Prevalence of Pre-Obesity/Obesity in Pre and Basic School Children at Vila Nova de Gaia, Portugal

A Prevalência de Pré-Obesidade/Obesidade nas Crianças do Ensino Pré-Escolar e Escolar na Autarquia de Vila Nova de Gaia, Portugal

ARTIGO ORIGINAL

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ABSTRACT

Introduction: Over 30% of Portuguese children present overweight. Being a serious public health problem with multiple causes, only a cross-sectorial and concerted action could contribute to their resolution. Municipalities have a set of skills that make them ideal for effective intervention in the fight against this problem. For this action to be effective there must be a local assessment of the extent of the problem and their spatial distribution. The aim of this study was to characterize, from the point of view of the prevalence of overweight, the population of pre-school and first cycle basic education under the responsibility of the municipality of Vila Nova de Gaia, the third most populous municipality in the country.

Material and Methods: Were evaluated 8 974 pre and basic-school children, in school year 2013/14. The assessment of the nutritional status of the sample was made using anthropometric measures height and weight. In the classification of nutritional status was considered z-scores or percentiles of body mass index for age according to the World Health Organization, Centers for Disease Control and Prevention and International Obesity Task Force.

Results: The prevalence of overweight by the World Health Organization requirements was 37.4%. There were some disparities in the distribution of overweight in schools of the municipality.

Discussion: The results were slightly higher than those of other national and international studies, being the sampling size the possible justification for the differences founded.

Conclusion: The prevalence found is high and with irregular geographical distribution, which could help identifying the main causes of the problem at the local level.

Keywords: Body Composition; Body Mass Index; Child; Child, Preschool; Overweight; Pediatric Obesity; Portugal; Prevalence.

RESUMO

Introdução: Mais de 30% das crianças portuguesas apresentam excesso de peso. Sendo um grave problema de saúde pública com múltiplas causas, só uma ação intersectorial e concertada poderá contribuir para a sua resolução. As autarquias possuem um conjunto de competências que as tornam ideais para uma intervenção eficaz na luta contra este problema. Para essa ação ser efetiva é necessária uma avaliação local da dimensão do problema e sua distribuição espacial. O objetivo deste estudo foi caracterizar, do ponto de vista da prevalência de excesso de peso, a população do pré-escolar e primeiro ciclo do ensino básico sob responsabilidade da autarquia de Vila Nova de Gaia, o terceiro município mais populoso do país.

Material e Métodos: Avaliaram-se 8 974 crianças do pré-escolar e primeiro ciclo do ensino básico do município, no ano letivo 2013/14. A avaliação do estado nutricional da amostra foi feita com recurso às medidas antropométricas peso e altura. Na classificação do estado nutricional considerou-se os percentis ou *z-scores* do índice de massa corporal para a idade de acordo com os critérios definidos pela Organização Mundial de Saúde, Centers for Disease Control and Prevention e pela International Obesity Task Force.

Resultados: A prevalência de excesso de peso pelo critério da Organização Mundial da Saúde foi de 37,4%. Identificaram-se disparidades na distribuição do excesso de peso nas escolas do concelho.

Discussão: Os resultados encontrados foram ligeiramente superiores aos de outros estudos nacionais e internacionais, podendo a abrangência amostral justificar as diferenças encontradas.

Conclusão: A prevalência encontrada é elevada e de distribuição aparentemente distinta a nível espacial, o que poderá contribuir para a identificação dos principais determinantes do problema a nível local.

Palavras-chave: Composição Corporal; Criança; Criança Pré-Escolar; Excesso de Peso; Índice de Massa Corporal; Obesidade Pediátrica; Portugal; Prevalência.

INTRODUCTION

Childhood obesity is a global issue. Worldwide, 42 million children under the age of 5 were overweight, in 2013.[1] In Europe, around 14 million children were overweight to which 400,000 are annually added.[2,3] In Portugal, more than 30% of the childhood population is overweight.[3] These figures have tripled in many European countries since 1980, in general population and these are about 10-times higher in children to those found in 1970,[3] making obesity a worldwide public health issue with epidemic proportions.[4-6] According to Marie Ng *et al.*,[7] around 2.1 billion people were

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overweight worldwide by 2013, while in 1980 these were around 857 million.[7]

World Health Organization (WHO) considered obesity as one of ten major risk factors for mortality in 2002 and,[8] in 2004, obesity was considered as the epidemic of the twenty-first century.[9] The number of overweight people is currently 2.5 times higher than the number of undernourished people.[10] However, it should be mentioned that a deceleration has been observed in high-income countries,[7,11] which has not been found in low and medium-income countries facing both ends of malnutrition dilemma: malnutrition and overweight.[2]

Obesity has a multifactorial aetiology, with inherited, genetic, environmental, metabolic, behavioural, cultural, social and economic interacting determinants. Its characteristics include excessive body weight, with high accumulation of fat, due to the maintenance of a positive energy balance over time.[12,13] Childhood obesity enhancers are described in literature and include parental obesity, low economic and social status, high birth weight, sedentary lifestyle and inadequate nutritional patterns.[14,15]

The human body has excellent physiological defences against depletion of its energetic reserves, whilst showing weak mechanisms against an excessive accumulation of energetic reserves when food is abundant.[16]

Some studies suggest that childhood overweight is a risk factor to the development of obesity in later adult life and around 60% of children showing this condition before puberty are estimated to remain overweight as young adults, with short-term and long-term adverse effects on adult morbidity and mortality.[9,12,13,17,18] Consequences of childhood and adolescence obesity include not only physical (high blood pressure, hypercholesterolaemia, metabolic syndrome, type-2 diabetes, osteoarticular pathology, sleep apnoea, asthma and liver cirrhosis) but also psychological, social and behavioural issues such as low self-esteem, social isolation, school failure, discrimination, depression and reduced overall quality of life.[13] Early approach to overweight, starting in childhood, is fundamental in order to prevent the dissemination of the epidemic and associated comorbidities.

The approach to childhood overweight mainly regards a prevention strategy, in spite of an individual intervention and treatment;[19] the earlier the approach is started (in terms of patient's age), the more effective it can be.[20] Childhood is considered as a priority period in the action against overweight and obesity.[21] Once established, childhood obesity is extremely difficult to be reverted, as described by de Onis M *et al.*[22] and obesity prevalence monitoring is a key issue for the definition and assessment of the impact of policies and strategies in this area.[22-24] In addition, the WHO enhances the need for a multi-sectoral approach involving the joint effort of agro-food, education, local authorities and healthcare sectors.[25]

Local authorities, particularly municipalities, within their own areas of action, have the means allowing for knowledge and actions against childhood obesity and acting on different environmental, cultural, social and economic determinants as a joint effort.[26,27]

Vila Nova de Gaia is currently the third most populous Portuguese municipality, with a population of 302,295, from whom 46,641 are aged 0-14.[28]

As in other Portuguese municipalities, according to the Law 75/2013 (12 September),[26] it is responsible for the management of pre-primary (*ensino pré-escolar* (PE)) and primary school education (*primeiro ciclo do ensino básico* (1CEB)), except regarding educational issues and the management of teaching staff, having to ensure the management of school meals. These educational levels are organized by School Clusters (*Agrupamentos de Escolas*).

Over the last few years, different nationwide and/or local studies aimed to the evaluation of overweight prevalence (pre-obesity and obesity) in Portuguese child population.[14,29-32] A high prevalence (>30%) of childhood pre-obesity and obesity has been generally found.[14,29-32] In fact, the National Program on the Promotion of a Healthy Nutrition ('*Programa Nacional para a Promoção da Alimentação Saudável*'),[33] established in 2012 by the *Direção-Geral da Saúde*, includes the control of childhood overweight prevalence as one of its indicators, limiting its growth to zero up to 2016.[33] In the updated and extended to 2020 edition of the National Health Plan (*Plano Nacional de Saúde*), one of its four fundamental aims is non-growth of childhood obesity.[34]

Therefore, considering these national targets, our research work aims to characterise the current situation as regards the prevalence of childhood pre-obesity and obesity in children living in the municipality of Vila Nova de Gaia, as well as to show the ability of holding an evaluation of childhood pre-obesity and obesity based on the communal services and from there defining intervention strategies with the use and potentiating skills and resources available to the municipality.

MATERIAL AND METHODS

This is an observational, descriptive, cross-sectional study led by the Department of Education at the *Câmara Municipal de Vila Nova de Gaia* and held at the PE and 1CEB public schools over the 2013/14 school year.

Over the 2013/2014 school year, 87 PE and 100 1CEB schools existed in Vila Nova de Gaia, grouped into 14 School Clusters and attended by 13,951 students (3,527 in PE and 10,424 in 1CEB schools).

All 13,951 students attending the 187 schools were

invited to participate in the study. Parents and guardians were explained on the aim of the study, its authors and contacts, on data collection and result destination, ensuring participant's anonymity and informing that participation was voluntary and that any harm to their children would arise from the participation in the study. Only students whom their parents/guardians' authorization was expressed were enrolled in the study; parents/guardians were asked to sign the abovementioned informed consent based on the *International Ethical Guidelines for Biomedical Research Involving Human Subjects*[35] according to the World Health Organization (WHO) European Childhood Obesity Surveillance Initiative (COSI) methodology[32,36] used as reference to the methodological design of our study.

Apart from this informed consent, our study was submitted and approved by the Board of School Clusters and Coordinators of each school.

In total, 8,974 students (2,697 PE and 6,277 1CEB students) aged between 3 and 13 were enrolled in our study.

The difference between the total number of participants and the total initial sample, from which those with any physical disability preventing from completing the anthropometric evaluation were excluded, correspond to non-authorised students or those that were absent on the day of the evaluation.

Even though the individual results were not sent to each student, this information was sent to any parent/guardian having expressed such interest.

Variables

Collected data included the information regarding each student provided by the school (date of birth, gender, address) and the information obtained through the anthropometric evaluations (body weight, standing height and date of evaluation).

Data collection and processing

The anthropometric evaluations were carried out by trained assistants according to the WHO recommended methodology.[37] Training occurred in December on the school year when our study took place and included a theoretical approach to the subject, study presentation and aim (45 minutes), followed by the presentation and standardisation of the anthropometric evaluation procedure and practical training (120 minutes).

Before measurements, each participant was asked to authorise the procedure and all children gave their agreement.

Body weight was assessed with the same electronic digital scale and measured to the nearest hectogram (0.1 kg. One of the scales was calibrated by the Department of Metrology at the *Câmara Municipal de Vila Nova de Gaia* over the 10, 20, 30, 40, 50, 60, 70 and 80 kg reading range, in order to gauge the 85 scales used in the study. The remaining scales were checked through three comparative evaluations with the calibrated scale. The differences found were recorded and considered in data processing from each school.

Standing height was evaluated using a non-stretchable measuring tape attached to a vertical and flat wall, the head assuming a position with eyes horizontally looking straight ahead, according to the Frankfurt plane[38] and the chin held by the evaluator with the index finger and the thumb, using a rectangular flat object placed at 90º as a headboard caliper. Standing height was measured to the nearest millimetre (0.1 cm). The measurement was obtained twice and the average value from both measurements was considered and the results were recorded in a digital support.

Ten schools were randomly selected in order to validate measurements and these were repeated by the nutritionists working at the Municipality. Apart from these, the evaluations were additionally repeated in three schools. Repeated measurements were obtained upon a first checking and subsequent cleaning of every obtained measurements and due to uncommon records obtained from three schools, when compared to the average values.

The anthropometric evaluation was held between 24 February and 6 April 2014 and children wore only one upper and one lower piece of clothing (apart from underwear). A maximum two-month timeframe between the starting and the end of procedures was considered in the definition of the evaluation period; procedure was started at least two weeks from the beginning of the school year.[36]

Data were entered into the Anthro® software (regarding students up to 60 months of age) and into the AnthroPlus®[39] software (students over that age) and, for each participant, body mass index (BMI), BMI-for-age percentile and BMI-for-age z-score were obtained.

Selected references for the classification of nutritional status

BMI was the selected anthropometric measure used for the evaluation of the prevalence of childhood pre-obesity and obesity and it is currently the international predictor of obesity adopted and accepted as an indirect measurement of childhood adiposity.[40]

BMI-for-age percentiles or z-scores were considered for the classification of nutritional status according to the criteria and cut-offs defined by the WHO,[22,41,42] by the Centers for Disease Control and Prevention (CDC)[43] and by the International Obesity Task Force (IOTF),[42,44] as shown in Table 1.

Data processing and subsequent analysis was carried

out and sample was subsequently split into two subgroups (children aged under the age of 5 and 5-13), due to the need for a separate evaluation of these two groups, according to the WHO criteria.[41,45]

A uniform language for the different criteria had to be established in the overall analysis, particularly with children under the age of 5; we opted to include children classified as 'increased risk of overweight' into the 'pre-obesity' class.

Data processing and analysis

A descriptive statistical analysis was carried out and the *Statistical Package for Social Sciences* (SPSS®) version 22.0 software was used.

Statistical analysis considered means and standard deviations of quantitative variables and frequencies of categorical variables. Differences in categorical variables were compared using Chi-square test. Quantitative variables were compared using t-Student's test. A <0.05 level of significance was considered.

RESULTS

Characteristics of the participants

In total, 8,974 children aged 3-13 were enrolled in the study, from 93 out of 113 pre-primary and primary schools within the 14 School Clusters of Vila Nova de Gaia.

Anthropometric characteristics by gender are shown in Table. The presence of a great homogeneity as regards the distribution by gender was found, either in the analysis of the overall sample (51.30%), in the subgroup of children under 5 years of age (48.96%) or in the 5-13 years subgroup (51.74% male participants). As regards the participants' body weight and standing height, even though similar values were found on both genders, higher values were found in boys (body weight: boys – 27.58 kg ± 8.51 and girls – 27.28 kg ± 9.02; $p = 0.096$; standing height: boys – 125.23 cm ± 12.66 and girls – 123.81 ± 13.35; $p < 0.001$) and the opposite was found when BMI was analysed (boys – 17.22 ± 2.77 and girls – 17.34 ± 2.92; $p = 0.041$). Overall, girls showed a higher level of variation in values. When both subgroups were analysed, we found the general trend in the group of children aged 5-13 – boys were heavier, taller and with lower BMI, while girls had lower BMI (16.27 ± 1.97), when compared to boys in the subgroup of children under 5 years of age.

Overweight prevalence. Pre-obesity and obesity.

Prevalence by gender, according to the three selected references (CDC, IOTF and WHO) are shown in Table.

Table 1 - BMI classification according to IOTF, CDC and WHO (2006 and 2007) criteria

	BMI Percentile (P)	Classification
IOTF 2 – 18 years of age[44]	$p < 15.5$	Underweight
	$15.5 \leq p < 90.5$	Normal weight
	$p \geq 90.5$	Overweight (including obesity)
	$90.5 \leq p < 98.9$	Pre-obesity
	$p \geq 98.9$	Obesity
CDC 2000 2 – 18 years of age[43]	$p < 5$	Underweight
	$5 \leq p < 85$	Normal weight
	$p \geq 85$	Overweight (including obesity)
	$85 \leq p < 95$	Pre-obesity
	$p \geq 95$	Obesity

	< 5 years of age (WHO, 2006)[41]		5 to 19 years of age (WHO, 2007)[45]	
	BMI Z-score (Zsc)	**Classification**	**BMI Z-score (Zsc)**	**Classification**
WHO 2006[41] and 2007[45]	Zsc < -2	Underweight	Zsc < -2	Underweight
	-2 ≤ Zsc ≤ +1	Normal weight	-2 ≤ Zsc ≤ +1	Normal weight
	Zsc > +1	Overweight (including obesity)	Zsc > +1	Overweight (including obesity)
	+1 < Zsc ≤ +2	Increased risk of overweight	+1 < Zsc ≤ +2	Pre-obesity
	+2 < Zsc ≤ +3	Pre-obesity	Zsc > +2	Obesity
	Zsc > +3	Obesity		

BMI: Body mass index; WHO World Health Organization; CDC: Centers for Disease Control and Prevention; IOTF: International Obesity Task Force

A lower overweight prevalence (pre-obesity + obesity) was found when IOTF references were used (31.85%) and very similar to CDC and WHO references – 37.54% and 37.44%, respectively. As regards the distribution by gender, higher overweight values were found in boys. However, when unfolding overweight into pre-obesity and obesity (O), we found that pre-obese participants (22.16% and 19.69%, respectively) had a higher contribution to overweight prevalence, using the WHO and the IOTF classification, while obese participants (22.14%) had the higher contribution to overweight prevalence, according to the CDC classification.

BMI classification of our group of participants among both age subgroups (under five years of age and 5-13) is shown in Tables 4 and 5. An overweight (obesity included) prevalence constantly above 30% was always found, except in children under five years of age when using the IOTF references. The percentage of obese children found in the subgroup of children under five years of age obtained by the WHO references (2.52%) was below the percentage found when using the IOTF references (8.44%) and even lower to the percentage found when the CDC references were used (18.59%), whenever each overweight reference was separately considered. Regarding the subgroup of children aged 5-13, a higher percentage of obese participants, constantly above 20%, regardless of gender, was still found when using the CDC references whereas, when using the WHO and IOTF references, the opposite to what was found in the subgroup of children under five years of age occurred and a higher percentage of obese participants was found when using the WHO references.

The summary of the distribution of pre-obesity and obesity prevalence in the 14 School Clusters of the Municipality of Vila Nova de Gaia is shown in Table. Important differences were found as regards the geographical distribution and the highest prevalence (54.41%) was found in the *Soares dos Reis* School Cluster while the lowest (32.89%) was found in the *Gaia Nascente* School Cluster, showing statistically significant differences between them (p = 0.003).

DISCUSSION

The isolated use of BMI as the anthropometric predictive indicator of overweight has been considered cautiously by some authors.[5] However, the advantages due to the ease of use, affordability and the fact that it is a non-invasive assessment apart from the constraints associated to other methods of evaluation of body fat and to the lack of references allowing for its interpretation, have made BMI-for-age the best indicator for childhood pre-obesity and obesity,[22] the reason why we opted to use it in our study.

There are currently different references aimed to the identification of childhood overweight (pre-obesity and obesity).[12,29] The European Childhood Obesity Group[46] as well as the International Pediatric Association[47] recommend the use of the WHO cut-offs for children under five years of age (WHO 2006)[41] and aged 5 to 19 (WHO 2007)[45] in order to standardise the management protocols and to improve quality of the comparison between the different studies and consequently to improve the quality of the research and monitoring of this subject.[46,47] However, many studies still use the CDC and OITF cut-offs[14,30,48,49] leading us to establish our evaluation according to these three different references, increasing the chances of comparison with the results found by other studies.

As regards the results, we found that these were in line with other Portuguese and international studies in which an overweight prevalence of approximately 30% was found.[14,18,30,50]

Few national and/or international studies involved patient's ages from pre-school (three years of age) to ten

Tablel 2 - Participants characteristics

		N	Age (years)	Body weight (kg)	Standing height (cm)	BMI	BMI-for-age percentile (%)
			mean ± sd	mean ± sd	mean ± sd	mean ± sd	mean ± sd
Overall	**Total**	**8,974 (100)**	**6.78 ± 1.97**	**27.44 ± 8.76**	**124.54 ± 13.02**	**17.28 ± 2.84**	**68.88 ± 29.95**
	Masculino	4,606 (51.30)	6.81 ± 1.96	27.58 ± 8.51	125.23 ± 12.66	17.22 ± 2.77	66.95 ± 30.19
	Feminino	4,368 (48.70)	6.75 ± 1.97	27.28 ± 9.02	123.81 ± 13.35	17.34 ± 2.92	65.81 ± 29.70
3 - 4 years of age	**Total**	**1,350**	**3.74 ± 0.44**	**18.32 ± 3.10**	**105.84 ± 6.18**	**16.29 ± 1.86**	**65.13 ± 29.43**
	Masculino	661 (48.96)	3.75 ± 0.44	18.63 ± 2.93	106.72 ± 6.20	16.31 ± 1.72	66.17 ± 28.93
	Feminino	689 (51.04)	3.73 ± 0.45	18.03 ± 3.24	105.00 ± 6.04	16.27 ± 1.97	64.13 ± 29.89
5 - 13 years of age	**Total**	**7,624**	**7.32 ± 1.61**	**29.05 ± 8.45**	**127.85 ± 10.95**	**17.46 ± 2.95**	**66.01 ± 30.04**
	Masculino	3,945 (51.74)	7.33 ± 1.61	29.09 ± 8.21	128.34 ± 10.66	17.37 ± 2.88	65.91 ± 30.40
	Feminino	3,679 (48.26)	7.32 ± 1.60	29.01 ± 8.69	127.33 ± 11.23	17.54 ± 3.03	66.13 ± 29.65

BMI: Body mass index

Table 3 - BMI classification according to the WHO, CDC and IOTF references

			WHO 2006/2007[41,45]		CDC[43]			IOTF[44]		
			Freq. (n)	%		Freq. (n)	%		Freq. (n)	%
Overall	Total	Underweight	158	1.76	Underweight	257	2.86	Underweight	802	8.94
		Normal weight	5,456	60.8	Normal weight	5,348	59.59	Normal weight	5,314	59.22
		Pre-obesity	**1,989**	**22.16**	**Pre-obesity**	**1,382**	**15.40**	**Pre-obesity**	**1,767**	**19.69**
		Obesity	**1,371**	**15.28**	**Obesity**	**1,987**	**22.14**	**Obesity**	**1,091**	**12.16**
		Total	**8,974**	**100**		**8,974**	**100**		**8,974**	**100**
	Male	Underweight	86	1.87	Underweight	136	2.95	Underweight	414	8.99
		Normal weight	2,782	60.4	Normal weight	2,728	59.23	Normal weight	2,702	58.66
		Pre-obesity	**970**	**21.06**	**Pre-obesity**	**684**	**14.85**	**Pre-obesity**	**848**	**18.41**
		Obesity	**768**	**16.67**	**Obesity**	**1,058**	**22.97**	**Obesity**	**642**	**13.94**
		Total	**4,606**	**100**		**4,606**	**100**		**4,606**	**100**
	Female	Underweight	72	1.65	Underweight	121	2.77	Underweight	388	8.88
		Normal weight	2,674	61.22	Normal weight	2,620	59.98	Normal weight	2,612	59.8
		Pre-obesity	**1,019**	**23.33**	**Pre-obesity**	**698**	**15.98**	**Pre-obesity**	**919**	**21.04**
		Obesity	**603**	**13.8**	**Obesity**	**929**	**21.27**	**Obesity**	**449**	**10.28**
		Total	**4,368**	**100**		**4,368**	**100**		**4,368**	**100**

BMI: Body mass index; WHO: World Health Organization; CDC: Center for Disease Control and Prevention; IOTF: International Obesity Task Force

Table 4 - BMI classification of participants under five years of age according to WHO, CDC and IOTF references

			WHO 2006[41]		CDC[43]			IOTF[44]		
			Freq. (n)	%		Freq. (n)	%		Freq. (n)	%
3-4 years	Total	Underweight	21	1.56	Underweight	40	2.96	Underweight	117	8.67
		Normal weight	854	63.26	Normal weight	833	61.70	Normal weight	858	63.56
		Increased risk of overweight	**295**	**21.85**	**Pre-obesity**	**226**	**16.74**	**Pre-obesity**	**261**	**19.33**
		Pre-obesity	**146**	**10.81**	**Obesity**	**251**	**18.59**	**Obesity**	**114**	**8.44**
		Obesity	**34**	**2.52**						
		Total	1,350	100		1,350	100		1,350	100
	Male	Underweight	7	1.06	Underweight	15	2.27	Underweight	46	6.96
		Normal weight	412	62.33	Normal weight	403	60.97	Normal weight	432	65.36
		Increased risk of overweight	**149**	**22.54**	**Pre-obesity**	**119**	**18.00**	**Pre-obesity**	**125**	**18.91**
		Pre-obesity	**76**	**11.50**	**Obesity**	**124**	**18.76**	**Obesity**	**58**	**8.77**
		Obesity	**17**	**2.57**						
		Total	**661**	**100**		**661**	**100**		**661**	**100**
	Female	Underweight	14	2.03	Underweight	25	3.63	Underweight	71	10.30
		Normal weight	442	64.15	Normal weight	430	62.41	Normal weight	426	61.83
		Increased risk of overweight	**146**	**21.19**	**Pre-obesity**	**107**	**15.53**	**Pre-obesity**	**136**	**19.74**
		Pre-obesity	**70**	**10.16**	**Obesity**	**127**	**18.43**	**Obesity**	**56**	**8.13**
		Obesity	**17**	**2.47**						
		Total	**689**	**100**		**689**	**100**		**689**	**100**

BMI: Body mass index; WHO: World Health Organization; CDC: Centre for Diseases Control and Prevention; IOTF: International Obesity Task Force

years of age (end of primary school). In Europe, within the project *Identification and prevention of Dietary - and lifestyle - induced health Effects In Children and infantS* (IDEFICS)[51] involving children under the age of 10, as in other studies, a higher overweight prevalence was found in Southern European countries[52] mainly a 42.4% prevalence in Italy.[51] The value found in our study is slightly above the 26.8% overweight (PO + O) prevalence described by Nogueira H *et al.*[53]

Internationally, the Organization for Economic Cooperation and Development (OECD) found a 21.4 and 22.9% overweight prevalence in 2011 in girls and in boys, respectively. In this study, Portugal was already above average, showing 21.6 and 23.5% prevalence in girls and in boys respectively,[54] clearly below those found in our study, which may be related to differences in sampling as well as in time gap between data collections.

The well-known difficult comparative analysis between studies on overweight prevalence, due to the scarce number of publications as to the lack of consistency in methodology, is even more difficult when we analyse the subgroup of children under 5 years of age.[51] Therefore, higher obesity and pre-obesity prevalence was found in this age group when compared to other studies, using the IOTF references.[52,55] We can say that the studies by Lourenço M *et al.*[49] and Rito A were in line with our study[55] using the CDC references, even though slightly lower overweight percentages were found. As regards the WHO criteria, our study found higher overweight prevalence to the one found in the study by Rito A.[55]

The results found in the subgroup of children aged 5-13 were mainly compared to those described by the COSI study. In line with what has been described by Wijnhoven T *et al.*[18] and by Rito A *et al.*,[56] the prevalence of pre-obesity, regardless of gender, according to the 2007 WHO references, was always higher than the prevalence found in the COSI study. However, as regards the prevalence of obesity, the CDC references showed to be the most sensitive in such evaluation, when compared to these two authors. Padez C *et al.*[30] found results in line with our study for the prevalence of pre-obesity (20.3% and 19.54% respectively) and obesity (11.3% and 11.90%). The study by Cordinhã AC *et al.*[48] found a lower (PO + O) prevalence of overweight to the one found in our study, except regarding the percentage of pre-obese girls (20.3%) which was of higher than the one found in our study (16.06%). Pedrosa C *et al.*[31] found in a group of children aged 7 to 9, mainly when using the CD references, a lower prevalence of obesity (14.0%), when compared to the prevalence found in our study regarding the subgroup of children aged 5-13 (22.7%).

The differences found in our study when compared to others may relate to the fact that our sample correspond to almost all the population considered in the study, as well as to the extended age range, as most studies are restricted to children populations within one or two-year age range.

Our study regards the 2013/2014 school year even

Table 5 - BMI classification of participants aged 5 - 13, according to WHO, CDC and IOTF references

			WHO 2007[45]			CDC[43]			IOTF[44]	
			Freq. (n)	%		Freq. (n)	%		Freq. (n)	%
5-13 years	Total	Underweight	137	1.80	Underweight	217	2.85	Underweight	658	8.63
		Normal weight	4,602	60.36	Normal weight	4,515	59.22	Normal weight	4,569	59.93
		Pre-obesity	**1,548**	**20.30**	**Pre-obesity**	**1,156**	**15.16**	**Pre-obesity**	**1,490**	**19.54**
		Obesity	**1,337**	**17.54**	**Obesity**	**1,736**	**22.77**	**Obesity**	**907**	**11.90**
		Total	**7,624**	**100**		**7,624**	**100**		**7,624**	**100**
	Male	Underweight	79	2.00	Underweight	121	3.07	Underweight	341	8.64
		Normal weight	2,370	60.08	Normal weight	2,325	58.94	Normal weight	2,383	60.41
		Pre-obesity	**745**	**18.88**	**Pre-obesity**	**565**	**14.32**	**Pre-obesity**	**707**	**17.92**
		Obesity	**751**	**19.04**	**Obesity**	**934**	**23.68**	**Obesity**	**514**	**13.03**
		Total	**3,945**	**100**		**3,945**	**100**		**3,945**	**100**
	Female	Underweight	58	1.58	Underweight	96	2.61	Underweight	317	8.62
		Normal weight	2,232	60.67	Normal weight	2,190	59.53	Normal weight	2,186	59.42
		Pre-obesity	**803**	**21.83**	**Pre-obesity**	**591**	**16.06**	**Pre-obesity**	**783**	**21.28**
		Obesity	**586**	**15.93**	**Obesity**	**802**	**21.80**	**Obesity**	**393**	**10.68**
		Total	**3,679**	**100**		**3,679**	**100**		**3,679**	**100**

BMI: Body mass index; WHO: World Health Organization; CDC: Centre for Diseases Control and Prevention; IOTF: International Obesity Task Force

Table 6 - Distribution of overweight prevalence (including obesity) by the 14 School Clusters (*Agrupamentos de Escolas*), according to the WHO

	Agrupamento António Sérgio n = 329	Agrupamento Canelas n = 1 112	Agrupamento Carvalhos n = 824	Agrupamento D. Pedro n = 852	Agrupamento Diogo Macedo n = 273	Agrupamento Dr. Costa Matos n = 932
Percentage of overweight children (including obesity) WHO references[41,45]	40.42% (n = 133)	39.83% (n = 443)	45.02% (n = 371)	37.68% (n = 321)	36.26% (n = 99)	33.26% (n = 310)

WHO: World Health Organization

though it is included into a follow-up work started in 2008/2009 and regarding pre-primary education. The 2014/2015 data are now being collected (April 2015) and this monitoring is intended to be kept annually. This is a very relevant tool for political and executive decision-making regarding the different local authorities, namely regarding healthcare, education, social action, sports, infrastructures and commercial licensing, as it was developed within the municipality itself, using the entire school population as study population and therefore ensuring a representative sample of the Municipality on its different realities (geographical, social and demographic).[26] Even though the evaluation of overweight distribution was not the major aim of this document, we found significant differences between different School Clusters, which will allow in future for a comparison between social and demographic characteristics and the prevalence of overweight found in our study.

Our study is according to the recommendations of the European Food and Nutrition Action Plan 2015-2020[25] as well as to the Vienna Declaration on Nutrition and Non-communicable Diseases in the Context of Health 2020[57] fully assuming the role of municipalities in the promotion of healthy nutrition, in encouragement of physical activity and in the prevention of childhood obesity[57] and local reality should be defined in order to find reality-adjusted solutions.

CONCLUSION

Regardless of classification method or subgroup analysed, a very high overweight prevalence (PO + O) was found in children aged 3-13 living at the Municipality of Vila Nova de Gaia, always higher to those found in national comparable studies.

The results found in our study are very relevant. Even though the high prevalence of childhood overweight was already known to exist in Portugal, this new characterisation allows for a more reliable local identification of the subject (22.16% prevalence of pre-obesity and 15.28% of obesity in children attending to pre-primary and primary public schools within the Municipality of Vila Nova de Gaia). These data also show an important geographical variation between schools, inserted in different social, urban and demographic realities.

These results and the possibility of keeping this local monitoring will allow for better planning and evaluation of the effects of different approach strategies to this serious subject, namely regarding (i) the control of food school supply, as well as the control of licensing of food catering services near schools, (ii) regarding the promotion of physical activity by including this discipline in school curricula or by building and managing sport facilities and (iii) by its capacity to control and modify some social, geographical and demographic determinants.

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HUMAN AND ANIMAL PROTECTION

The authors declare that the followed procedures were according to regulations established by the Ethics and Clinical Research Committee and according to the Helsinki Declaration of the World Medical Association. Our study complied with the *International Ethical Guidelines for Biomedical Research Involving Human Subjects* and was designed according to the recommendations of the World Health Organization (WHO) European Childhood Obesity Surveillance Initiative (COSI).

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

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references

	Agrupamento Escultor Fernandes Sá n = 434	Agrupamento Gaia Nascente n = 152	Agrupamento Júlio Dinis n = 693	Agrupamento Madalena n = 254	Agrupamento Soares Reis n = 68	Agrupamento Sophia Mello Breyner n = 1 281	Agrupamento Valadares n = 1 286	Agrupamento Vila d'Este n = 484
	42.86% (n = 186)	32.89% (n = 50)	38.82% (n = 269)	33.46% (n = 85)	54.41% (n = 37)	34.04% (n = 436)	33.98% (n = 437)	37.81% (n = 183)

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