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Association between recreational screen time and excess weight and obesity assessed with three sets of criteria in Spanish residents aged 2–14 years

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Abstract

Introduction and objective: Studies that assess the association between excess weight and screen time in childhood and adolescence are methodologically heterogeneous, and few studies have analysed the exposure to smartphones and tablets. Our study aimed to assess the association between daily recreational screen time and excess weight (overweight + obesity) and obesity in children aged 2–14 years residing in Spain using different sets of standards.

Methods: We conducted a cross-sectional study using data from the 2017 Spanish National Health Survey ($N = 4528$). We assessed the prevalence of overweight and obesity applying the criteria of the World Health Organization (WHO), International Obesity Task Force (IOTF), and Orbegozo 2011 study. We categorised daily recreational screen time in minutes as 0–59, 60–119, 120–179, and ≥ 180. We calculated crude and adjusted prevalence ratios (aPR) of excess weight and obesity based on the daily minutes of recreational screen time with the corresponding 95% confidence intervals (95%CI). Moreover, we calculated crude and adjusted change (aΔ) in the expected number of fulfilled excess weight/obesity criteria based on the minutes of daily recreational screen time with the corresponding 95% CI. We adjusted the association analyses for potential confounders.

Results: We found that spending 180 min or more a day of recreational screen time was associated with an increase in the adjusted prevalence of excess weight (e.g. Orbegozo 2011 aPR$_{\geq 180}$, 1.20; 95% CI, 1.02–1.42) and of obesity (e.g. IOTF aPR$_{\geq 180}$, 1.41; 95% CI, 1.06–1.86) as well as an increase in the adjusted number of fulfilled criteria for excess weight (a$\Delta_{\geq 180}$, 1.18; 95% CI, 1.06–1.31).

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Conclusions: Longer periods of recreational screen time were associated with excess weight and obesity in children aged 2–14 years. Cohort studies are required to confirm these findings, as this may be a determinant of health in children.

Asociación entre el tiempo de pantalla recreativo y el exceso de peso y la obesidad medidos con tres criterios diferentes entre residentes en España de 2-14 años

Resumen

Introducción y objetivo: Los estudios que evalúan la relación entre la obesidad y el tiempo de pantalla en la infancia y adolescencia son heterogéneos y siguen diferentes criterios para medir la obesidad. Además, existen pocos estudios que incluyan la exposición a los teléfonos inteligentes y las tabletas. Este estudio tiene como objetivo determinar la relación entre el tiempo de pantalla de ocio diario y el exceso de peso (sobrepeso más obesidad) y obesidad, utilizando diferentes criterios en personas de 2 a 14 años residentes en España.

Métodos: Estudio transversal con los datos de la Encuesta Nacional de Salud de España de menores del año 2017 (n = 4.528). Se determinó el sobrepeso y la obesidad a partir de los criterios de la Organización Mundial de la Salud (OMS), International Obesity Task Force (IOTF) y Orbegozo 2011. Se categorizó el tiempo diario de pantalla para fines recreativos en minutos como: 0-59, 60-119, 120-179 y ≥ 180. Calculamos la razón de prevalencias cruda y ajustada (RPa) y los intervalos de confianza al 95% (IC 95%) de exceso de peso y obesidad según el tiempo de pantalla de ocio diario en minutos. Además, calculamos el cambio crudo y ajustado (△a) y los IC 95% del número esperado de criterios de exceso de peso y obesidad cumplidos según el tiempo de pantalla recreativo en minutos. Ajustamos las asociaciones por las potenciales variables de confusión.

Resultados: Utilizar las pantallas para el ocio al menos 180 minutos diarios está asociado con una mayor prevalencia ajustada de tener exceso de peso (p. ej., Orbegozo 2011 $RPa_{\geq 180}$: 1,20; IC 95%: 1,02-1,42) y obesidad (i.e. IOTF $RPa_{\geq 180}$: 1,41; IC 95%: 1,06-1,86) y un mayor número esperado de criterios de exceso de peso cumplidos ($\triangle a_{\geq 180}$: 1,18; IC 95%: 1,06-1,31).

Conclusiones: Períodos más largos de pantalla están asociados con el exceso de peso y la obesidad en la población de 2 a 14 años. Se deberían confirmar estos resultados en estudios longitudinales ya que podríamos estar frente a un nuevo determinante de la salud infantil.

Introduction

Excess weight is defined by the World Health Organization (WHO) as an abnormal or excessive fat accumulation that presents a risk to health.[1] Childhood excess weight, including obesity and overweight, has reached epidemic levels worldwide.[2] In 2016, nearly 1 out of 5 children and adolescents worldwide had excess weight.[3] In Europe, in 2016, around 41 million children and adolescents aged 5–19 years had excess weight, with the most alarming proportions found in Mediterranean countries.[4] In this context, between 2014 and 2015, around 30% of children and adolescents aged 3–18 years in Spain had excess weight.[5] Children and adolescents with excess weight are likely to experience deleterious effects during childhood and adolescence, such as hypertension, metabolic disorders, or low self-esteem, and also later in adulthood, such as an increased risk of obesity and cardiovascular disease or poorer employment prospects.[4]

Excess weight in children is preventable. Although childhood excess weight can be associated with genetic factors, environmental factors (e.g., place of residence or family health history) and sociocultural factors (e.g. socioeconomic status and educational attainment in family), lifestyle factors (e.g. physical activity, dietary and sleep habits or screen time) also play a fundamental role on excess weight.[2] In this regard, a systematic review of studies that analysed the association between adiposity and lifestyle habits showed that unhealthy lifestyle habits, including a low level of physical activity, excessive use of screens and an unhealthy diet were associated with an increased risk of excess weight.[6] Furthermore, a recent systematic review of prevalence studies assessing the association between screen time and overweight/obesity in children under 18 years concluded that increased screen times could be a risk factor for obesity/overweight during childhood and adolescence.[7] The use of screens has become routine for children and adolescents. In this sense, the Ministry of Health, Social Services and

Equality of Spain (2015),[8] the American Academy of Pediatrics (2016),[9] the Canadian Society of Pediatrics (2017)[10] and the WHO (2019)[11] have recommended avoiding screen use completely in children under 2 years and limiting screen time to 1 h a day in children aged 2–5 years, and only the Ministry of Health of Spain recommended limiting recreational screen time to 2 h a day in children and adolescents aged 5–17 years (2015).[8] The existing literature shows that a vast majority of children do not adhere to screen time guidelines.[12–14] For instance, 44.7% of children aged 1–14 years in Spain spent at least 2 h a day in recreational screen use in 2017.[15] In addition, one systematic review highlighted that these findings could not be generalised to the use of smartphones or tablets due to the lack of studies assessing exposure to these devices.[7] However, it is known that 69.1% of Spanish children aged 10–15 years had a mobile phone of their own in 2017.[16]

Currently, the body mass index (BMI) for age is the criterion used most widely in epidemiological studies to assess excess weight in children and adolescents, since the BMI is a practical, universally applicable, inexpensive, and non-invasive measure. The BMI is calculated by dividing the body weight in kilograms by the square of the height in meters.[17] The references used most widely to calculate BMI-for-age in global and European populations are the WHO growth standards and the International Obesity Task Force (IOTF) reference values.[18,19] In 2017, the WHO published percentile charts for data collected in the WHO Multicentre Growth Reference Study.[18] The WHO also provided tools to calculate BMI-for-age z-scores, which are standardized values from a reference population, using the lambda-mu-sigma (LMS) method.[20] On the other hand, in 2000 the IOTF defined international BMI cut-off points for sex and age (2–18 years) to define overweight and obesity based on pooled international data for BMI and linked to the widely used adult overweight and obesity cut-off points of 25 kg/m^2 and 30 kg/m^2, respectively.[19] When it comes to Spain, the reference used most widely in clinical practice are the Orbegozo growth charts. The Orbegozo Foundation established BMI-for-age percentiles from longitudinal and cross-sectional studies in a sample of children from Bilbao (Spain), and the charts were last updated in 2011.[21] In this regard, two studies conducted in Italy[22] and in Spain,[23] which aimed to compare 3 different sets of growth standards used as reference to assess excess weight in children, found differences in the calculated prevalence of excess weight based on the reference used. Further, due to differences between the standards currently applied to assess excess weight in children and adolescents, the studies that assess the association between screen time and obesity/overweight are methodologically heterogeneous.[7]

Due to the lack of studies including smartphone or tablet use in the screen time and the methodological heterogeneity of published works due to the variation in the criteria used to assess obesity/overweight, the aim of our study was to assess the association between daily recreational screen time and excess weight and obesity applying 3 different standards to Spanish children aged 2–14 years.

Methods

We conducted a cross-sectional study using data from the 2017 Spanish National Health Survey (2017SNHS), which is the main source of information on the perceived health status of the population residing in Spain. More detailed information about the methodology of the 2017SNHS can be found elsewhere.[24] For the purpose of this study, we only took into account sociodemographic, environmental, cultural and lifestyle data of participants under 15 years ($N = 6106$). The data were reported by parents, legal guardians or, in the case of parents or legal guardians not being available, other relatives (e.g., grandparents or brother/sisters).[24] The exclusion criteria in our study were: 1) age less than 2 years, since the IOTF criteria cannot be applied to this age group ($n = 625$), 2) activity limitations in the child in the past half year due to health issues ($n = 320$), 3) lack of BMI and screen time data ($n = 633$). The final sample included 4528 children aged 2–14 years residing in Spain.

Ethical considerations

The study was conducted in adherence to the principles of the Declaration of Helsinki of 2013. We used secondary data available in a repository accessible to the public (https://www.mscbs.gob.es/estadEstudios/estadisticas/encuestaNacional/encuesta2017.htm). The study was exempted from written informed consent or approval by an ethics committee, as it used anonymous data. However, this article has derived from a PhD dissertation that was approved by the ethics committee of the Universitat Internacional de Catalunya (project code CBAS-2020-06).

Excess weight and obesity

We calculated the BMI with the weight in kilograms and height in metres reported by the survey respondent, dividing the weight by the height square.[17] We applied three different reference standards, based on BMI-for-age, as criteria for assessing overweight and obesity: 1) the WHO growth standards,[18] 2) the IOTF centiles[19], and 3) the Orbegozo 2011 growth tables[21] (Table S1). When it came to the WHO criteria, we calculated BMI-for-age z-scores from reference values provided by the WHO and using the LMS method.[20] We treated height-for-age, weight-for-age, and BMI-for-age values that seemed biologically implausible values (BIV) as missing data.[25–27] We also recorded the number of standards in which children in the sample met the criteria for excess weight/obesity. When it came to excess weight, the possible range was 0–6 fulfilled criteria, counting 1 point for each overweight and each obesity criterion met (e.g., a score of 0 points for children who were neither overweight nor obese based on any of the standards, and a score of 6 points for children who were obese according to all 3). We calculated the number of standards according to which children met the definition of obesity by counting 1 point for each met obesity criterion. The possible score ranged from 0 to 3 met criteria, with children who were not obese based on any of

the standards scoring 0 points, and children who were obese based on all 3 criteria scoring 3 points.

Daily recreational screen time

We collected data on the daily recreational screen time through the question ''Approximately, how much of his/her free time does the child spend in front of a screen, including computers, tablets, television, videos, videogames or cell phones?''. Respondents had 3 possible answers (Never or rarely, less than 1 h, and 1 h or more). Further, only those participants who answered 1 h or more also reported the number of hours, ranging from 1 h to 12 h. Respondents answered the same question for Monday to Friday and for the weekend (Saturday and Sunday). We calculated the average daily recreational screen time in minutes through a weighted mean. We assigned 0 min and 30 min for children reported to use screens ''never or rarely'' and ''less than 1 h'', respectively, to calculate the weighted mean for the whole sample. Then, we classified daily recreational screen time into the following categories: 0–59, 60–119, 120–179, and ≥180 min.

Potential confounders and covariates

We selected potential confounding variables and covariates based on the current literature[2,6]: (i) sex (male and female) and (ii) age in years; (iii) parental educational attainment (low: no education, completed or incomplete elementary education, or special education; medium: secondary education/high school or vocational education; and high: university education); (iv) relationship of survey respondent to the child (parent or other); (v) family structure (nuclear/headed by a couple, single-parent, extended/couple or single parent cohabiting with other relatives, and other); (vi) sleep duration (adequate sleep duration: sleep duration equal to or greater than the hours recommended by the National Sleep Foundation for age[28,29]; short sleep duration: duration less than recommended for age); (vii) recreational physical activity (no exercise; occasional physical activity or sports occasionally such as walking, riding a bicycle, or low impact physical activity; physical activity several times a month, such as gymnastics, jogging, swimming or team sports; and sports or fitness activities several times a week), (ix) adapted Mediterranean diet score (aMDS), comprising 6 items (fruits and natural juices; vegetables; meats and cold cuts; fish; legumes; and potatoes, rice, pasta, bread, and cereals). For each item, participants received 0, 1 or 2 points, or, in the case of meats and cold cuts, 2, 1, and 0 points if their daily intake was under the first tertile, between the first and second tertiles or over the second tertile, respectively, of the daily intake the distribution for their age group. The aMDS ranges from 0 to 12 points, with 0 indicating nonadherence to the Mediterranean diet and 12 perfect adherence to the Mediterranean diet. Lastly, (x) daily junk food intake, which included consumption of sweets, fast food, sugary drinks and snacks.

Statistical analysis

We described the characteristics of the sample using absolute frequencies and percentages for categorical variables and median and interquartile range (IQR) for numerical variables. We calculated absolute and relative frequencies of excess weight and obesity applying the WHO, IOTF, and Orbegozo 2011 criteria for each category of daily recreational screen time. We also calculated the crude and adjusted prevalence ratios (PRs and aPRs) of excess weight and obesity obtained by applying the WHO, IOTF, and Orbegozo 2011 criteria by daily recreational screen time category with the corresponding 95% confidence intervals (CIs). Finally, we calculated the crude and adjusted differences (△), with the corresponding 95% CIs, in the expected number of met criteria of excess weight and obesity based on the daily recreational screen time category. Furthermore, we assessed the association between daily recreational screen time and the expected number of met excess weight/obesity criteria stratified by parental educational attainment, family structure and their interaction. We calculated PRs, aPRs and 95% CIs by fitting Poisson regression models with robust variance,[30] and the △, adjusted △ (a△) and 95% CIs of the expected number of met criteria through zero-inflated Poisson regression.[31] We adjusted the associations for the potential confounding variables. The statistical analysis was performed with the software R version 3.5.2.

Results

The study included 4528 children. Of this total, 19.0%, 17.6% and 16.9% were classified as overweight based on the WHO, IOTF and Orbegozo 2011 criteria, respectively. In addition, 12.2%, 10.1% and 7.5% were classified as obese according to the WHO, IOTF, and Orbegozo 2011 criteria, respectively. As for the daily recreational screen time, 21.8% of the sample spent between 0 and 59 min, 30.7% between 60 and 119 min, 30.6% between 120 and 179 min, and 16.9% at least 180 min using screens in their leisure time (Table 1).

Table 2 shows that the prevalence of excess weight and obesity was greater in children with screen times of 120–179 min or at least 180 min compared to children that used screens for up to 59 min. We found statistically significant differences between children with screen times of 180 min or greater compared to children with screen times of less than 1 h in the adjusted prevalence of excess weight based on the Orbegozo 2011 criterion (aPR, 1.20; 95% CI, 1.02–1.42) and of obesity based on the WHO criterion (aPR, 1.36; 95% CI, 1.05–1.77) and the IOTF criterion (aPR, 1.41; 95% CI, 1.06–1.86) (Table 2).

Table 3 shows that the expected number of met criteria of excess weight and obesity was higher in children who spent 180 min or more a day using screens in their leisure time compared to those that spent between 0 and 59 min (Table 3).

The Supplemental material shows unadjusted and adjusted analysis of the association between the expected number met excess weight and obesity criteria and the daily recreational screen time by parental educational attainment (Table S2), family structure (Table S3) and the combination of both (Table S4). Table S2 shows that the

Table 1 Characteristics of the sample.

	n (%)/Median (IQR)
Total sample	4528 (100%)
WHO criteria	
Neither overweight nor obese nor BIV	2962 (65.4%)
Overweight	860 (19.0%)
Obese	551 (12.2%)
BIV	155 (3.4%)
IOTF criteria	
Neither overweight nor obese	3276 (72.3%)
Overweight	795 (17.6%)
Obese	457 (10.1%)
Orbegozo 2011 criteria	
Neither overweight nor obese	3420 (75.5%)
Overweight	767 (16.9%)
Obese	341 (7.5%)
Daily recreational screen time (min)	
0–59	986 (21.8%)
60–119	1391 (30.7%)
120–179	1384 (30.6%)
≥180	767 (16.9%)
Sex of child	
Male	2346 (51.8%)
Female	2182 (48.2%)
Age of child (years)	9 (5–12)
Educational attainment	
High	1515 (34.5%)
Medium	2529 (57.6%)
Low	344 (7.8%)
Relationship of questionnaire respondent to child	
Parents	4316 (95.3%)
Other	212 (4.7%)
Family structure	
Nuclear	3554 (78.5%)
Single-parent	515 (11.4%)
Extended (couple or single parent with other family members)	337 (7.4%)
Other	122 (2.7%)
Sleep duration	
Adequate sleep duration	3487 (77%)
Insufficient sleep duration	1041 (23%)
Physical activity	
No exercise	782 (17.3%)
Occasional exercise	1121 (24.8%)
Exercise several times per month	1259 (27.8%)
Exercise several times per week	1360 (30.1%)
Adapted Mediterranean diet score	8 (6–9)
Daily consumption of junk food	1.1 (0.7–1.5)

BIV, biologically implausible value; IOTF, International Obesity Task Forces; IQR, interquartile range; min, minute; WHO, World Health Organization.

adjusted prevalence was higher in children that used screens recreationally for at least 180 min compared to those that used them for up to 59 min, after we stratified associations between daily recreational screen times and the expected number of excess weight/obesity standards met by parental educational attainment (Table S2). Furthermore, as Table S3 shows, the expected number of met criteria for excess weight and obesity was higher in children with at least 3 h of recreational screen time a day compared to children with a daily recreational screen time of up to 59 min, and the adjusted associations were statistically significant only for children in nuclear families. We also found an inverse adjusted association between the expected number of met criteria for excess weight and obesity in children in extended and other types of families, although the differences were not statistically significant (Table S3). In addition, Table S4 shows that in children in nuclear families, the adjusted expected number of met criteria for excess weight and obe-

Table 2 Absolute and relative frequencies of excess weight (overweight + obesity) and obesity by daily recreational screen time. Crude and adjusted prevalence ratios of excess weight and obesity by daily recreational screen time.

Criterion	Daily recreational screen time	Excess weight (overweight + obesity)			Obesity		
		n (%)	PR (95% CI)	aPR (95% CI)	n (%)	PR (95% CI)	aPR (95% CI)
WHO (N = 4373)	0–59 min	278 (29.6%)	1.00 Reference	1.00 Reference	109 (11.6%)	1.00 Reference	1.00 Reference
	60–119 min	428 (31.7%)	1.07 (0.94–1.21)	1.05 (0.92–1.20)	163 (12.1%)	1.04 (0.83–1.30)	1.10 (0.87–1.39)
	120–179 min	444 (33.1%)	1.12 (0.98–1.26)	1.05 (0.92–1.20)	168 (12.5%)	1.08 (0.86–1.35)	1.15 (0.91–1.46)
	≥180 min	261 (35.1%)	**1.18 (1.03–1.36)**	1.08 (0.93–1.25)	111 (14.9%)	1.28 (1.00–1.64)	**1.36 (1.05–1.77)**
IOTF (N = 4528)	0–59 min	272 (27.6%)	1.00 Reference	1.00 Reference	111 (11.3%)	1.00 Reference	1.00 Reference
	60–119 min	371 (26.7%)	0.97 (0.85–1.10)	1.00 (0.87–1.15)	129 (9.3%)	0.82 (0.65–1.05)	0.98 (0.77–1.25)
	120–179 min	380 (27.5%)	1.00 (0.87–1.14)	1.04 (0.91–1.20)	135 (9.8%)	0.87 (0.68–1.10)	1.19 (0.94–1.52)
	≥180 min	229 (29.9%)	1.08 (0.93–1.26)	1.17 (1.00–1.37)	82 (10.7%)	0.95 (0.73–1.24)	**1.41 (1.06–1.86)**
Orbegozo 2011 (N = 4528)	0–59 min	241 (24.4%)	1.00 Reference	1.00 Reference	88 (8.9%)	1.00 Reference	1.00 Reference
	60–119 min	327 (23.5%)	0.96 (0.83–1.11)	1.00 (0.87–1.16)	96 (6.9%)	0.77 (0.59–1.02)	0.93 (0.71–1.23)
	120–179 min	335 (24.2%)	0.99 (0.86–1.14)	1.05 (0.90–1.21)	96 (6.9%)	0.78 (0.59–1.03)	1.14 (0.86–1.52)
	≥180 min	205 (26.8%)	1.09 (0.93–1.28)	**1.20 (1.02–1.42)**	61 (8.0%)	0.89 (0.65–1.22)	1.37 (0.99–1.90)

aPR Adjusted prevalence ratio; CI, confidence interval; IOTF, International Obesity Task Force; min, minute; PR, prevalence ratio; WHO, World Health Organization.
Bold values indicate statistically significant differences at level of 0.05.

Table 3 Crude and adjusted difference in the expected number of met criteria for excess weight and obesity by daily recreational screen time.

Daily recreational screen time	Excess weight (0–6 criteria)		Obesity (0–3 criteria)	
	△ Expected number of met criteria (95% CI)	a△ Expected number of met criteria (95% CI)	△ Expected number of met criteria (95% CI)	a△ Expected number of met criteria (95% CI)
0–59 min	1.00 Reference	1.00 Reference	1.00 Reference	1.00 Reference
60–119 min	1.02 (0.93–1.11)	1.07 (0.97–1.17)	0.94 (0.77–1.14)	1.05 (0.85–1.28)
120–179 min	1.04 (0.95–1.13)	**1.11 (1.01–1.21)**	0.95 (0.78–1.15)	1.12 (0.92–1.38)
≥180 min	1.08 (0.98–1.19)	**1.18 (1.06–1.31)**	0.99 (0.80–1.23)	1.25 (1.00–1.58)

a△, Adjusted difference; CI, confidence interval; h, hour; min, minute; △, difference.
Bold values indicate statistically significant differences at level of 0.05.

sity was higher in those with 3 h or more a day of recreational screen time compared to those who spent no more than 59 min, independently of parental educational attainment. We found that this adjusted association was maintained for children in single-parent families and medium-low parental educational attainment (Table S4).

Discussion

In children aged 2–14 years in Spain, spending at least 180 min a day in recreational screen use was associated with a higher adjusted prevalence of excess weight and obesity and a higher adjusted expected number of met criteria for excess weight compared to children with up to 59 min of daily recreational screen time.

Our results were consistent with the findings of a study published in 2019 that used data of the fourth round (2015/2017) of the WHO Childhood Obesity Surveillance Initiative (COSI 2015–2017), which included children aged 6–9 years from 35 European countries.[32] Its objective was to investigate the clustering of energy balance-related behaviours (physical activity, screen time, fruits and vegetables intake, and soft drinks intake) and whether the identified clusters were associated with weight status. The authors concluded that children residing in Mediterranean countries (including Spaniards), who were sedentary and physically inactive and spent longer periods using screens were more likely to be overweight/obese based on the WHO and the IOTF criteria compared to other clusters.[32] After reviewing the evidence on the paediatric population of Spain, we found that our results agreed with those of a study published in 2017 in a sample of adolescents (13–18 years) from Barcelona, Spain, in 2011–2012 that aimed, among other objectives, to analyse the potential relationship between multiple lifestyle risk behaviours, including excessive screen time, and excess weight assessed through the WHO criteria.[33] However, our findings contrasted with those of another study published in 2016 that sought to determine the prevalence of weight status categories, defined with the WHO criteria, and assess the determinants of weight status, including screen time, in schoolchildren aged 8 and 9 years in Barcelona in 2011, as this study did not find an association between overweight or obese status

and a daily screen time of 2 h or greater.[34] This discrepancy might be due to the fact that the age range was broader in our study and that data collection in the other study took place in 2011, so that screen time would have included smartphone and tablet usage.

Additionally, our study shows that the expected number of met criteria for excess weight is higher in children that spend at least 180 min of daily recreational screen time. We assume that the certainty of the presence of excess weight increases when there is agreement between the different criteria. In this regard, although it was not the main aim of this study, we found that the most frequently met criteria were those of the WHO criterion, with percentages of excess weight and obesity of 31.2% and 12.2%, respectively. On the other hand, the Orbegozo 2011 criteria were met least frequently, with a prevalence of 24.4% and 7.5% for excess weight and obesity, respectively. The prevalence of excess weight and obesity based on the IOTF criteria were slightly higher compared to the Orbegozo 2011 criteria (27.7% and 10.1%). These results are consistent with previous evidence.[23,35] Thus, the WHO criteria are the easiest to meet. Future studies should validate these criteria in relation to objective measures in order to establish which standard is most suitable.

Furthermore, we found that the association between the expected number of met criteria for excess weight and obesity and recreational screen time held independently of parental educational attainment. Thus, we found a greater expected number of met criteria for excess weight and obesity in children that spent at least 3 h a day in recreational screen use compared to peers with parents with the same educational attainment that spent up to 59 min a day in recreational screen use. We did not find a clear pattern for the association between the expected number met criteria for excess weight and obesity and daily recreational screen time stratified by family structure, for, unlike children in nuclear or single-parent families, in whom we found association between daily recreational screen time and the expected number of met criteria for excess weight/obesity, we found an inverse association between the same variables in children in extended families. However, in the group of children living in extended families or families with other structures, the frequency of

high parental educational attainment was lower (nuclear, 38%; single-parent, 25%; extended/other, 16%) and the proportion that engaged in physical activity several times a week was also lower (nuclear, 31%; single-parent, 32%; extended/other, 25%). Thus, future studies should explore more thoroughly the association between screen time and childhood excess weight/obesity in the types of families with lower representation.

Strengths and limitations

To the best of our knowledge, this is the first study that assesses the association between daily recreational screen time, including smartphone and tablet usage, and weight status determined with different sets of criteria in the Spanish paediatric population. Nonetheless, this study also has limitations that should be taken into account. First, weight and height were self-reported instead of measured objectively. In this regard, we compared the prevalence of excess weight and obesity obtained in our study with the values obtained in the Estudio Nutricional de la Población Española (Nutrition Study of the Spanish Population [ENPE]) 2014–2015, which used objective weight and height measurements,[5] and we found that the values we found were lower compared to those reported in the ENPE 2014–2015.[5] In any case, this limitation should not affect the association approached in this work. In addition, the collected data on daily recreational screen time was for overall usage and imprecise (e.g., did not differentiate children who did not use screens, did not quantify screen time in children who reported less than one hour of screen time daily), and all the data were collected through a questionnaire, which might be a source of bias. In addition, due to the cross-sectional design of this study, we were unable to establish causality, and could not rule out reverse causality.

Public health implications

The global targets 2025 of the WHO include stopping the increase in childhood excess weight.[36] Childhood obesity has increased approximately 10-fold in the last 40 years.[4] Therefore, it is important to know the determinants of childhood excess weight. In this sense, our findings provide more evidence of the possible adverse effects of screen time on children's health. Nonetheless, these results should be confirmed through cohort studies.

Conclusions

Longer periods of recreational screen use were associated with excess weight and obesity in children aged 2–14 years. Cohort studies should be conducted to confirm these findings, as we may be facing a potential determinant of child health.

What is known?

Longer periods of screen use are associated with a higher prevalence of childhood excess weight and obesity. However, there is a dearth of studies including the use of smartphones and tablets in recreational screen time. Besides, due to the variability of the criteria currently used to define childhood obesity, studies are statistically heterogeneous.

What is new?

Spending at least 180 min a day in front of screens for recreational purposes is associated with a higher prevalence of excess weight and obesity based on all 3 sets of criteria. Furthermore, the expected number of met criteria for excess weight was higher in children whose daily recreational screen time was 180 min or greater.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.anpede.2021.09.004.

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