poor diet, regardless of the BMI. This inverse association between screen time and eating patterns was found in boys and girls who watch too much TV and had an unhealthy dietary (e.g., increased consumption of soft drinks, fried foods, and snacks) [34].

One possible explanation for higher unhealthy weight control behaviour of the active gamers may be the high exposure to virtual models perfect in most video games. A similar impact as the media influence that disseminates body shape ideals unattainable by most could explain the adoption of more extreme and unhealthy weight control behaviours by these adolescents.

Finally, only motivation and satisfaction with school differentiated the three groups, since the healthy group had more healthy weight control behaviours and academic achievement than the other two groups. This could be important to health preventions (e.g., obesity and eating disorders), since in addition to healthy behaviour pattern (nutrition, physical activity, and weight control), there are three psychosocial variables that seem to represent risk factors in the other two groups: lack of motivation, disliking school, and poor academic achievement. The importance of motivation and its nature is highly supported by SDT research as a key factor to healthy psychological development [20]. On the other hand, the school and academic achievement are a part of social-contextual conditions, which could facilitate or impede the natural processes of self-motivation. As Glass and McAtee hypothesize (2006), social conditions existing in schools, neighbourhoods, and homes (such as cultural norms, area deprivation, laws and policies, and the local food environment) act as risk regulators that influence two key health behaviours, dynamically and throughout lifetime: feeding and physical activity. These authors developed a multilevel framework concerning the study of health behaviours and obesity, in social and biological context, and proposed three ways to extend the horizons of the behavioural science in public health: gaining altitude (to understand causal forces across the topography of social structure), looking "upstream" at the interactions of environments and biology across lifetime, and looking below the water's surface at how bodies metabolize (embody) social context [35].

The selected psychosocial factors, intrapersonal and interpersonal, that seem to predict the healthy group, allow hypothesizing protective factors of these healthy patterns in adolescents. On one hand, the self-regulation and motivation predictors were important to promote a healthy profile of physical activity, screen time, and nutrition, which seems in line with SDT principles of health promotion [17]. On the other hand, the better interpersonal factor (communication with father and liking school) could represent a social environment that facilitates the satisfaction of basic needs and the natural processes of self-motivation and healthy psychological development, as stated in the same theory [20]. Additionally, communication with father seems to be a protective factor in healthy group, probably because usually communication with the father is not frequent, and when it does occur, it becomes a high relevant factor on psychological health and wellbeing of adolescents. The communication with the father emerges as a protective factor in the consumption of marijuana only regarding boys in a study about risk behaviours and communication with parents, and communication with mother appears as a protective factor in smoking also only for boys [36].

In the same way, predictors of active gamers and the sedentary group showed some risk factors that can guide interventions to change health behaviours. The relationships with classmates seem to facilitate the excess of playing video games in boys, associated with unhealthy eating; in the case of sedentary adolescents, being an older girl with higher BMI than peers could be a risk factor for unhealthy behavioural pattern. The relationship with classmates could be problematic when on-line games addiction increases, which explains an extreme behaviour of withdrawal from real life and its challenges and duties, such as attending school, sleeping and eating properly, and engaging with family life and friends, but this only occurs when they become increasingly intense and frequent users of massive multiplayer on-line games [37]. A study showed that adolescents classified as being at high risk due to physical inactivity (be overweight, female, or having low perceived sport competence) benefit more from activity-related support than the participants with low risk

[38]. Probably, the sedentary group with this evident risk of physical inactivity would respond positively to physical activity promoting through school resources, since they feel satisfied with the school, or through family or friends [39].

Neither group was associated to any of the weight status; however, within each group similar prevalence of normal weight, overweight, and obesity was found with significant differences on the BMI average. These results suggest that there is time for both sedentary and active activities, and BMI is not clinically significant with key sedentary behaviours [40]. In fact, the relation between health behaviour and obesity was very complex, because neither group represents a unique overweight risk pattern, and weight problem affects different combinations of eating, physical activity, and inactivity behaviours. It was seen in other studies that BMI is associated with healthier dieting [12] and with sufficient active people, although also highly sedentary [3, 4, 41]. Other researchers agree that diet, physical activity, and psychosocial factors are obesity determinants independent and potentially interactive, and few studies have explored the complexity behind these patterns [42]. This reinforces the need to simultaneously consider multiple risk factors, rather than a single one [3, 4], and probably promote multiple protective factors for an effective decrease of pediatric obesity.

The analysis of weight control strategies showed that the participants used the healthiest ones. With the exception of diet (often associated with weight regain and eating disorders [43]) and "skipping meals" with a considerable prevalence, young people seem aware of better options. The results for each group, in particular, showed that the healthy group does diet oftener than the other two groups but otherwise adopts healthier weight control behaviours. Exercise is the most widely used strategy for all groups, except for the sedentary group that does more "walking and cycling"; in contrast, following a nutrition plan with professional supervision is less popular for everyone, although less prevalent in the sedentary group. This group does not show a significant prevalence in other eating-related strategies, which makes it less likely to adopt changes and a healthy weight. Regarding unhealthy weight control behaviour, it is also this group that had a significant prevalence in "skipping meals." However, active gamers had the highest prevalence on "fasting" and "using laxatives/diuretics." The healthy group, despite the lower risk of these behaviours, had a significant prevalence on "fasting" and "skipping meals." This result shows that most adolescents are already taking appropriate steps to manage their weight. Although any group is free of risk, there is a higher risk for the sedentary group.

The limitation of this study was the dependence of a project conditioned by international standards. This denies autonomy to the selection of variables related to the self-determination theory. The health behaviours used were also limited by the scales used in the questionnaire, which are unique and cannot be changed. Other two limitations of this study was its cross-sectional character and being based on self-report. However, for this last limitation a study [23] suggests that BMI based on self-reported weight and height is not accurate for BMI prediction at an individual level but could be used as a simple and valid tool for BMI estimates of overweight and obesity in epidemiological studies.

5. Conclusion

Three main patterns of physical activity, nutrition, and sedentary behaviour emerge from Portuguese adolescents of the 8th and 10th grade—the healthy group, the active gamers, and the sedentary—but none are free to develop overweight problems or obesity, and all have a risk of using unhealthy weight control behaviours. Multiple combinations of those behaviour should be considered in order to prevent obesity and understand the best way to achieve multiple health behaviour change and wellbeing in adolescent boys and girls. The inactivity, present in the sedentary group, seems to be associated with grater psychosocial risk, more likely to affect girls, but when combined with poor eating it can be worst even without overweight. Poor eating behaviour (low fruit/vegetable and high sweets/soft drinks) combined with a high screen time, despite doing exercise regularly (more usually in boys), is associated with a more extreme unhealthy weight control behaviour.

However, most adolescents in this study are already taking appropriate steps to manage their weight (more exercise, more water, more walking/biking, smaller portions) and although there does not exist a group free of risk, there is higher risk for sedentary group to use unhealthy weight control behaviours. The protective factors of the healthy group could be intrapersonal (self-regulation, motivation, and body satisfaction) and interpersonal (communication with parents, family relationship, and liking school). Those factors are psychosocial mediators of autonomous motivation and the fulfillment of basic psychological needs widely recognized by research and supported by SDT as key variables of the adoption and maintenance of health behaviours and wellbeing.

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