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Adolescent obesity facts

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Obesity prevalence through childhood and adolescence has been classified as a serious public health problem (Nowick & Flodmark, 2008) among diabetes, hypertension, and psychological disturbances. One can note a worldwide increase in the prevalence of overweight/obesity and, therefore, different etiologically related diseases, particularly cardiometabolic disorders (Huang et al., 2007). In developed countries, current prevalence levels reach 23.8% in boys and 22.6% in girls (Ng et al., 2014), with Portugal showing high prevalence values like other southern European and Mediterranean countries (WHO, 2017).

The need to find better multi-sectoral strategies for current public policies appears to be fundamental for the health of the present generation of young adolescents and future adult populations. Although it is not the main scope of this text, it will be important, in due course, to analyse the effectiveness of the current inter-sectoral health policies applied in some countries, although it is clear that no country until now has been able to reverse this phenomenon definitively.

Our main purpose of this research note is to present the preliminary results of the *Causes4adolescentObesity* (C4AO) project (POCI-01-0145-feder-023813), which included a sample of 603 students from the northern and central interior region of Portugal. Still, without a complete inferential statistical analysis, the data show a worrying prevalence of overweight and obesity in this population (Table 1), especially in girls over 15 years old (~28%). Although young adolescents are potentially more likely to be obese than their older peers in most countries and regions, Portugal shows a non-significant positive trend (WHO, 2017), which seems consistent with the results reported here, particularly for females.

Table 1. Obesity prevalence (*) by age-group and gender.

	Males (n= 267)	Females (n= 336)
Early adolescence (12–15yrs)		
Underweight (%)	8.3	4.6
Normal weight (%)	70.2	73.2
Pre-obesity (%)	15.7	20.3
Obese (%)	5.8	2.0
Late adolescence (15–18yrs)		
Underweight (%)	8.2	6.6
Normal weight (%)	76.0	62.8
Overweight (%)	11.6	22.4
Obese (%)	4.1	8.2
P-value	0.684	0.043*

*body mass index (BMI; kg/m^2) was calculated, and participants were categorized as underweight, normal weight, overweight or obese according to the cut-off points proposed by Cole et al. (2007).

To face this problem, innovative strategies have started to emerge in Portugal in recent years. We would like to highlight the recent study by Tallon et al. (2020a), which was a complementary study to the C4AO project, showing that school-based interventions, particularly with technology support, appear to be a valid tool for nutrition education and healthy lifestyles for adolescents, although with short-term effects and modest impacts on BMI. According to the authors, factors such as gender and adolescents' prior knowledge of related content seem to influence the effectiveness of self-learning on this type of digital platform. This seems to reinforce the need to look at this phenomenon from a multifactorial perspective in order

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to better customize the intervention strategies to the characteristics of each target population.

It is obvious that excessive caloric intake in a small number of daily meals is a focal contributor to the development and maintenance of obesity (Peebles, 2008). However, other crucial mediators should also be considered, involving a complex interaction among social, behavioral, psychological, and several biological factors. This was precisely one of the main objectives of the C4AO project; Table 2 presents the preliminary descriptive data for several mediators.

With regard to contextual factors, we would like to emphasize the importance of improving our understanding of the effect of the family environment on the prevalence of adolescent obesity. The literature is still very little consistent about the relationship between the family structure and functioning with the risk for child and adolescent obesity (Halliday, Palma, Mellor, Green, & Renzaho, 2014). Data from the C4AO project show gender differences in the perception of family functioning, and it seems that dysfunctional families are related ($p< 0.05$) to a higher BMI in boys.

Concerning biological and behaviour changes, it is important to describe and monitor eating habits and physical activity over age, their differences between genders, and the conditions of each subpopulation residential environment (e.g., Loureiro, Matos, Santos, Mota, & Diniz, 2010). Our results show that boys are clearly more active than girls, although there is a tendency for their sedentary behaviour to increase with age. Girls, on the other hand, show a significant decrease ($p< 0.05$) in moderate and vigorous physical activity (MET-min/week) in late adolescence (> 15 years). The data relating to eating habits also suggest a significant relationship between the "adequate food" dimension and the

Table 2. Descriptive characteristics of the sample stratified by gender.

		Girls n (%)	Boys n (%)	p-value
Biological	Demographics	-	-	-
	Age (decimal age)	15.11± 1.86	15.22± 1.85	0.36
	Anthropometry			
	BMI (kg/m^2)	22.06± 3.87	20.80 (± 3.72)	0.29
	Waist circumference (cm)	69.3± 7.66	72.40 ± 8.71	0.17
	Fat free mass (kg)	40.56± 5.32	49.35± 9.44	0.00
	Maturity offset (years to PHV)	2.08± 1.20	0.60 ± 1.58	0.00
Contextual	Maternal education			
	Low (9th grade or less)	117 (36.7)	101 (41.2)	0.279
	Medium (10–12th grade)	94 (29.5)	74 (30.2)	0.123
	High (higher education)	108 (33.9)	70 (28.6)	0.004
	Family environment (APGAR)[1]			
	Moderate to high dysfunction (0–6 points)	49 (15)	26 (10.2)	0.008
	Good functioning (7–10 points)	277 (85)	229 (89.8)	0.033
Behaviour	Physical activity (IPAQ_categorical)[2]			
	High	94 (34.3)	135 (60.3)	0.007
	Medium	114 (41.6)	52 (23.2)	0.000
	Low	66 (24.1)	37 (16.5)	0.004
	Sedentary behavior			
	Sitting time (hours/week)	38.25± 9.74	36.49± 10.36	0.61
	Eating habits[3]			
	Food quantity	48.13± 5.63	47.03± 5.71	0.91
	Food quality	21.92± 3.90	21.94± 3.77	0.54
	Food variety	30.44± 4.44	30.00± 4.29	0.85
	Principles of healthy eating	39.93± 4.82	39.47± 4.61	0.39
	Total score	140.53± 13.36	138.38± 12.85	0.60

[1]categorical classification of family functionality according to the portuguese version of the APGAR questionnaire (Vianna, Silva, & Souza-Formigoni, 2007); [2]categorical classification of the self-reported activity level/IPAQ (Lee, Macfarlane, Lam, & Stewart, 2011); [3] scale of eating habits validated for the portuguese population (Marques, Luzio, Martins, & Vaquinhas, 2011); BMI: body mass index.

BMI, highlighting the importance of nutritional education mentioned above.

One of the main moderating factors of obesity in adolescence, namely in girls, is age. In fact, early menarche in young adolescents is associated with the risk of developing obesity and metabolic syndrome (e.g., Freedman et al., 2003). Preliminary results from the C4AO project show that predicted maturity offset is a discriminating factor for overweight in girls (p= 0.037), which seems to be a temporal indicator for strengthening the monitoring of this population.

Finally, we would also like to emphasize the importance of clinical monitoring of overweight adolescents, whose initial diagnosis can be clearly made at school. The determination of resting metabolic rate (RMR) is an important issue in designing a weight loss program, allowing for individualized dietary recommendations to reach an optimal nutritional status. Because indirect calorimetry is quite impractical, several equations for predicting RMR have been developed based on normal subjects, with the Harris-Benedict equation (derived in 1919) being amongst the most study equations. However, if this formula effectively addresses basal metabolic rate/resting metabolic rate, it is still unclear as to whether this formula might over-predict or underestimate RMR (Müller et al., 2004). One of the complementary studies to the C4AO project sought to compare Portuguese adolescents/young adults' energy intake with their energy requirements by gender, age, and BMI category (Tallon et al., 2020b). Results showed that adolescents'/young adults' energy intake was significantly lower than their requirements for both genders, adolescents, normal weight, overweight and obese individuals, and across all school grades ($p < .05$). The authors suggest that Harris-Benedict equations (or other commonly used equations) ignore important factors such as lean body mass or fat-free mass. The development of new equations that integrate, for example, the subjects' body composition is therefore justified, which will improve diet prescription in the clinical setting.

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