

# BMJ Open Do adult obesity rates in England vary by insecurity as well as by inequality? An ecological cross-sectional study

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## ABSTRACT

**Objective:** Geographical variations in adult obesity rates have been attributed in part to variations in social and economic inequalities. Insecurity is associated with obesity at the cross-national level, but there is little empirical evidence to show that insecurity contributes to the structuring of adult obesity rates at the subnational level. This is examined in this study across local authorities in England, using a recently developed social classification for the British population.

**Setting:** Modelled obesity rates from the Health Survey for England 2006–2008 were related to social class (as estimated from the BBC's Great British Class Survey of 2011 and a nationally representative sample survey), across 320 local authorities in England.

## Primary and secondary outcome measures:

Comparisons of mean obesity rates across Z score categories for seven latent social classes were carried out using one-way analysis of variance. Pooled ordinary least square regression analyses of obesity rates by local authorities according to the proportion of different social classes within each of them were performed to determine the extent of geographical variations in obesity rates among the classes that were more greatly based on insecurity (emergent service workers, precariat), and those more closely based on inequality (elite, established middle class, technical middle class, new affluent workers, traditional working class).

**Results:** Adult obesity rates vary negatively across local authorities according to the proportion of people in the elite ( $F=39.06$ ,  $p<0.001$ ) and technical middle class ( $F=8.10$ ,  $p<0.001$ ) and positively with respect to the proportion of people of the established middle class ( $F=26.36$ ,  $p<0.001$ ), new affluent workers ( $F=73.03$ ,  $p<0.001$ ), traditional working class ( $F=23.00$ ,  $p<0.001$ ) and precariat ( $F=13.13$ ,  $p<0.001$ ). Social classes more closely based on inequality show greater association with adult obesity rates across local authorities than social classes more closely based on insecurity.

**Conclusions:** Both insecurity and inequality are associated with the geographical patterning of adult obesity rates across England.

## INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among

## Strengths and limitations of this study

- The geography of obesity in England may be associated with differing forms of deprivation in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class, including the National Statistics Socio-Economic Classification. While the study is based on data from the Health Survey for England, the modelled estimates of adult obesity rates by local authority combine data on men and women and it was not possible to test for gender effects in this analysis. Use of this data minimises selection bias on obesity rates.
- Six local authorities were excluded from analysis because numbers were too small to construct a distribution of social class by the new schema. These were rural local authorities which were likely to have had an enrichment of people of the precariat and traditional working class.
- The new social class schema adds the dimension of insecurity to social class analysis in Britain, which makes it attractive for examining the relationships between insecurity and obesity at a lower level than the cross-national one. The study shows that insecurity, in addition to inequality, is associated with the geographical patterning of adult obesity rates across England.

manual working classes than non-manual working classes.<sup>1–2</sup> Regional inequalities in obesity rates in England have also become established and persistent over recent decades,<sup>3–5</sup> and income inequality grew in some parts of the country and declined in others.<sup>6</sup> There are large regional variations in obesity in Britain,<sup>3–7</sup> which have been explained as being at least in part due to variations in proportions of the population of low social class across the country.<sup>8</sup> The geography of obesity in England may be associated with differing forms of deprivation<sup>8</sup> in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class,<sup>9</sup> including the National Statistics Socio-Economic

Classification (NS-SEC). The NS-SEC is based on employment relations, classifying at opposite ends of the spectrum occupations according to levels of trust, independent working practices and delegated authority, and occupations based on labour contracts with very little control.<sup>9</sup> Inequality affects health and well-being and influences obesity rates<sup>10</sup> by a number of related mechanisms, including effects of hierarchy, irrespective of income. One explanation for the higher rates of obesity among lower social classes in western societies is one of generally increased purchasing power, declines in food prices, and of the high energy density, low nutrient quality of food available to people of low socioeconomic status.<sup>11</sup> Others relate it to subordination stress<sup>12 13</sup> and economic and social insecurities of differing types.<sup>14 15</sup> The putative link is between insubordination stress and eating behaviour.<sup>13–16</sup>

Economic insecurity and economic inequality have been shown to be similarly associated with obesity among men and women at the cross-national level.<sup>14</sup> Economic insecurity can be characterised by the likely continued economic solvency of a person or population into the future, according to likelihood of continued employment, welfare provision, savings and pension, among others. Economic inequality is the variation between people or populations in their incomes and assets. The present analysis combines data on geographical variation in obesity rates among adults (men and women combined) in England in 2011–2012 with regional variation in social class according to the new schema of Savage *et al*<sup>17</sup> to examine the extent to which insecurity, as well as inequality, contributes to geographical variation in adult obesity rates in England.

## METHODS

Data on adult obesity by local authority come from the Health Survey for England (HSE) between 2006 and 2008,<sup>18</sup> and consists of a general population sample of 47 398 adults, representative of the whole population at both national and regional levels. These are model-based estimates of adult obesity rates at the local authority level for men and women combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health.<sup>18</sup> The analysis was guided by the social class mapping undertaken by Savage *et al*<sup>17</sup> at the local authority level. The model-based estimates of adult obesity rates are the only ones available at the local authority level for England. They combine data on men and women, and the author sought disaggregated data by local authority and gender from the modeller of the HSE data, but was informed that gender-based analyses had not been commissioned or undertaken (Peter Scarborough, personal communication). Thus it was not possible to test for gender effects.

The model of class was developed from the BBC's Great British Class Survey of over 160 000 respondents, complemented by a parallel national representative

survey, both carried out in 2011.<sup>17</sup> It is a parsimonious differentiation into social classes according to three forms of capital—economic, cultural and social—according to Bourdieu's<sup>19</sup> analysis of social position on the basis of different types of capital. Combining different forms of capital can bring new insights into variations of obesity rates according to social class.<sup>20 21</sup> The Savage *et al*<sup>17</sup> schema structures class differently from the NS-SEC. Latent class analysis is adopted by Savage *et al*<sup>17</sup> for clustering of six continuous variables: mean status scores of contacts, total number of contacts, highbrow cultural capital, emerging cultural capital, income and assets. Seven social class clusters were identified: the elite, who were 21.8% of the total survey sample, established middle class (43.3%), technical middle class (9.5%), new affluent workers (5.8%), traditional working class (1.6%), emergent service sector (17.3%) and precariat (0.7%). The social class map of Savage *et al*<sup>17</sup> expresses the proportion of each class in the sample by local authority as a Z score from the British average of the proportion of that class. This classification falls into five categories for the following classes: elite, established middle class, technical middle class, new affluent workers, and emergent service workers:  $-1.5$  or more,  $-0.5$  to less than  $-1.5$ , less than  $-0.5$  to less than  $0.5$ ,  $0.5$  to less than  $1.5$  and  $1.5$  or more. The Z score values for the traditional working class and precariat fall into four categories:  $-0.5$  or more, less than  $-0.5$  to less than  $0.5$ ,  $0.5$  to less than  $1.5$ , and  $1.5$  or more, because the proportions of these classes in the overall sample were small (1.6% and 0.7%, respectively). In the present analysis, each local authority was given a score according to Z score category for each social class, which was used as a dummy variable.

Of the 326 local authorities in England, six of them had numbers that were too small to construct a distribution of social class by the Savage *et al*<sup>17</sup> schema, and were excluded from the analysis. Obesity was classified as body mass index greater than  $30 \text{ kg/m}^2$ , and percentage rates of obese adults according to local authority were used as continuous variables. Comparisons of mean obesity rates across Z score categories for each of the seven social classifications were carried out and tested for statistical significance using one-way analysis of variance. Pooled ordinary least square regression analyses of obesity rates by local authority according to the proportion of different social classes within each of them were then performed. This was to determine the extent of geographical variation in obesity rates among the classes more greatly based on insecurity (emergent service workers, precariat), and those more closely based on inequality (elite, established middle class, technical middle class, new affluent workers, traditional working class). The Statistical Package for the Social Sciences V.20 was used for analysis.

## RESULTS

Obesity rates of adults vary across local authorities in England according to the proportion of people the

different social classes. The relationships are negative with respect to the proportion of people of the elite ( $F=39.06$ ,  $p<0.001$ ) and technical middle class ( $F=8.10$ ,  $p<0.001$ ), positive with respect to the proportion of people of the established middle class ( $F=26.36$ ,  $p<0.001$ ), new affluent workers ( $F=73.03$ ,  $p<0.001$ ), traditional working class ( $F=23.00$ ,  $p<0.001$ ) and precariat ( $F=13.13$ ,  $p<0.001$ ). The relationship is U shaped with respect to the proportion of people of the emergent service worker class ( $F=2.48$ ,  $p<0.05$ ; figure 1 and see online supplementary appendix tables 1.1–1.7).

Table 1 gives results of pooled ordinary least square regression of obesity rates by local authority according to the proportions of the different social classes in each authority. As many of the social class variables were correlated with each other (eg, local authorities with high proportions of new affluent workers also had high proportions of the traditional working class), the regression analysis incorporated tests of multicollinearity. In all cases, tolerances were above 0.20 and variance inflation factors below 5, indicating that there was no significant multicollinearity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker<sup>22</sup> similarly found an absence of significant multicollinearity when using composite measures of socioeconomic status together with education and occupation. The relative strength of association of each variable is indicated by the standardised  $\beta$  coefficients, and is the variable of interest, although the unstandardised regression coefficients are also intuitively meaningful. Including all social classes in the model (model 1), variation in adult obesity across local authorities is positively and most strongly associated with variations in the proportion of the population in a local authority that is of the new affluent worker class, followed by the proportions of the population of the established middle class and the traditional working class. Separating the classes into those more greatly based on insecurity

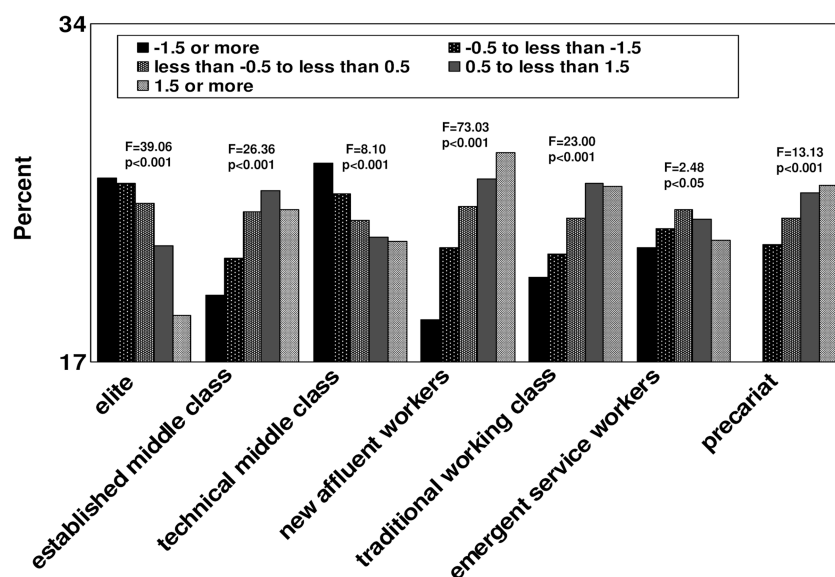
(emergent service workers, precariat), and those more closely based on inequality (elite, established middle class, technical middle class, new affluent workers, traditional working class; models 2 and 3) shows variation in adult obesity rates across local authorities to be positively associated with variation in the proportions of the population in a local authority that are of the established middle class, new affluent workers or traditional working class (model 2). Model 3 shows, to a greater extent, the relationship between insecurity and adult obesity. The model explains a much smaller proportion of total variance in adult obesity rates across regions, but remains statistically significant. The proportion of the precariat is positively associated with adult obesity rates, while the proportion of emergent service workers is not.

## DISCUSSION

At the cross-national level, both economic insecurity and inequality have been shown to be associated with obesity,<sup>14 23 24</sup> and the present study takes this analysis to the lower level of within-country comparison of social class and obesity rates across local authorities. It shows that geographical variation in adult obesity rates in England can, in part, be attributed to variations in social class based on insecurity as well as inequality.

Employment relations remain very important to structuring socioeconomic position,<sup>25</sup> but the nature of employment has changed in recent decades. With increasing mechanisation and adoption of technology into many occupations, it has become more difficult to segregate manual from non-manual occupations. At the upper extreme of socioeconomic position, there has been a growth of high-income individuals who have collectively commanded a greater proportion of overall income and wealth in England in the 2000s than in the 1980s.<sup>26</sup> They remain the most economically secure section of the population by far. At the lower end of

**Figure 1** Obesity rates of adults (men and women combined) 2006–2008 by different social class categories, as determined from social, cultural and economic capital.<sup>17</sup>



**Table 1** Ordinary least square regression of obesity rates by local authority according to proportion of different social classes therein

Model Variables	1			2			3		
	B	$\beta$	T-statistic	B	$\beta$	T-statistic	B	$\beta$	T-statistic
Elite	−0.117	−0.036	−0.551	−0.168	−0.052	−0.904			
Established middle class	0.633	0.181	3.477***	0.606	0.173	3.571***			
Technical middle class	−0.087	−0.024	−0.551	−0.096	−0.027	−0.621			
New affluent workers	1.343	0.433	7.106***	1.399	0.452	7.664***			
Traditional working class	0.622	0.182	3.968***	0.626	0.184	4.035***			
Emergent service workers	0.014	0.004	0.084				−0.021	−0.006	−0.116
Precariat	0.235	0.066	1.507				1.170	0.329	6.087***
Constant	16.712		9.160***	17.313		13.048***	21.884		35.213***
Observations	320			320			320		
Adjusted R <sup>2</sup>	0.50***			0.51***			0.11***		

\*\*\*p&lt;0.001, \*\*p&lt;0.01, \*p&lt;0.05.

Model 1: all social classes; model 2: social classes more greatly based on inequality (elite, established middle class, technical middle class, new affluent workers, traditional working class); model 3: social classes more greatly based on insecurity (emergent service workers, precariat).

socioeconomic position, service workers with poor work security and a precariat that suffers not only from job insecurity but also identity insecurity and lack of time control<sup>27</sup> have emerged. There is a new elite class, whose wealth separates them from an established middle class, a class of technical experts and another of new affluent workers. In addition to an ageing traditional working class, there is a precariat characterised by very low levels of capital of all kinds, and a class of emergent service workers, whose work security is low.

The relationships between obesity and the new social class schema are negative with respect to the proportion of people of the elite and technical middle class, positive with respect to the proportion of people of the established middle class, new affluent workers, traditional working class and precariat. The relationship is U shaped with respect to the proportion of people of the emergent service worker class. The technical middle class differs from the established middle class with respect to economic capital (much higher), but is distinguished above all by its relative social isolation and cultural apathy. It is enriched by people doing research, scientific and technical forms of work with graduates from established and prestigious universities with strong reputations for science,<sup>17</sup> as compared with the established middle class that has an enrichment of people in the professions or management. This might suggest that economically secure, scientifically educated individualism may therefore be protective against obesity.

The relationships of obesity with classes more closely based on inequality (elite, established middle class, technical middle class, new affluent workers, traditional working class) by the Savage *et al*<sup>17</sup> schema show similar results to associations made with the NS-SEC indicators, although the r squared value is lower (adjusted R<sup>2</sup>: 0.51<sup>17</sup>; 0.69 (NS-SEC)). The value of using the Savage *et al*<sup>17</sup> schema is that it reveals the relationship between insecurity and adult obesity, which the NS-SEC cannot.

The geography of obesity is associated with differing forms of deprivation between postindustrial and more rural areas,<sup>8</sup> as well as differences in the proportions of people of different socioeconomic positions.<sup>3</sup> While complex,<sup>8</sup> the distribution of adult obesity in England can be a little better understood when a measure of insecurity is incorporated into analysis of social class and obesity.

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**Data sharing statement** The author has full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Appendix Table 1.1. Obesity rates of adults (males and females combined) 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Elite:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	13	26.22	1.82
2	-0.5 to less than -1.5	64	25.96	2.76
3	Less than -0.5 to less than 0.5	117	24.96	2.29
4	0.5 to less than 1.5	105	22.83	2.63
5	1.5 or more	21	19.34	3.11
	Total	320	24.15	3.09
ANOVA	F		39.06	
Significance: p			<0.001	
Scheffe test: post-hoc differences			1v4 (p<0.001) 1v5(p<0.001) 2v4 (p<0.001) 2v5 (p<0.001) 3v4 (p<0.001) 3v5 (p<0.001) 4v5 (p<0.001)	

Most represented occupations in this class: Chief executive officers, IT and telecommunications directors, marketing and sales directors, functional managers and directors, barristers and judges, financial managers, dental practitioners, advertising and public relations directors

Appendix Table 1.2. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Established middle class:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	25	20.34	3.75
2	-0.5 to less than 1.5	52	22.24	2.60
3	Less than -0.5 to less than 0.5	151	24.57	2.60
4	0.5 to less than 1.5	90	25.58	2.57
5	1.5 or more	2	24.65	1.77
	Total	320	24.15	3.09
ANOVA	F		26.36	
Significance p			p<0.001	
Scheffe test: post-hoc differences			1v3 (p<0.001) 1v4(p<0.001) 2v3 (p<0.001) 2v4 (p<0.001)	

Most represented occupations in this class: Electrical engineers, occupational therapists, midwives, environmental professionals, police officers, quality assurance and regulatory professionals, town planning officials, special needs teaching professionals

Appendix Table 1.3. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Technical middle class:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	14	26.98	2.99
2	-0.5 to less than 1.5	47	25.47	2.51
3	Less than -0.5 to less than 0.5	149	24.13	3.17
4	0.5 to less than 1.5	100	23.26	2.95
5	1.5 or more	10	23.08	1.11
	Total	320	24.15	3.09
ANOVA	F		8.10	
Significance p			<0.001	
Scheffe test: post-hoc differences			1v3 (p<0.05) 1v4(p<0.001) 1v5 (p<0.05) 2v4 (p<0.01)	

Most represented occupations in this class: medical radiographers, aircraft pilots, pharmacists, higher education teachers, natural and social science professionals, physical scientists, senior professionals in education establishments, business, research, and administrative positions



Appendix Table 1.4. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

New affluent workers:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	33	19.12	2.74
2	-0.5 to less than 1.5	75	22.75	2.42
3	Less than -0.5 to less than 0.5	125	24.79	1.91
4	0.5 to less than 1.5	77	26.18	2.15
5	1.5 or more	10	27.53	3.44
	Total	320	24.15	3.09
ANOVA	F		73.03	
Significance p			<0.001	
Scheffe test: post-hoc differences			1v2 (p<0.001) 1v3(p<0.001) 1v4 (p<0.001) 1v5 (p<0.001) 2v3 (p<0.001) 2v4(p<0.001) 2v5 (p<0.001) 2v4 (p<0.01) 2v5 (p<0.001) 3v4(p<0.001) 3v5 (p<0.01)	

Most represented occupations in this class: electricians and electrical fitters, postal workers, plumbers and heating and ventilation engineers, sales and retail assistants, housing offices, kitchen and catering assistants, quality assurance technicians

Appendix Table 1.5. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Traditional working class:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	15	21.25	3.74
2	-0.5 to less than 1.5	83	22.42	3.09
3	Less than -0.5 to less than 0.5	126	24.25	2.57
4	0.5 to less than 1.5	89	25.96	2.42
5	1.5 or more	8	25.83	2.55
	Total	321	24.15	3.09
ANOVA	F		23.00	
Significance p			<0.001	
Scheffe test: post-hoc differences			1v3 (p<0.01) 1v4(p<0.001) 1v5 (p<0.01) 2v3 (p<0.001) 2v4(p<0.001) 2v5 (p<0.05) 3v4(p<0.001)	

Most represented occupations in this class: medical secretaries, legal secretaries, electrical and electronic technicians, cleaners, electricians, residential, day, and domiciliary carers

Appendix Table1.6. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Emergent service workers:			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-1.5 or more	14	22.76	2.37
2	-0.5 to less than 1.5	86	23.70	2.88
3	Less than -0.5 to less than 0.5	139	24.65	3.09
4	0.5 to less than 1.5	68	24.18	3.48
5	1.5 or more	13	23.11	2.14
	Total	320	24.15	3.09
ANOVA	F		2.48	
Significance p			<0.05	
Scheffe test: post-hoc differences			none	

Most represented occupations in this class: bar staff, chefs, nursing auxiliaries and assistants, assemblers and routine operatives, care workers, elementary storage occupations, customer service occupations, musicians

Appendix Table 1.7. Obesity rates of adults 2006-08 by different social class categories as determined from social, cultural and economic capital (Savage et al, 2013).

Precariat;			% obese	
Category	Z score	Number of local authorities	Mean	SD
1	-0.5 or more	107	22.91	3.40
2	Less than -0.5 to less than 0.5	126	24.22	3.07
3	0.5 to less than 1.5	71	25.49	1.89
4	1.5 or more	16	25.86	2.06
	Total	320	24.15	3.09
ANOVA	F		13.13	
Significance p			<0.001	
Scheffe test: post-hoc differences			1v2 (p<0.01) 1v3(p<0.001) 1v4 (p<0.01) 2v3 (p<0.05)	

Most represented occupations in this class: cleaners, carpenters and joiners, caretakers, leisure and travel service occupations, shopkeepers and proprietors, retail cashiers