Do we get fat because of air pollution? A new socio-economic approach

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Abstract

Air pollution and obesity are two of the main challenges that need to be addressed in developed countries. This paper analyses the relationship between obesity/overweight rates and outdoor (ambient) air quality in Spain. The results confirm, through logistic regressions, that the typical profile of an obese/overweight person is that of an older man. Air pollution does not have a clear negative effect on obesity/overweight for our sample selection (OR: 0.99; N = 23,089, men and women aged 15 and over). Similarly, there does not appear to be an urban pollution/obesity pattern. However, we find a detrimental effect for the group of elderly people, perhaps linked to a negative exposure duration effect (OR: 1.11; for those aged ≥55 years, N = 10,932). In our study we argue that public policies should address lifestyles and at the same time reduce specific air pollutants to enhance population health and wellbeing.

Keywords: Obesity, Overweight; Air quality; Logistic regressions, Spain.

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‘Not applicable’.

Declarations

Compliance with Ethical Standards

Ethics approval is not required for this paper, since we did not collect data with personal information. The paper is the result of research carried out independently by the authors. No plagiarism and no conflict of interest can be associated with this research.

Availability of data and material

All data can be obtained by contacting the corresponding author.

Conflict of interest

The authors declare that they have no conflicts of interest.

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Authors’ contributions

All the authors contributed to the writing of the manuscript and read and approved the final manuscript.

1. Introduction

Air pollution and obesity are two of the main challenges currently faced worldwide. They require new strategies and policies to improve the well-being of citizens, and entail expenditure and growth in the near future (Grecu and Rotthoff, 2015). The potential links between the two problems have received little attention, especially in Spain (Raftopoulou, 2017; O'Callaghan-Gordo et al., 2020).

Although there is no consensus in the empirical literature as to whether air pollution has an impact on body weight (for a more in-depth explanation see An et al. 2018), we take the idea as the theoretical background of this paper, as more studies in this field are needed.

Our objective is to analyse whether or not air pollution is significantly linked to obesity/overweight for Spanish adults. The hypotheses to be tested are: i) outdoor (ambient) air quality has a substantial, significant link with obesity/overweight in Spain; ii) demographic, socioeconomic, health and regional factors matter in obesity/overweight among individuals those aged 15 and over in Spain.

We are thus making a new contribution of interest to the existing applied health economics literature. The originality of our study is that we provide new highlights for obesity risk factors in a southern European country (Spain). Indeed, the strengths of the manuscript are the novelty of the topic and the data (we use the latest sample available).

2. Material and Methods

2.1. Data sample

The analysis reported here requires individual-level data. Our empirical study therefore uses microdata drawn from the latest Spanish National Health Survey (ENSE, 2017).

This survey provides information on health, socioeconomic and demographic characteristics of individuals and households. It also shares a group of harmonised variables with the European Health Survey. The original dataset contains information on approximately 37,500 households distributed across 2,500 censuses.

2.2. Measures

The sample comprises 23,089 individuals aged 15 and over. Table 1 defines the variables. As our dependent variable, we take *Obese*.

[Insert Table 1]

This outcome variable is modelled as a function of a range of demographic, socioeconomic, health and regional characteristics. Variables are selected based on previous empirical literature (Ventosa-Merino and Urbanos-Garrido, 2016; Raftopoulou, 2017; Hernandez-Yumar et al., 2018). The importance of air pollution is also studied.

2.3. Methodology

The econometric approach needs to take into account that the dependent variable *Obese* is dichotomic. Here, results are based on a logistic model, as follows:

$$Obese_i = \beta air\ pollution_i + X_i'\Gamma + \varepsilon_i\ , \qquad (1)$$

where X_i includes both the set of explanatory variables previously mentioned and a constant term, and ε is an error term. To ensure that they are understood in multidisciplinary terms, our empirical results are presented through Odds Ratios (OR).

2.4. Descriptive findings

Table 2 summarises the main descriptive statistics of the analytical sample used in our estimates. Fig. 1 shows the distribution of *Obese* when it takes a value of 1, whereas Fig. 2 shows the evidence for exposure to outdoor air pollution.

[Insert Table 2]

[Insert Fig.1]

[Insert Fig.2]

From this first approximation to our data, no air pollution-obesity pattern is observed.

3. Results

Table 3 presents the results for the full sample (n = 22,089), while whereas Table 4 focuses on older adults (those aged 55 and over, n = 10,932). Divergences by gender are contemplated in both tables. Thus, in each Table and for each subsample (males and females) Column 1 shows the OR and Column 2 presents confidence intervals at the 95% level.

[Insert Table 3]

The logistic regression results in Table 3 do not validate our main hypothesis that outdoor (ambient) air quality has a substantial, significant link with obesity/overweight in Spain. That is, the negative link between air pollution and overweight/obesity is not corroborated.

Living in rural areas seems to increase the probability of being overweight/ obese. This result is statistically significant for males. Individual demographic, socioeconomic and health characteristics also seem to explain obesity/overweight in Spain.

As expected, the greatest likelihood is obtained for elder men. Low socioeconomic status is also statistically significant and positively linked to overweight/ obesity. That is, individuals with lower income and/or lower education tend to exhibit higher levels of overweight and a greater probability of being obese. This income effect is also statistically significant for females (OR = 1.28; 95 % C.I. 1.14, 1.44).

The same goes for sedentary individuals, who have higher expected levels of overweight/obesity than non-sedentary individuals (OR = 1.26; 95 % C.I. 1.19, 1.33). By contrast, not cohabiting seems to be associated with lower levels of overweight/ obesity than living as a couple (OR = 0.84; 95 % C.I. 0.79, 0.89). As expected, nationality has no statistically significant effect.

The findings when the sample is split for those aged ≥ 55years (Table 4) are interesting, and show differences from the full sample and between genders.

[Insert Table 4]

It is important to highlight that for this subsample of older adults the negative link between air pollution and overweight/obesity is corroborated to some extent. The odds ratio of 1.11 means that the likelihood of overweight/obesity is 11% greater for responders whose households are exposed to air pollutants.

For this group, living in rural areas is not a statistically significant factor, and a sedentary lifestyle does not seem to be relevant for men. Our findings are just about unchanging in regard to age, cohabitation, nationality and/or socioeconomic status.

4. Discussion

In recent years there have been several studies on the risk factors for and consequences of obesity/overweight. Other authors have attributed a wide range of diseases and

adverse effects to the exposure of the population to poor air quality. An emerging claim has thus arisen concerning the need to reduce both the concentration of air pollutants and hazardous levels of exposure to them.

Regarding our initial hypothesis, we first show that there is no substantial, significant link between air pollution and obesity/overweight in Spain. Similar results have been found elsewhere (Zheutlin et al., 2014) and appears to be no urban pollution/obesity pattern. However, air pollution is found to have a detrimental effect on elderly people, perhaps linked to a negative exposure duration effect (Zhang et al, 2019).

Secondly, demographic, socioeconomic, health and regional factors are found to matter for obesity/overweight among those aged 15 and over in Spain. Our empirical results confirm that the typical profile of an obese/overweight person is an older man with low socioeconomic status who is sedentary and lives alone (Hernandez-Yumar et al., 2018).

We believe that our findings are consistent with those of studies that address the potential impact of air pollution on body weight (An et al., 2018).

5. Conclusion

This study analyses the main factors traditionally considered to explain obesity/overweight in Spain, i.e. socio-demographic factors and air pollution.

Our findings have powerful public health policy implications. Our study supports the notion that public intervention is needed to improve lifestyles and at the same time reduce specific air pollutants and boost the health and wellbeing of the population, particularly among disadvantaged groups such as older people.

However, our study has certain limitations. Although we have used microdata, it must be taken into account that the information is self-reported. Hence, recommendations and policy implications should be taken with caution. Finally, as an extension of this study it would be interesting to explore more air quality variables as data become available.

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Tables and Figures

Table 1

Description of variables

Variables		Description
Dependent variable	Obese	1 if overweight or obese, 0 otherwise
Demographic factors	Male	1 when male, 0 otherwise
	Age	Age in years
	Age^2	Square of age
	Not married or partnered	1 if not cohabiting, 0 otherwise
	Spanish	1 if Spanish nationality, 0 otherwise
Socioeconomic factors	Low education	1 if primary/lower than primary education, 0 otherwise
	Low income	1 if household monthly income is less than €800, 0 otherwise
Health-related behaviour factor	Sedentary lifestyle	1 if does not exercise & free time is spent almost completely in sedentary pursuits, 0 otherwise
Regional factors	Air pollution	1 if household is exposed to air pollutants, 0 otherwise
	Rural	1 if living in an area with fewer than 10,000 inhabitants

Source: Authors' own work.

Table 2

Descriptive statistics

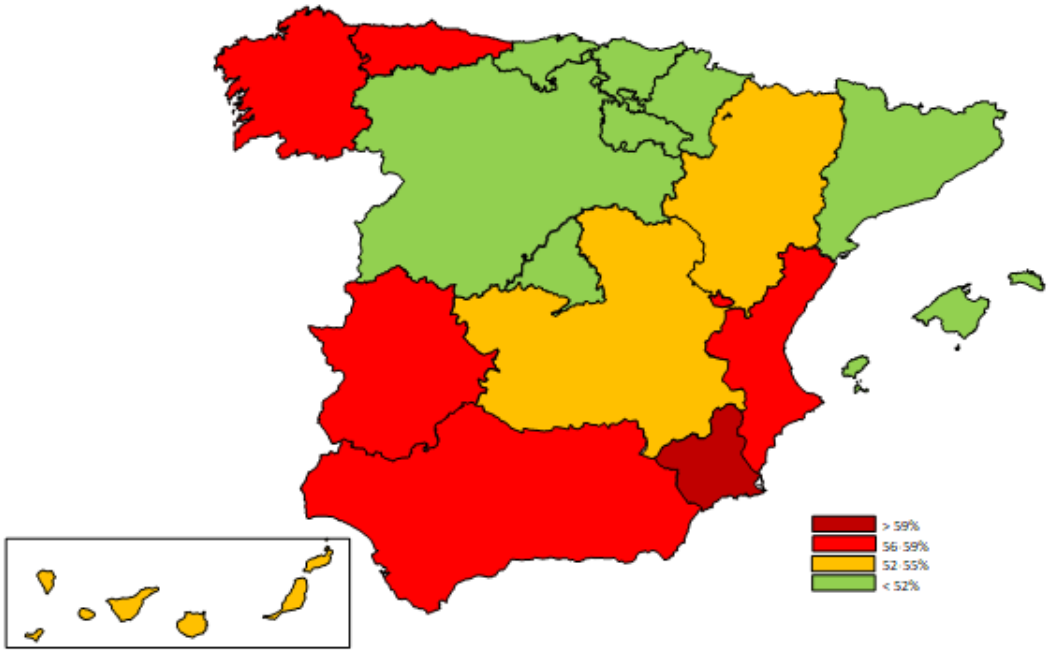
Variables		Full sample		Men		Women	
		Mean	%	Mean	%	Mean	%
Dependent variable	Obese		53.03		62.32		45.14
Demographic factors	Male		45.89				
	Age (range: 15-103)	54.43± 8.89		51.96± 18.16		54.69± 18.40	
	Not married or partnered		45.37		39.76		50.12
	Spanish		93.73		93.72		93.74
Socioeconomic factors	Low education		31.21		27.76		34.13
	Low income		12.26		9.90		14.25
Health-related behaviour factor	Sedentary lifestyle		38.45		33.79		42.40
Regional factors	Air pollution		15.28		15.30		15.24
	Rural		23.21		24.77		21.90

Source: Authors' own work.

Notes: 23,089 observations. 10,595 males and 12,494 females.

Fig. 1

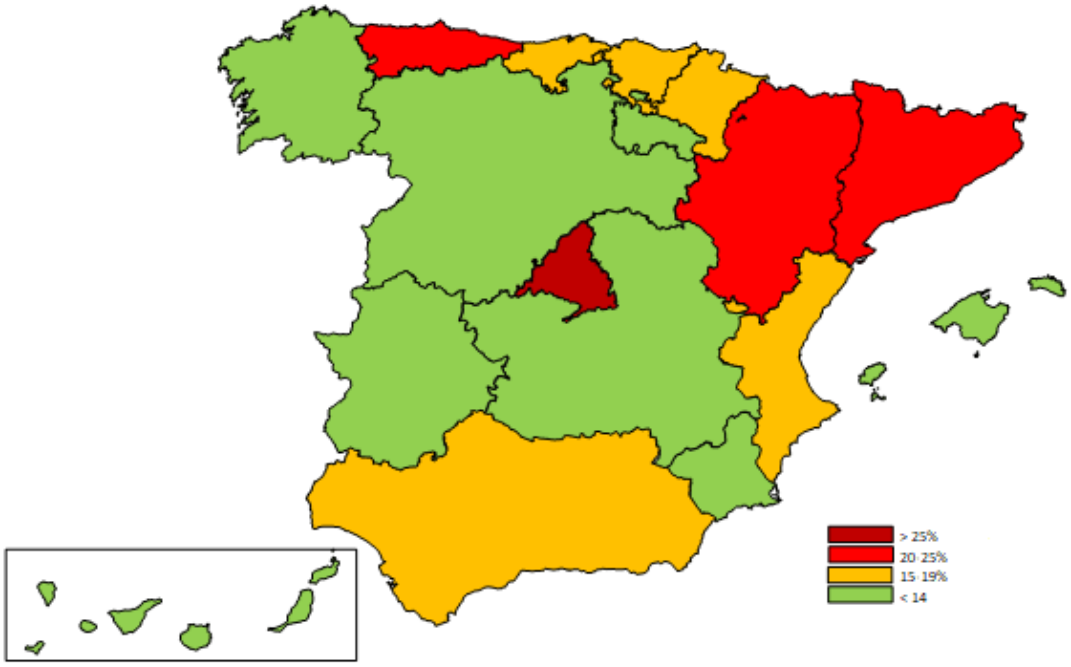
Distribution of *Obese* across Spanish regions



Source: Authors' own work.

Fig. 2

Distribution of *Air pollution* across Spanish regions



Source: Authors' own work.

Table 3

Logistic estimates

Variables		Full sample (n = 23,089)			Males (n = 10,595)			Females (n = 12,494)		
		OR	**95%CI**		**OR**	**95%CI**		**OR**	**95%CI**	
Demographic factors	Male	2.21	[2.09-2.34]	***						
	Age	1.11	[1.10-1.12]	***	1.13	[1.12-1.15]	***	1.10	[1.09-1.12]	***
	Age^2	1.00	[1.00-1.00]	***	1.00	[1.00-1.00]	***	1.00	[1.00-1.00]	***
	Not married or partnered	0.84	[0.79-0.89]	***	0.76	[0.70-0.84]	***	0.89	[0.82-0.96]	***
	Spanish	0.97	[0.86-1.09]		1.07	[0.90-1.27]		0.88	[0.76-1.03]	
Socioeconomic factors	Low education	1.45	[1.35-1.56]	***	1.15	[1.04-1.29]	***	1.76	[1.59-1.93]	***
	Low income	1.15	[1.05-1.26]	***	0.92	[0.80-1.06]		1.28	[1.14-1.44]	***
Health-related behaviour factor	Sedentary lifestyle	1.26	[1.19-1.33]	***	1.17	[1.08-1.28]	***	1.29	[1.20-1.40]	***
Regional factors	Air pollution	0.99	[0.92-1.07]		0.94	[0.84-1.06]		1.02	[0.92-1.14]	
	Rural	1.07	[1.00-1.14]	**	1.09	[0.99-1.20]	*	1.07	[0.98-1.17]	
	Constant	0.03	[0.02-0.04]	***	0.05	[0.04-0.07]	***	0.04	[0.03-0.06]	***

Notes: ***, ** and * indicate significance at 1%, 5% and 10%, respectively.

Table 4

Logistic estimates: population aged 55 or over

Variables		Full sample (n = 10,932)			Males (n = 4,720)			Females (n = 6,212)		
		OR	**95%CI**		**OR**	**95%CI**		**OR**	**95%CI**	
Demographic factors	Male	1.96	[1.80-2.13]	***						
	Age	1.21	[1.15-1.28]	***	1.18	[1.07-1.29]	***	1.23	[1.15-1.32]	***
	Age^2	1.00	[1.00-1.00]	***	1.00	[1.00-1.00]	***	1.00	[1.00-1.00]	***
	Not married or partnered	0.89	[0.81-0.97]	***	0.82	[0.72-0.95]	***	0.92	[0.81-1.03]	
	Spanish	1.19	[0.92-1.55]		1.37	[0.92-2.06]		1.07	[0.76-1.51]	
Socioeconomic factors	Low education	1.47	[1.35-1.61]	***	1.27	[1.10-1.46]	***	1.64	[1.46-1.85]	***
	Low income	1.13	[1.02-1.27]	**	0.95	[0.78-1.15]		1.22	[1.06-1.40]	***
Health-related behaviour factor	Sedentary lifestyle	1.19	[1.09-1.29]	***	1.00	[0.87-1.14]		1.30	[1.17-1.45]	***
Regional factors	Air pollution	1.11	[0.98-1.25]	*	1.11	[0.92-1.34]		1.09	[0.94-1.27]	
	Rural	1.00	[0.92-1.10]		1.02	[0.88-1.17]		1.02	[0.91-1.16]	
	Constant	0.00	[0.00-0.01]	***	0.01	[0.00-0.32]	***	0.00	[0.00-0.01]	***

Notes: ***, ** and * indicate significance at 1%, 5% and 10%, respectively.