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ORIGINAL ARTICLE

Prevalence of overweight and obesity in Aragón and variations according to health determinants

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KEYWORDS
Childhood obesity;
Overweight;
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Socioeconomic factors

Abstract
Introduction: Childhood obesity is a serious global health problem that is continuously increasing worldwide. Many studies suggest that socioeconomic factors are related to the development of obesity. The objective of our study was to analyse the prevalence of overweight and obesity in Aragón, calculated applying the World Health Organization (WHO) growth standards, and to study its association with socioeconomic factors.
Material and methods: We collected data for the entire paediatric population of Aragón aged 2–14 years. We classified each child as normal weight, overweight or obese based on the body mass index. We calculated prevalences by province and basic health care zone. To analyse differences in relation to social inequalities, we used the Aragón deprivation index as an indicator of socioeconomic status.
Results: The final sample consisted of 161 335 children aged 2–14 years, 51% male and 49% female. The overall prevalence of excess weight was 31.1% (17.7% overweight and 13.3% obesity) and was significantly higher in boys. We found a high frequency of under-recording in health records (65%). There was a direct association between the deprivation index and the prevalence of obesity and overweight throughout Aragón, with a significant strong correlation in urban areas, where socioeconomic factors explained up to 66.4% of obesity and 48.9% of body weight excess.

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Conclusions: In Aragón, the prevalence of obesity and excess weight is high and associated with low family socioeconomic status.

PALABRAS CLAVE
Obesidad infantil;
Sobrepeso;
Prevalencia;
Índice masa corporal;
Factores socioeconómicos

Prevalencia de sobrepeso y obesidad en Aragón y variaciones según condicionantes de salud

Resumen
Introducción: La obesidad infantil constituye un grave problema de salud global en continuo aumento en todo el mundo. Muchos estudios señalan que determinados factores socioeconómicos están relacionados con el desarrollo de obesidad. El objetivo de este estudio fue analizar la prevalencia de sobrepeso y obesidad en Aragón, calculadas según los estándares de OMS y estudiar su relación con factores socioeconómicos.
Material y métodos: Se recopiló información sobre la totalidad de la población infantil de Aragón entre 2 y 14 años y cada individuo fue clasificado como normopeso, sobrepeso u obesidad según su índice de masa corporal. Se obtuvieron las prevalencias por provincias y zonas básicas de salud. Utilizamos el índice de privación de Aragón como marcador de la situación socioeconómica.
Resultados: La muestra final estuvo constituida por 161.335 niños (51%) y niñas (49%) de 2 a 14 años. La prevalencia global de sobrecarga ponderal fue de 31,1% (17,7% sobrepeso y 13,3% obesidad), siendo significativamente mayor en niños. Detectamos un porcentaje elevado (65%) de infrarregistro en la historia clínica. Se encontró una relación directa entre el índice de privación y la prevalencia de obesidad y sobrecarga ponderal en todo Aragón, con una fuerte correlación significativa en zonas urbanas, en las que los factores socioeconómicos llegan a explicar hasta un 66,4% de la obesidad y un 48,9% de la sobrecarga ponderal total.
Conclusiones: En Aragón, la prevalencia de obesidad y sobrecarga ponderal es elevada y está relacionada con una situación socioeconómica familiar desfavorable.

Introduction

At present, childhood obesity is an important public health problem that has been increasing globally since the past century.[1–5] In Spain, the combined prevalence of overweight and obesity, or excess weight (EW), ranges between 26% and 32.5% depending on the time and place the studies are conducted and the standards used for reference.[6–9] In a study conducted by our group in 2014[10] in Sector II of Zaragoza, one of the 8 health care sectors in Aragon, which mostly comprises urban health care districts (HCDs), we found a prevalence of EW of 30.8% applying the child growth standards of the World Health Organization (WHO).[8]

On the other hand, several studies have shown that living conditions play a role in health[11–14] and in obesity.[15,16] In Aragon, the incidence of overweight has been found to be higher in rural areas and disadvantaged neighborhoods,[16] and there is evidence of an inverse association between obesity and educational attainment.[15] A higher incidence has also been found in students in public schools compared to private schools.[17]

The aim of our study was to assess the prevalence of overweight, obesity and EW calculated in reference to the WHO growth standards in Aragon and its health sectors, and to analyse its association with socioeconomic factors. Obtaining current knowledge on EW in the paediatric population of Aragon would allow the identification of the areas that require urgent or intensive intervention, and sets the foundation for a more detailed analysis of the potential causes and risk factors to target in future studies. It can also serve as a baseline to start monitoring obesity in the paediatric population of Aragon, observing its temporal trends and comparing them with other autonomous communities (ACs) in Spain and/or other European countries.

Material and methods

Design

We conducted a cross-sectional prevalence study with data from Healthy Child programme records for the paediatric population of Aragon, retrieved from the primary care electronic health record system of the region (known as OMI-AP). We retrieved this data on December 31, 2020. The study universe included every child aged 2–14 years (that is, born between December 31, 2003 and December 31, 2018) in Aragon for who, at the time of data collection, the OMI-

Table 1 Prevalence of overweight and obesity by sex and age in Aragon.

				Overweight						Obesity					
	Male	Female	Total	Male			Female			Male			Female		
	n	n	N	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
2 years	6059	5643	11 702	717	11.8%	(9.4%–14.1%)	769	13.6%*	(11.1%–16.0%)	311	5.1%	(2.5%–7.4%)	297	5.3%	(2.6%–7.6%)
3 years	7144	6810	13 954	1249	17.5%	(15.3%–19.5%)	1156	17.0%	(14.8%–19.1%)	696	9.7%	(7.5%–11.9%)	610	9.0%	(6.6%–11.1%)
4 years	7603	7227	14 830	1305	17.2	(15.1%–19.2%)	1255	17.4%	(15.2%–19.4%)	706	9.3%	(7.1%–11.4%)	613	8.5%	(6.2%–10.6%)
5 years	2173	2026	4199	335	15.4%	(11.4%–19.1%)	304	15.0%	(10.8%–18.9%)	261	12.0%	(7.9%–15.8%)	208	10.3%	(5.9%–14.2%)
6 years	17 260	15 755	33 015	2611	15.1%	(13.7%–16.5%)	2610	16.6%*	(15.1%–18.0%)	2492	14.4%*	(13.0%–15.8%)	1777	11.3%	(9.8%–12.7%)
7 years	1747	1790	3537	243	13.9%	(9.4%–18.1%)	285	15.9%	(11.5%–20.0%)	356	20.4%	(16.1%–24.4%)	329	18.4%	(14.0%–22.4%)
8 years	5150	4847	9997	879	17.1%	(14.5%–19.5%)	987	20.4%*	(17.8%–22.8%)	1119	21.7%*	(19.3%–24.1%)	817	16.9%	(14.2%–19.4%)
9 years	6505	6312	12 817	1223	18.8%	(16.6%–20.9%)	1345	21.3%*	(19.1%–23.5%)	1487	22.9%*	(20.7%–25.0%)	1060	16.8%	(14.5%–19.0%)
10 years	3472	3534	7006	693	20.0%	(16.9%–22.9%)	799	22.6%*	(19.6%–25.4%)	818	23.6%*	(20.6%–26.4%)	525	14.9%	(11.7%–17.8%)
11 years	1820	1826	3646	356	19.6%	(15.3%–23.5%)	339	18.6%	(14.3%–22.6%)	432	23.7%*	(19.6%–27.6%)	268	14.7%	(10.3%–18.7%)
12 years	10 403	10 324	20 727	2271	21.8%*	(20.1%–23.5%)	2066	20.0%	(18.3%–21.7%)	2110	20.3%*	(18.5%–22.0%)	1269	12.3%	(10.4%–14.1%)
13 years	1544	1370	2914	310	20.1%	(15.5%–24.4%)	250	18.2%	(13.3%–22.8%)	250	16.2%*	(11.4%–20.6%)	172	12.6%	(7.3%–17.2%)
14 years	11 842	11 149	22 991	2247	19.0%	(17.3%–20.6%)	2014	18.1%	(16.4%–19.7%)	1516	12.8%*	(11.1%–14.5%)	1018	9.1%	(7.3%–10.9%)
TOTAL	82 722	78 613	161 335	14 439	17.5%	(16.8%–18.1%)	14 179	18.0%	(17.4%–18.7%)	12,554	15.2%	(14.5%–15.8%)	8963	11.4%	(10.7%–12.1%)

* Significant differences between sexes found with the χ^2 test.

AP database had at least one record of weight and height measurements taken at the same time. We calculated the age of each child as the difference between the date of birth and the date the weight and height were documented.

As of December 31, 2020, the population aged 2–14 in Aragon comprised 165 642 children, based on data from the Instituto Nacional de Estadística (National Institute of Statistics).[18] We obtained data for 166 440 children, and the final sample included 161 335 children after excluding 5105 due to erroneous or extreme values (a body mass index [BMI] greater than 50 or smaller than 10).

We obtained anonymised data for the following variables: health care sector and district, sex, date of birth, most recent weight and height and the date they were recorded, and diagnosis of overweight/obesity documented at any time. Usually, this information is recorded during Healthy Child programme visits.

We calculated the BMI with the most recent weight and height measurements. We recorded the age of the individual as the age at the time this information was entered in the health record. Of the total sample, 37% of the children had BMI values based on measurements taken in the past year, and 87% values based on measurements taken within the past 3 years.

We classified each participant as having normal weight, overweight or obesity applying the WHO growth standards and the thresholds used most widely for their definition in Spain (overweight: 85th percentile [P85] to 97th percentile [P97]; obesity: >P97).[19] We calculated the prevalence of overweight and obesity for each age, sex, province, health care sector and HCD. We used the term EW to refer to the presence of obesity or overweight of any degree.

To analyse differences in EW in relation to social inequalities in each HCD, we used the deprivation index (DI) of Aragon.[20] This index was developed by the Section on Health Care Information and Research of the Directorate General of Public Health, the Instituto Aragonés de Estadística (Aragon Institute of Statistics) and the Universidad de Zaragoza to assess health inequalities between the different HCDs of Aragon based on population and household census data for year 2011. The DI values for each HCD in Aragon are published in the website of the Government of Aragon[21] and range between −2.33 and +3.04, with higher values indicating higher levels of deprivation.

We conducted a simple descriptive analysis of frequencies. To analyse the association between the DI and the prevalence of overweight and obesity, we used the Pearson correlation coefficient and linear regression. We set the level of significance at a *P* value of less than .05. Lastly, we used the χ^2 test for the detailed assessment of differences in the prevalence of overweight, obesity and EW broken down by HCD, sector and province.[2] The statistical analysis was carried out with the RStudio software (version 3.5.0).

Results

Of all children in the sample, 51% were male and 49% female. The overall prevalence of EW was 31.1% (17.7% overweight and 13.3% obesity). Table 1 presents the prevalence of overweight and obesity by sex and age in the entire region of

Table 2 Prevalence of overweight and obesity by province and health sector.

		Population	Overweight			Obesity			Excess weight		
Province	Health sector	N	n	%	95% CI	n	%	95% CI	n	%	95% CI
TERUEL	Alcañiz	8499	1530	18.0%	(16.0%–19.9%)	1160	13.6%	(11.6%–15.6%)	2690	31.7%	(29.9%–33.4%)
	Teruel	8140	1339	16.4%*	(14.4%–18.4%)	1003	12.3%*	(10.2%–14.3%)	2342	28.8%*	(26.9%–30.6%)
	Teruel province total	16 639	2869	17.2%	(15.8%–18.6%)	2163	13.0%	(11.6%–14.4%)	5032	30.2%**	(29.0%–31.5%)
HUESCA	Barbastro	13 741	2491	18.1%	(16.6%–19.6%)	1962	14.3%*	(12.7%–15.8%)	4453	32.4%*	(31.0%–33.8%)
	Huesca	13 497	2233	16.5%*	(15.0%–18.1%)	1500	11.1%*	(9.5%–12.7%)	3733	27.7%*	(26.2%–29.1%)
	Huesca province total	27 238	4724	17.3%	(16.3%–18.4%)	3462	12.7%**	(11.6%–13.8%)	8186	30.1%**	(29.1%–31.0%)
ZARAGOZA	Calatayud	4401	819	18.6%	(15.9%–21.2%)	784	17.8%*	(15.1%–20.4%)	1603	36.4%*	(34.0%–38.7%)
	Zaragoza I	27 345	4808	17.6%	(16.5%–18.6%)	3485	12.7%*	(11.6%–13.8%)	8293	30.3%*	(29.3%–31.3%)
	Zaragoza II	45 162	8122	18.0%	(17.1%–18.8%)	5782	12.8%*	(11.9%–13.7%)	13,904	30.8%	(30.0%–31.6%)
	Zaragoza III	40 550	7276	17.9%	(17.1%–18.8%)	5841	14.4%*	(13.5%–15.3%)	13,117	32.3%*	(31.5%–33.1%)
	Zaragoza province total	117 458	21 025	17.9%**	(17.4%–18.4%)	15,892	13.5%**	(13.0%–14.1%)	36,917	31.4%**	(31.0%–31.9%)
ARAGON overall		161 335	28 618	17.7%	(17.3%–18.2%)	21,517	13.3%	(12.9%–13.8%)	50,135	31.1%	(30.7%–31.5%)

Significant difference in the health care sector * or province ** compared to the rest of Aragon found with the χ^2 test.

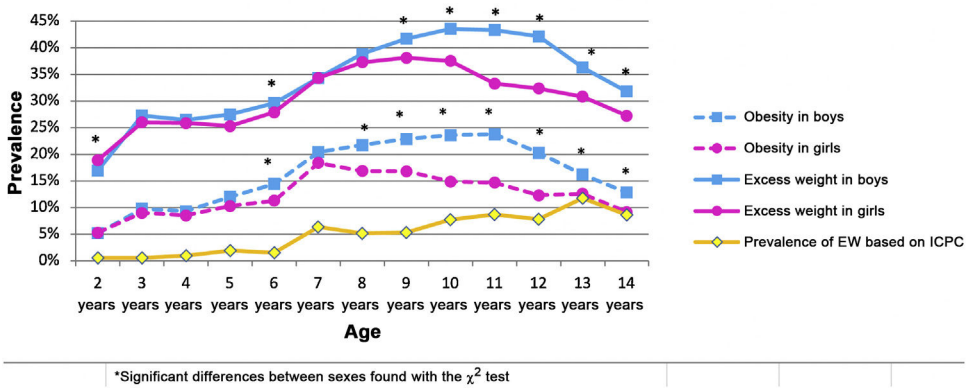

Figure 1 Prevalence of overall excess weight and of obesity by sex and age in Aragon.

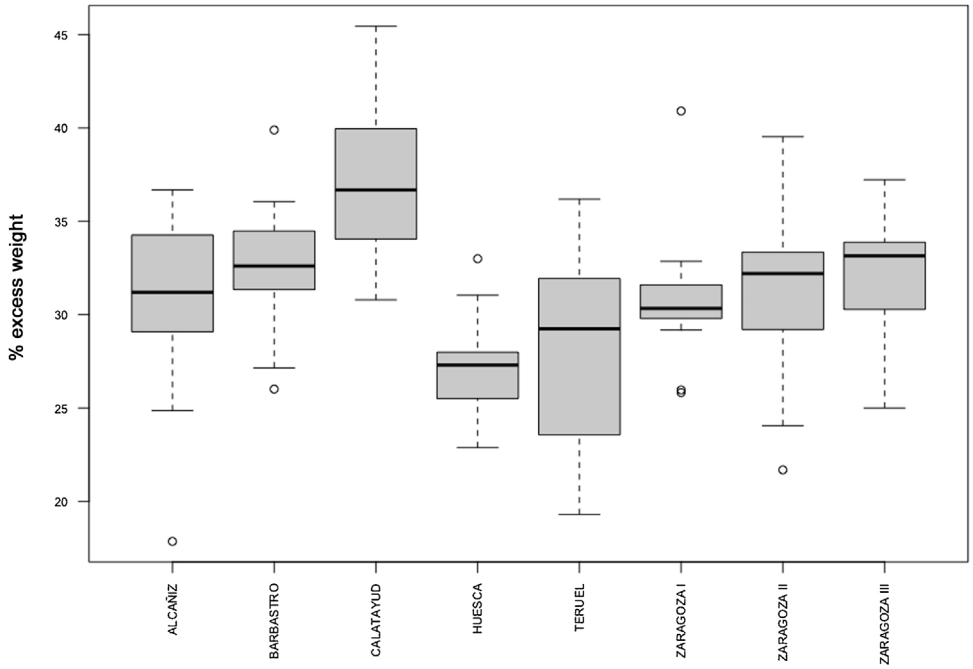

Figure 2 Excess weight by health care sector.

Aragon. Table 2 presents the prevalence by province and health care sector.

Fig. 1 shows the prevalence of EW and obesity by sex and age and the percentage of children whose records included an International Classification of Primary Care (ICPC) code for overweight or obesity by age. We found higher frequencies of EW and obesity in boys at every age except 2 years, with significant differences compared to girls at ages 6, 8, 9, 10, 11, 12, 13 and 14 years. The percentage of underdiagnosis in the health records was high at every age. In children under 6 years, fewer than 7% of patients with EW had a diagnostic code in the health record, and at age 13 years, the percentage was 34.8%.

By province, Zaragoza was the one with a significantly greater prevalence of obesity and EW ($P < .001$ for both). We found significant differences in the prevalence of EW between health care sectors, with a markedly greater prevalence in Calatayud and lesser prevalence in Huesca and Teruel (Fig. 2).

Overall, rural areas in Aragon had significantly higher prevalences of obesity ($P < .001$) and EW ($P < .05$). In the provinces of Zaragoza and Teruel, the observed prevalences of obesity and EW were significantly higher in rural areas, but we did not find significant differences based on the setting in the province of Huesca (Table 3). We also found no differences in prevalence comparing by HCD or health care sector.

We found a significant positive correlation between the DI and the overall prevalence of overweight (r = 0.18; $P < .05$), obesity (r = 0.43; $P < .001$) and EW (r = 0.4; $P < .001$) in the whole of Aragon. The linear regression model showed that socioeconomic factors are associated with the development of obesity. The DI explained 17.9% of the variance of obesity and 15.5% of the variance of EW (adjusted R^2, Table 4).

Table 3 Prevalence of overweight, obesity and excess weight by province, overall and in rural versus urban settings.

	Rural %	Urban %	*P*
HUESCA			
Overweight	17.27	17.38	.83
Overall obesity	12.18	13.0	.51
Excess weight	29.45	30.39	.10
ZARAGOZA			
Overweight	17.57	17.99	.11
Overall obesity	14.74	13.17	< .001*
Excess weight	32.31	31.16	.026*
TERUEL			
Overweight	17.61	16.74	.14
Overall obesity	13.67	12.09	< .001*
Excess weight	31.29	28.83	< .001*
ALL OF ARAGON			
Overweight	17.52	17.82	.14
Overall obesity	13.98	13.08	< .001*
Excess weight	31.49	30.91	.022*

P values calculated with the χ^2 test.
* significant.

When we compared the urban versus rural settings in Aragon overall, we found a strong and significant correlation in urban HCDs between the DI and obesity (r = 0.82; *P* < .001) and the DI and EW (r = 0.71; *P* < .001). In rural HCDs, the correlation coefficients were only 0.25 for obesity and 0.28 for excess weight (Table 4); and the linear regression model showed that in urban areas, the DI could explain up to 66.4% of the variance in obesity and 48.9% of the variance in EW (adjusted R^2), while these percentages were much smaller in rural areas (Table 4).

Discussion

In our study, we found high prevalences of obesity and EW in the paediatric population of Aragon, with differences between the sexes and a significantly higher prevalence in boys (Fig. 1). In addition, the prevalence of EW was clearly associated with the DI and was higher in areas with households of lower socioeconomic status.

The overall prevalence of EW (30.3%) was similar to the one found in our previous study limited to Sector II of Zaragoza (30.8%),[10] which is predominantly urban. However, we found that the prevalence of obesity had increased from 12.2% to 12.8% (*P* < .05) in only 5 years. While this is a short time span, and there has not been an overall increase in EW, this increase in the prevalence of obesity suggests that the situation continues to worsen as time goes by.

The correlation found between the DI and EW and obesity is particularly important. The variables with which the DI is obtained contribute information on aspects as relevant as education, employment, occupation and demographics, so this index holds information on the percentage of unemployment, temporary employment, insufficient education and foreign nationals in each HCD. In urban areas, the correlation was very strong, which corroborates the descriptions of other authors of the impact of socioeconomic factors not only on the prevalence of obesity, but also on its severity.[22,23] Although the aetiology of obesity is multifactorial, our findings support the hypothesis that these determinants of health need to be improved if we aim at reducing this important public health problem.

In rural areas, the correlation of the DI with EW and with obesity at the HCD level was not as high (Table 4), suggesting that there may be lifestyle, sociocultural, family or dietary factors that ameliorate the impact of health determinants on obesity. Living in rural areas may reduce sedentary habits and/or promote healthier dietary habits.

As was the case in our previous study,[10] we found an important under-recording of obesity in the health records. Although it decreased with increasing patient age, this under-recording probably reflects a minimization of EW as a health problem until it progresses to obesity. This is alarming, as underdiagnosis or delayed diagnosis probably entail a decreased likelihood of early preventive intervention. However, documentation in health records in the form of an ICPC code was significantly more frequent compared to our previous 2014 study (26.6% compared to 34.8% at age 13 years; *P* < .001), which may reflect a growing concern about the issue.

The large sample size of our study guarantees the reliability of its findings. Thus, we believe that the results constitute an adequate reference and could be used in the monitoring of in the paediatric population of the autonomous community of Aragon, in addition to allowing comparisons with other regions or countries.

One of the limitations of our study is that the DI data were from 2011 (more recent data were not available), and this variable may have changed since. In addition, the definitions of obesity and overweight are not homogeneous across studies in the literature, and there is no consensus on the standards to be used for reference, which may result in differences in the measurement of prevalence and hinder

Table 4 Correlation and results of regression analysis comparing obesity and excess weight with the deprivation index in Aragon, its provinces and their urban and rural settings.

		Correlation	*P*	B	IC 95%	*P*	Adjusted R^2
Aragon (n = 123)	Overweight	0.179	.048	0.46	0.004 a 0.925	.048	0.0239
	Overall obesity	0.432	< .001	1.41	0.879 a 1.938	< .001	0.1797
	Excess weight	0.404	< .001	1.87	1.109 a 2.637	< .001	0.1559
Rural Aragon (n = 76)	Overweight	0.188	ns				
	Overall obesity	0.251	.029	0.91	0.0925 a 1.728	.029	0.0497
	Excess weight	0.283	.013	1.51	0.3226 a 2.696	.014	0.0674
Urban Aragon (n = 47)	Overweight	0.264	ns				
	Overall obesity	0.819	< .001	2.07	1.635 a 2.503	< .001	0.6647
	Excess weight	0.708	< .001	2.41	1.686 a 3.130	< .001	0.4895
HUESCA (n = 29)	Overweight	−0.10	ns				
	Overall obesity	0.371	.048	1.25	0.0141 a 2.4891	.048	0.1056
	Excess weight	0.18	ns				
Rural Huesca (n = 22)	Overweight	−0.17	ns				
	Overall obesity	0.193	ns				
	Excess weight	0.014	ns				
Urban Huesca (n = 7)	Overweight	0.19	ns				
	Overall obesity	0.855	.014	2.13	0.6453 a 3.6213	.014	0.6771
	Excess weight	0.71	ns				
ZARAGOZA (n = 66)	Overweight	0.35	.005	0.66	0.2102 a 1.1036	.005	0.105
	Overall obesity	0.49	< .001	1.54	0.8604 a 2.2326	< .001	0.2287
	Excess weight	0.55	< .001	2.20	1.3737 a 3.0331	< .001	0.2946
Rural Zaragoza (n = 29)	Overweight	0.40	.03	0.99	0.1011 a 1.892	.03	0.1308
	Overall obesity	0.17	ns				
	Excess weight	0.36	ns				
Urban Zaragoza (n = 37)	Overweight	0.33	.04	0.42	0.0143 a 0.8289	.04	0.0867
	Overall obesity	0.83	< .001	2.12	1.6429 a 2.6016	< .001	0.6891
	Excess weight	0.74	< .001	2.54	1.7673 a 3.3206	< .001	0.5456
TERUEL (n = 28)	Overweight	0.26	ns				
	Overall obesity	0.38	.044	1.22	0.0359 a 2.4073	.044	0.1143
	Excess weight	0.40	.036	2.14	0.15 a 4.14	.036	0.1258
Rural Teruel (n = 25)	Overweight	0.28	ns				
	Overall obesity	0.34	ns				

ns, not significant.

comparisons between our results and those of other studies. At any rate, we believe that indicators of obesity and overweight should be based on reference standards such as those of the WHO, and we invite other authors to apply them.

The results of the study highlight the areas requiring more intense or urgent intervention, and the substantial underrecording warns of the need to create awareness among health care professionals. On the other hand, our results hinted at other factors yet unidentified that warrant continued investigation of this important health problem.

Conclusion

In Aragon, the prevalence of obesity and EW is high and could be increasing, which is a public health problem of utmost importance.

We found a strong correlation between EW and the socioeconomic characteristics of the family.

The correlation between EW and socioeconomic factors was stronger in urban settings.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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