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**VENDING MACHINES OF FOOD AND BEVERAGES AND NUTRITIONAL PROFILE OF THEIR PRODUCTS AT SCHOOLS IN MADRID, SPAIN, 2014-2015**

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**ABSTRACT**

**Background:** Policies restricting access to sugary drinks and unhealthy foods in the school environment are associated with healthier consumption patterns. In 2010, Spain approved a Consensus Document regarding Food at Schools with nutritional criteria to improve the nutritional profile of foods and drinks served at schools. The objective of this study was to describe the frequency of food and drink vending machines at secondary schools in Madrid, the products offered at them and their nutritional profile.

**Methods:** Cross-sectional study of a random sample of 330 secondary schools in Madrid in 2014-2015. The characteristics of the schools and the existence of vending machines were recorded through the internet and by telephone interview. The products offered in a representative sample of 6 vending machines were identified by in situ inspection, and its nutritional composition was taken from its labeling. Finally, the nutritional profile of each product was analyzed with the United Kingdom profile model, which classifies products as healthy and less healthy.

**Results:** The prevalence of vending machines was 17.3%. Among the products offered, 80.5% were less healthy food and drinks (high in energy, fat or sugar and poor in nutrients) and 10.5% were healthy products.

**Conclusion:** Vending machines are common at secondary schools in Madrid. Most products at vending machines are less healthy.

**Keywords:** Childhood obesity, Food vending machines, Secondary school. Dietary guidelines, Nutritive value, Diet, high-fat. Spain.

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**RESUMEN****Presencia de máquinas expendedoras de alimentos y bebidas y perfil nutricional de sus productos en los institutos de enseñanza secundaria de la Comunidad de Madrid, 2014-2015**

**Fundamento:** Las políticas restrictivas del acceso a bebidas azucaradas y alimentos no saludables en el entorno escolar se asocian con patrones de consumo más saludables. En 2010 se aprobó en España el Documento de Consenso sobre la Alimentación en los Centros Educativos con criterios nutricionales para mejorar el perfil nutricional de los alimentos y bebidas ofertados. El objetivo de este estudio fue describir la frecuencia de máquinas expendedoras de bebidas y alimentos y perfil nutricional de sus productos en los Institutos de Enseñanza Secundaria (IES) de Madrid.

**Métodos:** Estudio transversal sobre una muestra aleatoria de 330 IES de la Comunidad de Madrid durante el curso 2014-2015. A través de internet y por entrevista telefónica se registraron las características de los centros y la existencia o no de máquinas expendedoras en ellos. Los productos ofertados en una muestra representativa de 6 máquinas expendedoras se obtuvieron mediante inspección *in situ* y su composición nutricional se tomó del etiquetado. Por último, el perfil nutricional de los productos se analizó con el modelo del Reino Unido, que clasifica los productos en saludables y menos saludables.

**Resultados:** La prevalencia de máquinas expendedoras fue del 17,3%. El 80,5% de sus productos fueron menos saludables, altamente energéticos, ricos en grasa o azúcar y pobres en micronutrientes. El 10,5% resultaron ser productos saludables.

**Conclusión:** Las máquinas expendedoras son frecuentes en los IES de Madrid y la mayoría de sus productos tienen un mal perfil nutricional.

**Palabras clave:** Obesidad infantil. Máquinas expendedoras de alimentos. Escuela secundaria. Recomendaciones alimentarias.

## INTRODUCCIÓN

Childhood obesity is associated with a number of health problems, such as osteomuscular complaints, arterial hypertension, dyslipidaemia and type 2 diabetes mellitus, exacerbation of respiratory diseases including asthma, and psychosocial disorders, such as low self-esteem, discrimination and, among girls, depression.<sup>(1,2)</sup> One third of children aged 2 to 15 years in Spain and one in four in the Madrid Region suffer from excess weight (overweight or obesity).<sup>(3,4)</sup> The 2013 Aladino (Alimentación, Actividad física, Desarrollo Infantil y Obesidad - Food, Physical activity, Child Development and Obesity) study, based on a representative population sample aged 7 and 8 years, reported that the prevalence of childhood obesity was stabilising and displaying a downward trend.<sup>(5)</sup> Excess weight among children and adolescents is partly due to an obesogenic environment which favours sedentarism, negligible physical activity and an unhealthy diet. The main risk factors of food-related childhood obesity are habitual consumption of sugary drinks, and high energy-dense diets due to excessive intake of processed foods rich in fats and added sugars.<sup>(6-8)</sup>

School plays a highly relevant role when it comes to developing dietary habits.<sup>(9-11)</sup> In 2004, the World Health Organisation (WHO) implemented the Global Strategy on Diet, Physical Activity and Health, to reduce morbidity-mortality associated with these habits.<sup>(12)</sup> In 2005, the Ministry of Health and Consumption drew up the Strategy for Nutrition, Physical Activity and Prevention of Obesity (Estrategia para la Nutrición, Actividad Física, Prevención de la Obesidad y Salud/NAOS) in Spain, with special emphasis on childhood.<sup>(13)</sup> One of its initiatives in the school sphere was the agreement entered into with the Spanish National Association of Automatic Vending Distributors (Asociación Nacional Española de Distribuidores Automáticos) aimed at impeding the access of primary-school pupils to food and drink vending machines at educational centres and improving the nutritional quality of the items

on offer. Nevertheless, a 2008 study at primary schools in Madrid reported widespread ignorance of and negligible compliance with the agreement.<sup>(14)</sup> In this same year, the WHO issued a document to guide governments in the development of healthy school-dietary policies and facilitate implementation of its recommendations.<sup>(15)</sup> More recently, in its Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020 and in its European Food and Nutrition Action Plan 2015-2020, the WHO proposed various initiatives for fostering healthy dietary choices at school and limiting access to products high in fat, salt and/or sugar.<sup>(16,17)</sup> The European Union has moved in the same direction, by also promoting the consumption of tap water through the installation of water fountains at schools.<sup>(18)</sup>

In 2010, the National Health System Inter-territorial Council (NHSIC) approved the Consensus Document on School Meals (CDSM) (Documento de Consenso sobre la Alimentación en los Centros Educativos) with nutritional criteria for school food and drink.<sup>(19)</sup> In 2011, the government passed the Food Safety & Nutrition Act (Ley de Seguridad Alimentaria y Nutrición).<sup>(20)</sup> Article 40 of this Act prohibits the sale of food and drinks having a statutorily-defined high content of saturated fatty acids, trans-fatty acids, salt and sugar at nursery schools and schools. Although Spanish school menus are healthy<sup>(21)</sup> and eating at school is associated with a lower risk of childhood obesity,<sup>(22)</sup> two recent studies in Madrid have nevertheless shown that, for the most part, food and drink vending machines offer energy-dense, nutrient-poor (EDNP) processed products. These studies do not, however, furnish detailed information on the nutritional profile of the products sold.<sup>(14,23)</sup>

Accordingly, the aim of this study was to ascertain the frequency with which food and drink vending machines were to be found at secondary schools in Madrid during the 2014-2015 academic year, along with the range of products on display and their nutritional profile.

## MATERIALS AND METHODS

We conducted a cross-sectional study whose target population were secondary schools (SS) (Institutos de Enseñanza Secundaria) in the Madrid Autonomous Region (MAR) during the 2013-2014 academic year. The list of schools was obtained from the MAR Internet School Portal.<sup>(24)</sup> In December 2013, a letter was sent to all SS describing this study and encouraging them to participate if selected. In January 2014, 511 SS were selected by simple random sampling and a senior staff member contacted by telephone to seek their participation. Where a school failed to reply, the telephone invitation was repeated and the school sent the e-mail questionnaire. The non-response rate was 35.4%, and the final sample comprised 330 SS. The main reasons for non-participation were lack of interest in the study or lack of time and availability.

Of the 330 SS, 57 (17.3%) had one or more vending machines, making a total of 93 such machines, with 23 (24.7%) selling food, 55 (59.2%) selling drink and 15 (16.1%) selling a mixed range of items. In view of the small variation in the products sold by machines in a previous study,<sup>(14)</sup> we included the lowest number of these that would make for a distribution similar to that of the original sample (food, drink and mixed). We thus obtained a subsample of 6 machines, made up of 1 with a mixed range (16.7%), due to this being the least frequent in the original sample, 2 with food (33.3%) and 3 with drink (50%). The machines were selected from 2 private, 2 public and 2 subsidised schools. Where the same product was available in more than one machine, we tallied as many as there were machines offering them, up to a maximum of 6 per product. As a result, the sample of products studied totalled 77.

Data were collected in two stages. In the first stage, from January to December 2014, we collected data on territorial area, school ownership (public, private, private subsidised), presence of a school canteen, and existence of other educational stages (nursery,

primary or special), via the MAR Internet School Portal.<sup>(24)</sup> In addition, we used telephone interviews to obtain data on knowledge of the consensus document, number and type of vending machines, availability of cafeterias and water fountains, and existence of school food service supervisors and their professional qualifications.

In the second stage, from January to May 2015, visits were paid to SS to identify the 6 machines and photograph their products. Where the nutritional information of any item was not visible and was not available on the company's web page, a sample item was taken from the vending machine and the information obtained from the label. The CDSM lays down the following nutritional criteria for products sold in vending machines: a maximum energy value of 200 Kcal, a maximum of 35% of which may come from fat, 10% from saturated fats and 30% from sugars, as well as a maximum of 0.2 g of sodium; and no trans-fatty acids, artificial sweeteners, caffeine or other stimulants.

Products were classified into food items, which were, in turn, grouped into two categories as per earlier studies, namely: essentials (nutrient dense with a low-calorie content: cereals low in sugar and high in fibre (<20g sugar/100g and >5g dietary fibre/100g), vegetables and legumes, fruit, skimmed or semi-skimmed dairy products (milk and yoghurt with <3g fat/100g, and cheese with <15g fat/100g), lean meat and poultry, fish, eggs, tofu, nuts and seeds); and non-essentials (with a high salt, fat, added sugar and/or energy content).<sup>(25)</sup> Furthermore, we analysed each product using the United Kingdom Nutrient Profiling Model, which was purpose-designed by experts to regulate food advertising targeted at children, by summarising the key nutritional dimensions (healthy and less healthy nutrients, and size of portion) and discriminating between products on the basis of their nutritional quality, and was therefore considered ideal for the purpose of this study.<sup>(26-28)</sup> This model assesses healthy components

(fibre, proteins, vegetables, fruit and nuts) and less healthy components (energy, sugars, saturated fats and salt) per 100g of edible product. The model obtains a final score using an algorithm that includes all the components. If the score is <4 for food or <1 for drinks, the product is then deemed to be “healthy”. Where scores exceed these limits, however, the product is deemed to be “less healthy” (high saturated fat, sugar and salt content).

**Statistical analysis.** We calculated the frequency of SS which were equipped with vending machines, and then used the  $\chi^2$  test to compare these by reference to their characteristics (territorial area, educational stage, knowledge of the CDSM, and existence of cafeterias, water fountains, canteens, and school food service supervisors). Similarly, we calculated the frequency of products by item and category (essential/non-essential foods) and nutritional profile. All data analyses were performed using the Stata 12.0 software programme.<sup>(29)</sup>

## RESULTS

Of the 330 SS that participated, 65.1% were located in metropolitan Madrid. In terms of ownership, educational stage and presence of school canteens, the percentages of the sample were similar to those of the target population, with 64% of the participating schools being privately owned (10.6% private and 53.4% subsidised private), 63% imparting primary and secondary education, and 62.1% having a canteen (table 1).

Table 2 shows that the percentage of schools with vending machines was higher among private (45.7%) than among public (16.8%) and subsidised schools (12%) ( $p<0.01$ ). The presence of machines was also higher at schools with previous knowledge of the CDSM (23.4% vs 14.8%;  $p=0.06$ ), water fountains (22.1% vs 12.7%;  $p=0.02$ ) and school food service supervisors (47.1% vs. 11.5%;  $p<0.01$ ); 41.2% of these supervisors lacked professional qualifications in nutrition (data not shown in table).

**Table 1**  
**Characteristics of secondary schools**  
**in the Madrid Autonomous Region, 2014-2015**

		Sample n=330 (%)	Population n=801 (%)
Territorial area	Metropolitan Madrid	215 (65.1)	378 (47.2)
	Madrid- East	26 (7.9)	87 (10.9)
	Madrid-North	11 (3.3)	54 (6.7)
	Madrid-West	26 (7.9)	102 (12.7)
	Madrid-South	52 (15.8)	180 (22.5)
Ownership	Private	35 (10.6)	95 (11.8)
	Subsidised	176 (53.4)	394 (49.2)
	Public	119 (36.0)	312 (39)
Educational stage	Secondary	122 (37)	315 (39.3)
	Primary and Secondary	208 (63.0)	484 (60.5)
	Others*		2 (0.2)
School canteen service	Yes	205 (62.1)	475 (59.3)
	No	125 (37.9)	326 (40.7)
*Other educational centres: Regional Children’s Hospital School (Centro Regional de Enseñanzas Integrales y Aulas Hospitalarias).			

**Table 2**  
**Frequency of food and drink vending machines according to characteristics of secondary schools in the Madrid Autonomous Region, 2014-2015**

		Centers	Machines available n (%)	p*
Territorial area	Metropolitan Madrid	215	38 (17.7)	0.95
	Madrid- East	26	3 (11.5)	
	Madrid-North	11	2 (18.9)	
	Madrid-West	26	5 (19.2)	
	Madrid-South	52	9 (17.3)	
Ownership	Private	35	16 (45.7)	< 0.01
	Subsidised	176	21 (12)	
	Public	119	20 (16.8)	
Educational stage	Secondary	122	22 (18)	0.78
	Primary and Secondary	208	35 (16.8)	
Knowledge of consensus†	Yes	94	22 (23.4)	0.06
	No	236	35 (14.8)	
Presence of a cafeteria	Yes	128	21 (16.4)	0.74
	No	202	36 (17.8)	
Water fountains	Yes	158	35 (22.1)	0.02
	No	172	22 (12.7)	
School canteen service	Yes	205	33 (16)	0.47
	No	125	24 (19.2)	
School food service supervisor	Yes	53	25 (47.1)	< 0.01
	No	277	32 (11.5)	
Total		330	57 (17.3)	

\*D\*p associated with the  $\chi^2$  statistic † Consensus Document on School Meals (CDSM).

**Table 3**  
**Nutritional profile of products offered in food and drink vending machines at secondary schools in the Madrid Autonomous Region, 2014-2015**

FOOD CATEGORY		Products available n=77		Less healthy products n=62	
		n	%	n	%*
Essentials	a. Bottled water	4	5.2	0	0
	b. Soups, salads and sandwiches, frozen food and low-fat savoury sauces.	1	1.3	1	100
	c. Skimmed or semi-skimmed milk, yoghurt, custard, cheese and alternatives (including probiotic drinks)..	3	4	1	33.3
	Total	8	10.5	2	25
No essentials	d. Potato products, frozen/fried (excluding chips)	3	4	3	100
	e. Fruit juices and drinks.	8	10.4	7	87.5
	f. Cakes, buns, biscuits, high-fat biscuits, pies and pastries.	21	27.2	21	100
	g. Sweetened beverages, including non-alcoholic drinks, cordials, sports drinks and flavour additives/enhancers (including diet varieties).	18	23.3	10	55.6
	h. Savoury snacks, including chips, extruded snacks, popcorn, snacks and muesli bars, sweetened fruit and vegetable products, and salted or sugar-coated nuts	9	11.7	9	100
	i. Chocolate and confectionary (including normal chewing gum, sugar-free and sweetened).	10	12.9	10	100
	Total	69	89.5	60	87

\* Percentage of less healthy products within each food item or category, according to the UK Nutrient Profiling Model.

Table 3 describes the 77 products present in the 6 vending machines selected. In the category of essential products (10.5% of the total) water, milk and dairy products were the most frequent, accounting for 5.2% and 4% of the total respectively. In the non-essential category, the most frequent items were cakes and pastries (cakes, buns, biscuits, pies and pastries), with 27.2%, and sugary drinks with 23.3%. A total of 80.5% of all products were less healthy. Of the essential products, 2 were less healthy (25%), namely, 1 sandwich and 1 chocolate shake, which was one of the 3 low-fat dairy products. Of the non-essential products, 87% were less healthy, with this figure being lower for sugary drinks (55.6%) (table 3).

## DISCUSIÓN

This study shows a considerable prevalence of vending machines at SS in Madrid, especially at private schools. Such machines were also more frequent in SS that were familiar with the CDSM, were equipped with water fountains and had school food service supervisors. The most frequent products on sale were cakes, buns and sugary drinks: of these, four in five were less healthy and only one in ten was essential.

The presence of vending machines was very similar to that of Catalonia in the period 2006-2012, with 18.3% of schools, though pupils were not permitted access to these machines at half of the schools.<sup>(30)</sup> In comparison with a similar study conducted in the city of Madrid in 2008,<sup>(14)</sup> i.e, before the CDSM had been approved, the percentage of subsidised and private schools equipped with vending machines has almost doubled, rising from 10% in 2008 to 18% in 2014. Although the 2008 study was conducted on a representative primary-school sample, our data on subsidised and private schools are directly comparable because they all the schools involved impart two educational cycles. The differences might be due partly to the fact that our data are representative of schools in the Madrid Region as a whole, whereas those of the previous study correspond exclusively to the city of Madrid.

However, our study shows that the frequency of school vending machines in the city of Madrid and the rest of the region is almost identical. Furthermore, another study targeting all primary schools in the MAR in 2008-2009 also reported the absence of such machines at public schools and a very similar prevalence at private and subsidised schools.<sup>(23)</sup> Insofar as public SS were concerned, the percentage with machines fell sharply from 2008 to 2014, going from 32.3% in the city of Madrid<sup>(31)</sup> to 16.8% in our study.

The existence of the CDSM does not account for the differences in the presence of machines at public and private schools, since knowledge of this was very poor overall and slightly higher at subsidised and private schools (35.5%; data not shown in tables). This may possibly be due to the economic crisis, because from 2006 to 2012 the price of food and drinks increased by 12% in Spain,<sup>(32)</sup> and 41% of Spaniards reported having changed their dietary habits in order to economise.<sup>(33)</sup> This would appear to have led to a decrease in consumption of superfluous foods (e.g. refreshments and snacks), particularly among the lowest social classes,<sup>(34)</sup> thereby reducing the profit margin of machines at public schools.

Most of the products offered were rich in energy, high in fat, sugar and/or salt, and poor in micronutrients and fibre, in line with other studies in Spain<sup>(14,23,31)</sup> and abroad.<sup>(35-37)</sup> Barely 10% of the items on sale were essential products.<sup>(19)</sup> Although the percentage of healthy products, according to the UK Nutrient Profiling Model, was double this figure, the differences were fundamentally due to the fact that refreshments with artificial sweeteners, discouraged by the CDSM, managed to obtain a healthy profile due to their low calorie content. Moreover, the consensus document displays a notable absence of many priority foods, such as fresh fruit, nuts, low-fat and low-salt cheese, and cereals and cereal products rich in fibre and low in fat, sugar and salt. This is surprising because half of the schools had school food service supervisors, though four in ten had no nu-

trition qualifications and only one in four knew of the existence of the CDSM.

In view of the fact that energy foods and sugary drinks in school vending machines are associated with a higher intake of these products<sup>(36,38)</sup> and that this, in turn, increases the risk of obesity,<sup>(6,7,39)</sup> the dominant presence of such products in the machines could contribute to the high prevalence of childhood obesity in the MAR4. Substituting water for sugary drinks reduces calorie intake among children and adolescents,<sup>(40)</sup> so that replacing the machines with water fountains is an obesity-prevention strategy. A trial which consisted of installing water fountains at schools and undertaking a simple educational intervention designed to foster water consumption, succeeded in reducing overweight among pupils by one third.<sup>(41)</sup> Our data show that more than half of the SS are not equipped with water fountains, and that in 1 in 4 of all SS which do have water fountains, there are also machines stocked with sugary drinks. This means that there is still room for intervention in this field.

In the European Union, Norway and Switzerland, policies governing food and drink vending machines in schools range all the way from prohibiting such machines, as in France and Denmark, to banning unhealthy products or requiring a range of items in line with national dietary guidelines, through to simply recommending that healthy foods be prioritised.<sup>(42)</sup> Along with Belgium and Italy, Spain is one of the least stringent countries, with the CDSM being limited to recommendations which Autonomous Regions may or may not apply. Furthermore, no formal follow-up and evaluation system is established. The Murcia Region has gone one step further by decreeing a ban on the sale of EDNP food and drinks at schools, whether in vending machines or in canteens, bars and shops.<sup>(43)</sup> Prohibiting the sale of sugary drinks and energy foods and/or requiring a range of healthy products is effective in promoting healthier consumption patterns.<sup>(4)</sup> Even so, our study shows the inefficacy of a policy based solely on recom-

mendations, without funding or a follow-up and evaluation system with clear goals and indicators. Indeed, the United Kingdom's experience with compulsory dietary standards in schools since September 2013 highlights the fact that the effectiveness of this measure requires adequate investment and an appropriate follow-up and evaluation mechanism.<sup>(26)</sup>

This study's principal limitation is the high percentage of non-response. However, there were no great differences between the characteristics of the schools that agreed and those that refused to participate. A further limitation lies in the fact that the results are only directly applicable to the MAR, which means that, though the recommendations analysed are of a national nature, the results cannot be directly extrapolated to the rest of the country.

In conclusion, the approval of the CDSM in 2010 has not succeeded in ensuring that products offered in school-based food and drink vending machines in the MAR have a good nutritional profile. The immense majority of these products are high in energy, rich in fats and/or sugar, and poor in micronutrients, in contravention of NHSIC guidelines. In view of the limited effectiveness of the NHS nutritional guidelines, compliance with these should thus be statutorily regulated, as envisaged by the Food Safety & Nutrition Act.

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