

# Variation in adult obesity rates in England by the new social class schema

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#### Variation in adult obesity rates in England by the new social class schema Stanley J. Ulijaszek Professor of human ecology Institute of Social and Cultural Anthropology **University of Oxford** 51 Banbury Road **Oxford OX2 6PF** UK Stanley.ulijaszek@anthro.ox.ac.uk Short title: Obesity, inequality and insecurity

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# Strengths and limitations of this study

This study uses nationally representative data and shows insecurity as well as inequality to be associated with the geographical patterning of adult obesity rates across England.

The proportion of the middle classes resident within any local authority have both positive and negative associations with obesity rates, according to whether they are established middle class, or the recently emergent technical middle class.

Although variation in proportions of people of non-dominant ethnicity across local authorities is unlikely to influence the overall results and interpretation of this analysis, ethnicity may be an important factor in the obesity rates found in local authorities with high proportions of emergent service workers.

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#### INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among manual working classes than non-manual working classes (1.2). Regional inequalities in obesity rates in England have also become established and persistent across recent decades (3.4.5). Although inequalities in equivalent income did not change overall between 1995-7 to 2006-8, London and the Southwest, the Northeast, and Yorkshire saw increased income inequality, while the Midlands (East and West), the East and South East of England saw declines in income inequality (6). There are large regional variations in obesity in Britain (3,7), which have been explained as being at least in part due to variation in proportions of the population of low social class across the country (2new Moon et al 2007). The geography of obesity in England may be associated with differing forms of deprivation (8), and this may not be totally captured by the most commonly used measures of social class (9), 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, to occupations based on labour contracts with very little control (9). Inequality affects health and well-being and influences obesity rates (10) by a number of related mechanisms. One explanation for the higher rates of obesity among lower social classes in western societies has 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 (11). Others relate it to subordination stress (12.13) and economic and social insecurities of differing types (14,15). The putative link is between insubordination stress and eating behaviour (13,14, 15,16).

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Employment relations remain very important to structuring socioeconomic position (17), 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 (18). They are less likely to be found in the North East, North West, Yorkshire and Humberside, East Midlands, West Midlands and the South West, and more likely to be found in the East and South East of England, and especially London (18). They remain the most economically secure section of the population by far. At the lower end of socio-economic position, service workers with poor work security, and a precariat that not only suffers from job insecurity but also identity insecurity and lack of time control (19) have emerged. Both economic insecurity and inequality have been shown to be associated with obesity at the cross-national level (20), and the present analysis combines data on geographical variation in obesity rates among adults in England in 2011-2012 with regional variation in social class according to the new schema of Savage et al (21) 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 2006-2008 (22), and was a general population sample of 47,398 adults, representative of the whole population at both national and regional level. These are model-based estimates of adult obesity for males and females combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health. The 2001 Census provided the main source of demographic and social covariate data. Other routine sources of data providing area-

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level characteristics for local authorities included all age-all cause mortality, diversity index, life expectancy, emergency hospital admissions, hospital admissions attributable to alcohol, job seekers allowance claimant counts and educational attainment. The model outputs were applied in conjunction with covariate data (available for all local authorities) to estimate the expected prevalence given the characteristics of the area. The modelbased estimate generated for a particular area is the expected measure for that area based on its population characteristics, and does not provide an estimate of the actual prevalence. As such, the estimates are unable to take account of any additional local factors that may impact on the true prevalence rate, such as local initiatives designed to reduce obesity rates. These estimates are not comparable between years, were developed solely for local authorities and cannot be translated onto any other geographical boundary system.

Social class data came from maps of the seven latent classes, published by Savage et al (21). This 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 (21). It is a parsimonious differentiation into social classes according to three forms of capital - economic, cultural and social – according to Bourdieu's (23) analysis of social position according to different types of capital. Combining different forms of capital can bring new insights into variation of obesity rates according to social class (24,25). The Savage et al (21) schema structures class differently to the NS-SEC. 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. This schema of socio-economic position is the only one in the UK that allows insecurity, as well as inequality, to be mapped (9). The social

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class map of Savage et al (21) expresses each class as a Z score from the British average, according to local authority. 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 technical 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. 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 (21) schema, and were excluded from the analysis. These were rural local authorities in Lincolnshire, Lancashire and Devon which are likely to have an enrichment of people of the precariat and traditional working class. Obesity was classified as body mass index greater than 30kg per meter squared, and percentage rates of obese adults according to local authority were used as continuous variables. Obesity data were available only for males and females combined, and analyses were carried out on this basis, although it is very likely that there are important gender differences to be found. 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 squares 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 version 20 was used for analysis.

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### 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 energent service worker class (F=2.48, p<0.05) (Table 1.1-7).

Table 2 gives results of pooled ordinary least squares 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 (for example, 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 multicollinarity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker (26) 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 standardized *beta* coefficients, and is the variable of interest, although the unstandardardised 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

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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 (14,20), 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 variation in social class based on insecurity as well as inequality. The relationships 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

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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 (21), 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.

New affluent workers largely come from non-middle class families and few have been to university (21), and it is likely that they are similar in social background to the traditional working class, only younger on average. They include people of the following professions: electricians, postal workers, plumbers, and heating and ventilation engineers. They have fewer savings and higher income than the traditional working class, but have house values that are similar to them (21). It is perhaps unsurprising that adult obesity rates are higher in the local authorities that have higher proportions of this class, as with the traditional working class. The U-shaped relationship between obesity rates and proportions of emergent service workers in local authorities may influenced by data from those authorities where high proportions of this class are accompanied by high or middling proportions of the elite and technical middle classes (for example, Lincoln, Tower Hamlets, Bright and Hove, Newcastle, and York). The new affluent workers and traditional working class are similar in social background, the former being younger. The former have fewer savings and higher income than the traditional working class, but have house values that are similar to them (21). The established middle class is a provincial formation, residing mostly outside of the Southeast of England and mainly away from large towns or urban environments. Their rural presence goes some way to explaining the high obesity rates in rural local authorities such as Tamworth, Swale, and Nuneaton and Bedworth. The precariat class is insecure and is enriched with care workers, as well as with cleaners, shopkeepers, and retail cashiers, but with a proportion of people of ethnic minority that is

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similar to all classes apart from emergent service workers, and the elite (among whom the proportion is low). Local authorities with above average proportions of the precariat are both urban and rural, and have significantly higher rates of obesity than those with average or below average proportions of them. Local authorities with the highest concentrations of the precariat include Leicester, Lincoln, West Lindsey, Ashfield, Doncaster, East Northamptonshire, Sunderland, Bolton, mid Devon and Stoke-on-Trent. Local authorities that have concentrations of both the established middle class and the precariat include Thurrock, Great Yarmouth, Weymouth and Portland, Tameside, Burnley and Newcastle under Lyme, half of which are rural, the other half, urban..

The geography of obesity is associated with differing forms of deprivation between postindustrial and more rural areas (8), as well as differences in the proportions of people of different socio-economic position (3). While complex (8), 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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The author constructed the database from existing databases, designed the study, undertook the analysis, interpreted the results and drafted the article.

There were no competing interests.

Ethics approval was not required.

No funding, other than the salary of the author from University of Oxford, was required.

The decision to submit the article for publication was totally that of the author.

The author was independent from funders.

The author had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

The author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Data sharing: full dataset available from the author.

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1	-0.5 or more	107	22.91	3.40	d from http eur (ABES) d data mini
2	Less than -0.5 to less than 0.5	126	24.22	3.07	//bmjopen.  ng, Al train
3	0.5 to less than 1.5	71	25.49	1.89	bmj.com ing, and
4	1.5 or more	16	25.86	2.06	/ on Jur
	Total	320	24.15	3.09	ne 10, 21 technol
ANOVA	F		13.13	, I	025 at Age ogies.
Significance p			< 0.00	1	ence
Scheffe test: post-hoc differences			1v2 (p<0.01) 1v3(p<0.001) 1v4 (p<0.01) 2v3 (p<0.05)		Bibliographic

Page 23 of 27

7 BMJ Open Table 2. Ordinary least squares regression of obesity rates by local authority according to proportion of different social classes therein.

Model		1			2			ıy 2014. hSeigner es relate	
	В	beta	T statistic	В	beta	T statistic	В	Download ment Sup d Bo text a	T statistic
Variables								ded fro erieur ( and dat	
Elite	-0.117	-0.036	-0.551	-0.168	-0.052	-0.904		n http ABES a min	
Established middle class	0.633	0.181	3.477***	0.606	0.173	3.571***		://bmjo ) . ing, Al t	
Technical middle class	-0.087	-0.024	-0.551	-0.096	-0.027	-0.621		pen.bmj raining,	
New affluent workers	1.343	0.433	7.106***	1.399	0.452	7.664***		and sim	
Traditional working class	0.622	0.182	3.968***	0.626	0.184	4.035***		i June 1 ilar tecl	
Emergent service workers	0.014	0.004	0.084				-0.021	0, 2025 a 1000logie:	-0.116
Precariat	0.235	0.066	1.507				1.170	0.329 <b>Ag</b>	6.087***
Constant	16.712		9.160***	17.313		13.048***	21.884	ance Bibl	35.213***
Observations		320		320					
Adjusted R-squared		0.50***			0.51***			0.11 <b>0</b> *	

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

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# Variation in adult obesity rates in England by the new social class schema

# Stanley J. Ulijaszek

#### **Reporting checklist**

### Title and abstract

1a The study's design is indicated with a commonly used term in the title

1b Abstract gives an informative and balanced summary of what was done and what was found

### Introduction

Background and rationale

2 scientific background and rationale of investigation is explained

#### Objectives

3 specific objectives are explained

#### Methods

Study design

4 key elements of study design explained early in the paper

#### Setting

5 The setting is described giving relevant dates and databases used

### Participants

# **BMJ Open**

6	Not applicable: eligibility criteria and and selection criteria given in publications
asso	ciated with primary databases used for this analysis
Varia	bles
7	All outcomes, predictors and potential confounders described
Data	sources
8	Sources of data and details of measurement given for each variable interest
Bias	
9	Efforts to address potential sources of bias described
Stud	y size
10	Explanation of how study size was arrived at is given
Quar	ntitative variables
11	The way in which quantitative variables are handled in the analysis is explained
Statis	stical methods
12	a) All statistical methods are described
	b) Methods used to examine subgroups and interactions are described
	c) Explanation given of how missing data were addressed
	d) Sampling strategy considered in publication of original databases
Resu	ılts
Part	icipants
13	Not applicable, since aggregated data used from collated published databases

14 Characteristics of study groups given

#### Outcome data

15 Summary measures reported

### Main results

- 16 a) Unadjusted estimates given
  - b) Category boundaries reported

#### Other analyses

17 No other analyses done

#### Discussion

Key results

18 Key results summarised with reference to study objectives

#### Limitations

19 Limitations of the study discussed

#### Interpretation

20 Cautious overall interpretation of results given, considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence

#### Generalisability

21 Generalisability of the study results discussed

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# Other information

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

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Keywords:	EPIDEMIOLOGY, SOCIAL MEDICINE, PUBLIC HEALTH



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

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#### Short title: Obesity, inequality and insecurity

#### Abstract

# Objectives

Geographical variation in adult obesity rates have been attributed to variation in social and economic inequality. Insecurity is associated with obesity at cross-national level, but there is little empirical evidence to show that insecurity contributes to the structuring of adult obesity rates at the sub-national 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 2006-8 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 squares regression analyses of obesity rates by local authority according to the proportion of different social classes within each of them were performed 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).

# 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.

# 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 (NS-SEC). While the study is based on data from the Health Survey for England, the modelled estimates of adult obesity rates by local authority do not disaggregate by gender. 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.

 

#### INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among manual working classes than non-manual working classes (1,2). Regional inequalities in obesity rates in England have also become established and persistent across recent decades (3,4,5), income inequality grew in some parts of the country and declined in others (6). There are large regional variations in obesity in Britain (3,7), which have been explained as being at least in part due to variation in proportions of the population of low social class across the country (8). The geography of obesity in England may be associated with differing forms of deprivation (8) in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class (9), 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, to occupations based on labour contracts with very little control (9). Inequality affects health and well-being and influences obesity rates (10) 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 has 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 (11). Others relate it to subordination stress (12, 13) and economic and social insecurities of differing types (14, 15). The putative link is between insubordination stress and eating behaviour (13, 14, 15, 16).

Both economic insecurity and economic inequality have been shown to be similarly associated with obesity among males and females at the cross-national level (14). Economic insecurity can be characterised by the likely continued economic solvency of a person or

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#### **BMJ Open**

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 (males and females combined) in England in 2011-2012 with regional variation in social class according to the new schema of Savage et al (17) 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 2006-2008 (18), and was a general population sample of 47,398 adults, representative of the whole population at both national and regional level. These are model-based estimates of adult obesity rates at the local authority level for males and females combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health (18). The analysis was guided by the social class mapping undertaken by Savage et al (17) 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 males and females, thus making it impossible to disaggregate the extent to which inequality and insecurity relate differently to obesity by gender. 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 nor undertaken (Peter Scarborough, personal communication).

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Social class data came from maps of distribution of seven latent social classes by local authority, published by Savage et al (17). This 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 (17). It is a parsimonious differentiation into social classes according to three forms of capital - economic, cultural and social - according to Bourdieu's (19) analysis of social position according to different types of capital. This schema of socio-economic position is the only one in the UK that allows insecurity, as well as inequality, to be mapped (9). Combining different forms of capital can bring new insights into variation of obesity rates according to social class (20, 21). The Savage et al (17) schema structures class differently to the NS-SEC. Latent class analysis is adopted by Savage et al (17) 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: elite, who were 21.8% of the total survey sample, established middleclass (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 (17) 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 (17) schema, and were excluded from the analysis. These were rural local authorities in Lincolnshire, Lancashire and Devon which are likely to have an enrichment of people of the precariat and traditional working class. Obesity was classified as body mass index greater than 30kg per meter squared, and percentage rates of obese adults according to local authority were used as continuous variables. Obesity data were available only for males and females combined, and analyses were carried out on this basis, although it is very likely that there are important gender differences to be found. 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 squares 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 version 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 Appendix Table 1.1-7).

Table 1 gives results of pooled ordinary least squares 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 (for example, 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 multicollinarity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker (22) 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 standardized beta coefficients, and is the variable of interest, although the unstandardardised 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

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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 (14, 23, 24), 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 variation in social class based on insecurity as well as inequality.

Employment relations remain very important to structuring socioeconomic position (25), 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 socio-economic 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 (26). They remain the most economically secure section of the population by far. At the lower end of socio-economic position, service workers with poor work security, and a precariat that not only suffers from job insecurity but also identity insecurity and lack of time control (27) have emerged. There is a new elite class, whose wealth separates them from an established middle class, a class of

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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 (17), 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 schema (17) shows similar results to associations made with the NS-SEC indicators, although the r squared value is lower (adjusted R square: 0.51 (Savage et al); 0.69 (NS-SEC)). The value of using the Savage et al (17) schema is that it reveals the relationship between insecurity and adult obesity, which the NS-SEC cannot.

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New affluent workers largely come from non-middle class families and few have been to university (17), and it is likely that they are similar in social background to the traditional working class, only younger on average. It is perhaps unsurprising that adult obesity rates are higher in the local authorities that have higher proportions of this class, as with the traditional working class. The U-shaped relationship between obesity rates and proportions of emergent service workers in local authorities may influenced by data from those authorities where high proportions of this class are accompanied by high or middling proportions of the elite and technical middle classes. The new affluent workers and traditional working class are similar in social background, the former being younger. The former have fewer savings and higher income than the traditional working class, but have house values that are similar to them (17). The established middle class is a provincial formation, residing mostly outside of the Southeast of England and mainly away from large towns or urban environments. Their rural presence goes some way to explaining the high obesity rates in some rural local authorities. The precariat class is insecure and is enriched with cleaners, carpenters and joiners, caretakers, shopkeepers and retail cashiers, but with a proportion of people of ethnic minority that is similar to all classes apart from emergent service workers, and the elite (among whom the proportion is low). Local authorities with above average proportions of the precariat are both urban and rural, and have significantly higher rates of obesity than those with average or below average proportions of them.

The geography of obesity is associated with differing forms of deprivation between post-industrial and more rural areas (8), as well as differences in the proportions of people of different socio-economic position (3). While complex (8), 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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The author constructed the database from existing databases, designed the study, undertook the analysis, interpreted the results and drafted the article.

There were no competing interests.

Ethics approval was not required.

No funding, other than the salary of the author from University of Oxford, was required.

The decision to submit the article for publication was totally that of the author.

The author was independent from funders.

The author had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

The author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Data sharing: full dataset available from the author.

.en the author. Table 1. Ordinary least squares regression of obesity rates by local authority according to proportion of different social classes therein.

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Footnote: 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). ***p<0.001, **p<0.01, *p<0.05

Model		1			2			3	
Variables	В	beta	T statistic	В	beta	T statistic	В	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	-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- squared		0.50***			0.51***			0.11***	

1		
2	1	
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# 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 (NS-SEC). While the study is based on data from the Health Survey for England, the modelled estimates of adult obesity rates by local authority do not disaggregate by gender. 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. Theis study shows uses nationallyrepresentative data and shows that insecurity, in addition to as well as inequality, isto be associated with the geographical patterning of adult obesity rates across England.

The proportion of the middle classes resident within any local authority have both positive and negative associations with obesity rates, according to whether they are establishedmiddle class, or the recently emergent technical middle class. **BMJ Open** 

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Ithough variation in proportions of people of non-dominant ethnicity across local-
uthorities is unlikely to influence the overall results and interpretation of this analysis,
hnicity may be an important factor in the obesity rates found in local authorities with high
oportions of emergent service workers.

### INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among manual working classes than non-manual working classes (1,2). Regional inequalities in obesity rates in England have also become established and persistent across recent decades (3,4,5), income inequality grew in some parts of the country and declined in others . Although inequalities in equivalent income did not change overallbetween 1995-7 to 2006-8. London and the Southwest, the Northeast, and Yorkshire sawincreased income inequality, while the Midlands (East and West), the East and South East of England saw declines in income inequality (6). There are large regional variations in obesity in Britain (3.7), which have been explained as being at least in part due to variation in proportions of the population of low social class across the country (82new Moon et al-2007). The geography of obesity in England may be associated with differing forms of deprivation (8) in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class (9), 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, to occupations based on labour contracts with very little control (9). Inequality affects health and well-being and influences obesity rates (10) 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 has 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 (11). Others relate it to subordination stress (12, 13) and economic and social insecurities of differing types (14, 15). The putative link is between insubordination stress and eating behaviour (13, 14, 15, 16).

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Employment relations remain very important to structuring socioeconomic position (17). but the nature of employment has changed in recent decades. With increasingmechanisation and adoption of technology into many occupations, it has become moredifficult to segregate manual from non-manual occupations. At the upper extreme of socioeconomic position, there has been a growth of high-income individuals who havecollectively commanded a greater proportion of overall income and wealth in England inthe 2000s than in the 1980s (18). They are less likely to be found in the North East, North-West, Yorkshire and Humberside, East Midlands, West Midlands and the South West, and more likely to be found in the East and South East of England, and especially London-(18). They remain the most economically secure section of the population by far. At the lower end of socio-economic position, service workers with poor work security, and a precariat that not only suffers from job insecuritybut also identity insecurity and lack of time control (19) have emerged. Both economic insecurity and economic inequality have been shown to be similarly associated with obesity among males and females at the cross-national level (1420). 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 oebesity rates among adults (males and females combined) in England in 2011-2012 with regional variation in social class according to the new schema of Savage et al (217) 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 2006-2008 (<u>18</u>22), and was a general population sample of 47,398 adults,

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representative of the whole population at both national and regional level. These are model-based estimates of adult obesity <u>rates at the local authority level</u> for males and females combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health (18). The analysis was guided by the social class mapping undertaken by Savage et al (17) 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 males and females, thus making it impossible to disaggregate the extent to which inequality and insecurity relate differently to obesity by gender. 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 nor undertaken (Peter Scarborough, personal communication).

The 2001 Census provided the main source of demographic and social covariate data. Other routine sources of data providing area level characteristics for local authorities included all age all cause mortality, diversity index, life expectancy, emergency hospital admissions, hospital admissions attributable to alcohol, job seekers allowance claimant counts and educational attainment. The model outputs were applied in conjunction with covariate data (available for all local authorities) to estimate the expected prevalencegiven the characteristics of the area. The model based estimate generated for a particular area is the expected measure for that area based on its population characteristics, and does not provide an estimate of the actual prevalence. As such, the estimates are unableto take account of any additional local factors that may impact on the true prevalence rate, such as local initiatives designed to reduce obesity rates. These estimates are notcomparable between years, were developed solely for local authorities and cannot betranslated onto any other geographical boundary system.

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Social class data came from maps of distribution of the seven latent social celasses by local authority, published by Savage et al (217). This 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 (217). It is a parsimonious differentiation into social classes according to three forms of capital - economic, cultural and social – according to Bourdieu's (1923) analysis of social position according to different types of capital. This schema of socio-economic position is the only one in the UK that allows insecurity, as well as inequality, to be mapped (9). Combining different forms of capital can bring new insights into variation of obesity rates according to social class (20, 21). The Savage et al (17) schema structures class differently to the NS-SEC. Latent class analysis is adopted by Savage et al (17) 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: 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%). Combining differentforms of capital can bring new insights into variation of obesity rates according to social The Savage et al (21) schema structures class differently to the NS-SEC. whose wealth separates them from an established middle class, a class of technical experts and another of new affluent workers. In addition to anageing traditional working class, there is a precariat characterised by capital of all kinds, and a class of emergent service workers, whose work security is low. This schema of socio-economic position is the only one in the UK that allows insecurity, as well as inequality, to be mapped (9). The social class map of Savage et al (217) 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, according to local authority. This classification falls into five categories for the following classes: elite, established middle-class, technical

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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 <u>traditional working technical working</u> 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, <u>because the proportions of these classes in the overall sample were small (1.6% and 0.7% respectively)</u>. In the present analysis, eEach 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 (217) schema, and were excluded from the analysis. These were rural local authorities in Lincolnshire, Lancashire and Devon which are likely to have an enrichment of people of the precariat and traditional working class. Obesity was classified as body mass index greater than 30kg per meter squared, and percentage rates of obese adults according to local authority were used as continuous variables. Obesity data were available only for males and females combined, and analyses were carried out on this basis, although it is very likely that there are important gender differences to be found. 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 squares 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 version 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 Appendix Table 1.1-7).

Table <u>1</u><sup>2</sup> gives results of pooled ordinary least squares 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 (for example, 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 multicollinarity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker (2<u>2</u><del>6</del>) 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 standardized-\_ beta-\_coefficients, and is the variable of interest, although the unstandardardised 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 (14, 230, 24), 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 variation in social class based on insecurity as well as inequality.

Employment relations remain very important to structuring socioeconomic position (25), 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 (26). They remain the most economically secure section of the population by far. At the lower end of socio-economic position, service workers with

poor work security, and a precariat that not only suffers from job insecurity but also identity insecurity and lack of time control (27) 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 Uu-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 (217), 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 schema (17) shows similar results to associations made with the NS-SEC indicators, although the r squared value is lower (adjusted R square: 0.51 (Savage el al); 0.69 (NS-SEC)). The value of using the Savage et al (17) schema is that it reveals the relationship between insecurity and adult obesity, which the NS-SEC cannot.

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New affluent workers largely come from non-middle class families and few have been to university (217), and it is likely that they are similar in social background to the traditional working class, only younger on average. They include people of the following professions:electricians, postal workers, plumbers, and heating and ventilation engineers. They have fewer savings and higher income than the traditional working class, but have house values that are similar to them (21). It is perhaps unsurprising that adult obesity rates are higher in the local authorities that have higher proportions of this class, as with the traditional working class. The U-shaped relationship between obesity rates and proportions of emergent service workers in local authorities may influenced by data from those authorities where high proportions of this class are accompanied by high or middling proportions of the elite and technical middle classes (for example, Lincoln, Tower-Hamlets, Bright and Hove, Newcastle, and York). The new affluent workers and traditional working class are similar in social background, the former being younger. The former have fewer savings and higher income than the traditional working class, but have house values that are similar to them (217). The established middle class is a provincial formation, residing mostly outside of the Southeast of England and mainly away from large towns or urban environments. Their rural presence goes some way to explaining the high obesity rates in some rural local authorities such as Tamworth, Swale, and Nuneaton and Bedworth. The precariat class is insecure and is enriched with cleaners, carpenters and joiners, caretakers, shopkeepers and retail cashierscare workers, as well as with cleaners, shopkeepers, and retail cashiers, but with a proportion of people of ethnic minority that is similar to all classes apart from emergent service workers, and the elite (among whom the proportion is low). Local authorities with above average proportions of the precariat are both urban and rural, and have significantly higher rates of obesity than those with average or below average proportions of them. Local authorities with the highest concentrations of the precariat include Leicester, Lincoln, West Lindsey, Ashfield,

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Doncaster, East Northamptonshire, Sunderland, Bolton, mid Devon and Stoke-on-Trent. Local authorities that have concentrations of both the established middle class and the precariat include Thurrock, Great Yarmouth, Weymouth and Portland, Tameside, Burnleyand Newcastle under Lyme, half of which are rural, the other half, urban..

The geography of obesity is associated with differing forms of deprivation between postindustrial and more rural areas (8), as well as differences in the proportions of people of different socio-economic position (3). While complex (8), 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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Contributorship statement:

The author constructed the database from existing databases, designed the study, undertook the analysis, interpreted the results and drafted the article.

There were no competing interests.

Ethics approval was not required.

No funding, other than the salary of the author from University of Oxford, was required.

The decision to submit the article for publication was totally that of the author.

The author was independent from funders.

The author had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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The author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Vallable from un Data sharing: full dataset available from the author.



Figure 1. Obesity rates of adults (males and females combined) 2006-8 by different social class categories, as determined from social, cultural and economic capital (Savage et al 2013)

figure 1 173x130mm (300 x 300 DPI) BMJ Open: first published as 10.1136/bmjopen-2013-004430 on 13 May 2014. Downloaded from http://bmjopen.bmj.com/ on June 10, 2025 at Agence Bibliographique de I Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

Elite:			% obe	pclud	
Category	Z score	Number of local authorities	Mean	ing for use	
1	-1.5 or more	13	26.22	1.82 gg	
2	-0.5 to less than -1.5	64	25.96	2.76 to te	
3	Less than -0.5 to less than 0.5	117	24.96	oaded fron uperieur (/ 2.2 2.2	
4	0.5 to less than 1.5	105	22.83	2.63 ning	
5	1.5 or more	21	19.34	3.1 <b>≵</b> trair	
	Total	320	24.15	3.0 <b>g</b> i	
ANOVA	F		39.06	and	
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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 praetitioners, advertising and public relations directors E

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cultural and e	ble 1.2. Obesity rate economic capital (S	es of adults 200 avage et al, 20	16-08 by differe 13).	nt social cla	ss categ	jongestas determined from social, cc 4 cc 4 cc 4 cc 4 cc 4 cc 4 cc 4 cc
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	1	-1.5 or more	25	20.34	3.75	lload ext a
	2	-0.5 to less than 1.5	52	22.24	2.60	rieur (Al
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	4	0.5 to less than 1.5	90	25.58	2.57	raining.
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# Page 45 of 52

New affl workers	uent :			% obe	se	04430 on	
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BMJ Open Appendix Table 1.7. Obesity rates of adults 2006-08 by different social class categories as determined from social, and economic capital (Savage et al, 2013).

				÷ .
Precariat;			% obese	Ense pr uses r
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Most represented occupations in this class: cleaners, carpenters and joiners, caretakers, leisure and travel service occupations,

shopkeepers and proprietors, retail cashiers

# Variation in adult obesity rates in England by the new social class schema Stanley J. Ulijaszek **Reporting checklist** Title and abstract 1a The study's design is indicated with a commonly used term in the title 1b Abstract gives an informative and balanced summary of what was done and what was found Introduction Background and rationale scientific background and rationale of investigation is explained Objectives specific objectives are explained **Methods** Study design key elements of study design explained early in the paper Setting The setting is described giving relevant dates and databases used Participants

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6 Not applicable: eligibility criteria and and selection criteria given in publications associated with primary databases used for this analysis

# Variables

7 All outcomes, predictors and potential confounders described

# Data sources

8 Sources of data and details of measurement given for each variable interest

# Bias

9 Efforts to address potential sources of bias described

# Study size

10 Explanation of how study size was arrived at is given

# Quantitative variables

11 The way in which quantitative variables are handled in the analysis is explained

# Statistical methods

- 12 a) All statistical methods are described
  - b) Methods used to examine subgroups and interactions are described
  - c) Explanation given of how missing data were addressed
  - d) Sampling strategy considered in publication of original databases

# Results

# Participants

13 Not applicable, since aggregated data used from collated published databases

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Descriptive data

14 Characteristics of study groups given

# Outcome data

15 Summary measures reported

# Main results

- 16 a) Unadjusted estimates given
  - b) Category boundaries reported

# Other analyses

17 No other analyses done

# Discussion

Key results

18 Key results summarised with reference to study objectives

# Limitations

19 Limitations of the study discussed

# Interpretation

20 Cautious overall interpretation of results given, considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence

# Generalisability

21 Generalisability of the study results discussed

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

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Keywords:	EPIDEMIOLOGY, SOCIAL MEDICINE, PUBLIC HEALTH



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### Abstract

#### Objectives

Geographical variation in adult obesity rates have been attributed to variation in social and economic inequality. Insecurity is associated with obesity at cross-national level, but there is little empirical evidence to show that insecurity contributes to the structuring of adult obesity rates at the sub-national 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 2006-8 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 squares regression analyses of obesity rates by local authority according to the proportion of different social classes within each of them were performed 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).

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

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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.

# 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 (NS-SEC). 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 males and females 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.

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# INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among manual working classes than non-manual working classes (1,2). Regional inequalities in obesity rates in England have also become established and persistent across recent decades (3,4,5), income inequality grew in some parts of the country and declined in others (6). There are large regional variations in obesity in Britain (3,7), which have been explained as being at least in part due to variation in proportions of the population of low social class across the country (8). The geography of obesity in England may be associated with differing forms of deprivation (8) in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class (9), 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, to occupations based on labour contracts with very little control (9). Inequality affects health and well-being and influences obesity rates (10) 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 has 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 (11). Others relate it to subordination stress (12, 13) and economic and social insecurities of differing types (14, 15). The putative link is between insubordination stress and eating behaviour (13, 14, 15, 16).

Both economic insecurity and economic inequality have been shown to be similarly associated with obesity among males and females at the cross-national level (14). Economic insecurity can be characterised by the likely continued economic solvency of a

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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 (males and females combined) in England in 2011-2012 with regional variation in social class according to the new schema of Savage et al (17) 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 2006-2008 (18), and was a general population sample of 47,398 adults, representative of the whole population at both national and regional level. These are model-based estimates of adult obesity rates at the local authority level for males and females combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health (18). The analysis was guided by the social class mapping undertaken by Savage et al (17) 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 males and females, 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 nor 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 (17). It is a parsimonious differentiation into social classes according to

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three forms of capital - economic, cultural and social – according to Bourdieu's (19) analysis of social position according to different types of capital. The Savage et al (17) schema structures class differently to the NS-SEC. Latent class analysis is adopted by Savage et al (17) 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: 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 (17) 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 (17) schema, and were excluded from the analysis. Obesity was classified as body mass index greater than 30kg per meter squared, 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 squares

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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 version 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 Appendix Table 1.1-7).

Table 1 gives results of pooled ordinary least squares 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 (for example, 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 multicollinarity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker (22) similarly found an absence of significant multicollinearity when using composite measures of socioeconomic status

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together with education and occupation. The relative strength of association of each variable is indicated by the standardized *beta* coefficients, and is the variable of interest, although the unstandardardised 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 (14, 23, 24), 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 variation in social class based on insecurity as well as inequality. Employment relations remain very important to structuring socioeconomic position (25), but the nature of employment has changed in recent decades. With increasing

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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 (26). They remain the most economically secure section of the population by far. At the lower end of socio-economic 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 (27) 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 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.

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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 schema (17) shows similar results to associations made with the NS-SEC indicators, although the r squared value is lower (adjusted R square: 0.51 (Savage el al); 0.69 (NS-SEC)). The value of using the Savage et al (17) 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 (8), as well as differences in the proportions of people of different socio-economic position (3). While complex (8), 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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Contributorship statement:

The author constructed the database from existing databases, designed the study, undertook the analysis, interpreted the results and drafted the article.

There were no competing interests.

Ethics approval was not required.

No funding, other than the salary of the author from University of Oxford, was required.

The decision to submit the article for publication was totally that of the author.

The author was independent from funders.

The author had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

The author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Data sharing: full dataset available from the author.

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New Dange. 27 Standing G. The Precariat: The New Dangerous Class. London: Bloomsbury

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Table 1. Ordinary least squares regression of obesity rates by local authority according to proportion of different social classes therein. Footnote: 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). \*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Model		1			2			3	
Variables	В	beta	T statistic	В	beta	T statistic	В	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	-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	I		320			320	1
Adjusted R- squared		0.50***			0.51***			0.11***	

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# 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 (NS-SEC). 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 males and females 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. Theis study shows uses nationallyrepresentative data and shows that insecurity, in addition to as well as inequality, isto be associated with the geographical patterning of adult obesity rates across England.

The proportion of the middle classes resident within any local authority have both positive and negative associations with obesity rates, according to whether they are establishedmiddle class, or the recently emergent technical middle class.-

<text> Although variation in proportions of people of non-dominant ethnicity across local authorities is unlikely to influence the overall results and interpretation of this analysis,ethnicity may be an important factor in the obesity rates found in local authorities with highproportions of emergent service workers.

# INTRODUCTION

Obesity rates among adults in England have risen greatly since the 1990s, more so among manual working classes than non-manual working classes (1,2). Regional inequalities in obesity rates in England have also become established and persistent across recent decades (3,4,5), income inequality grew in some parts of the country and declined in others . Although inequalities in equivalent income did not change overallbetween 1995-7 to 2006-8, London and the Southwest, the Northeast, and Yorkshire sawincreased income inequality, while the Midlands (East and West), the East and South East of England saw declines in income inequality (6). There are large regional variations in obesity in Britain (3.7), which have been explained as being at least in part due to variation in proportions of the population of low social class across the country (82new Moon et al-2007). The geography of obesity in England may be associated with differing forms of deprivation (8) in addition to income and occupation, and this may not be totally captured by the most commonly used measures of social class (9), 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, to occupations based on labour contracts with very little control (9). Inequality affects health and well-being and influences obesity rates (10) 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 has 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 (11). Others relate it to subordination stress (12, 13) and economic and social insecurities of differing types (14, 15). The putative link is between insubordination stress and eating behaviour (13, 14, 15, 16).

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Employment relations remain very important to structuring socioeconomic position (17), but the nature of employment has changed in recent decades. With increasingmechanisation and adoption of technology into many occupations, it has become moredifficult to segregate manual from non-manual occupations. At the upper extreme of socioeconomic position, there has been a growth of high-income individuals who havecollectively commanded a greater proportion of overall income and wealth in England inthe 2000s than in the 1980s (18). They are less likely to be found in the North East, North-West, Yorkshire and Humberside, East Midlands, West Midlands and the South West, and more likely to be found in the East and South East of England, and especially London-(18). They remain the most economically secure section of the population by far. At the lower end of socio-economic position, service workers with poor work security, and a precariat that not only suffers from job insecuritybut also identity insecurity and lack of time control (19) have emerged. Both economic insecurity and economic inequality have been shown to be similarly associated with obesity among males and females at the cross-national level (1420). 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 oebesity rates among adults (males and females combined) in England in 2011-2012 with regional variation in social class according to the new schema of Savage et al (217) 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 2006-2008 (<u>18</u>22), and was a general population sample of 47,398 adults,

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representative of the whole population at both national and regional level. These are model-based estimates of adult obesity <u>rates at the local authority level</u> for males and females combined, using HSE, Census and other data, carried out by the National Centre for Social Research and commissioned by the Department of Health (18). The analysis was guided by the social class mapping undertaken by Savage et al (17) 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 males and females, 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 nor undertaken (Peter Scarborough, personal communication). Thus it was not possible to test for gender effects.

The 2001 Census provided the main source of demographic and social covariate data. Other routine sources of data providing area level characteristics for local authoritiesincluded all age all cause mortality, diversity index, life expectancy, emergency hospitaladmissions, hospital admissions attributable to alcohol, job seekers allowance claimantcounts and educational attainment. The model outputs were applied in conjunction withcovariate data (available for all local authorities) to estimate the expected prevalencegiven the characteristics of the area. The model-based estimate generated for a particulararea is the expected measure for that area based on its population characteristics, and does not provide an estimate of the actual prevalence. As such, the estimates are unableto take account of any additional local factors that may impact on the true prevalence rate, such as local initiatives designed to reduce obesity rates. These estimates are notcomparable between years, were developed solely for local authorities and cannot betranslated onto any other geographical boundary system.

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	Social class data came from maps of the seven latent classes, published by Savage et al-
	(21). Th <u>e</u> is 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 ( $\frac{217}{}$ ). It is a parsimonious differentiation into social classes
ć	according to three forms of capital - economic, cultural and social – according to
	Bourdieu's ( <u>19</u> 23) analysis of social position according to different types of capital. <u>The</u>
	Savage et al (17) schema structures class differently to the NS-SEC. Latent class analysis
	is adopted by Savage et al (17) for clustering of six continuous variables: mean status
ç	scores of contacts, total number of contacts, highbrow cultural capital, emerging cultural
	capital, income and assets. Seven social class clusters were identified; 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%). Combining different forms of capital cap
•	pring new insights into variation of obesity rates according to social class (24.25). The
с	Sources at al (21) asheres atructures along differently to the NS SEC. There is a new alite
9	Avage et al (21) schema structures class dimerentity to the NS-SEC. There is a new ente-
C	lass, whose wealth separates them from an established middle class, a class of technical
e	experts and another of new affluent workers. In addition to an ageing traditional working-
e	class, there is a precariat characterised by very low levels of capital of all kinds, and a
e	lass of emergent service workers, whose work security is low. This schema of socio-
e	economic position is the only one in the UK that allows insecurity, as well as inequality, to
k	<del>e mapped (9).</del> The social class map of Savage et al ( <del>2</del> 1 <u>7</u> ) expresses <u>the proportion of</u>
e	each class <u>in the sample by local authority</u> as a Z score from the British average <u>of the</u>
ŗ	proportion of that class, according to local authority. This classification falls into five
с	ategories for the following classes: elite, established middle-class, technical middle-class,
ľ	new affluent workers, and emergent service workers: -1.5 or more, -0.5 to less than -1.5,
ľ	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 technical working class and precariat fall into four categories: -

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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, eE ach 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 (217) schema, and were excluded from the analysis. These were rural local authorities in Lincolnshire, Lancashire and Devon which are likely to have an enrichment of people of the precariat and traditional working class. Obesity was classified as body mass index greater than 30kg per meter squared, and percentage rates of obese adults according to local authority were used as continuous variables. Obesity data were available only for males and females combined,and analyses were carried out on this basis, although it is very likely that there areimportant gender differences to be found. 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 squares 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 version 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 Appendix Table 1.1-7).

Table <u>1</u><sup>2</sup> gives results of pooled ordinary least squares 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 (for example, 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 multicollinarity, and that this did not need to be taken into account in interpreting this analysis. Campbell and Parker (2<u>2</u>6) 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 standardized\_ *beta*\_coefficients, and is the variable of interest, although the unstandardardised 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,

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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 (14, 230, 24), 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 variation in social class based on insecurity as well as inequality.

Employment relations remain very important to structuring socioeconomic position (25), 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 (26). They remain the most economically secure section of the population by far. At the lower end of socio-economic 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 (27) 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 <u>between obesity and the new social class schema</u> 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>Uu-shaped with respect to the</u> 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 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 schema (17) shows similar results to associations made with the NS-SEC indicators, although the r squared value is lower (adjusted R square: 0.51 (Savage et al); 0.69 (NS-SEC)). The value of using the Savage et al (17) schema is that it reveals the relationship between insecurity and adult obesity, which the NS-SEC cannot. Formatted: Normal, Level 3, Space Before: 6.75 pt, Font Alignment: Baseline and similar technologies.

New affluent workers largely come from non-middle class families and few have been to university (21), and it is likely that they are similar in social background to the traditional working class, only younger on average. They include people of the following professions: electricians, postal workers, plumbers, and heating and ventilation engineers. They have savings and higher income than the traditional working class, but havesimilar to them (21). It is perhaps unsurprising that adult obesity higher in the local authorities that have higher proportions of this class, working class The U-shaped relationship between obesity rates and proportions of emergent service workers in local authorities may influenced by data fromwhere high proportions of this class are accompanied by high or middling those authorities technical middle classes (for example Bright and Hove, Newcastle, and York). The new affluent workers and traditional-Hamlets. are similar in social background, the former being younger former have fewer savings and higher income than the traditional working class, but have house values that are similar to them (21). The established middle class is a provincial formation, residing mostly outside of the Southeast of England and mainly away from large towns or urban environments. Their rural presence goes some way to explaining the high obesity Swale, and Nuneaton and Bedworth. authorities such as Tamworth. shopkeepers, and retail cashiers, but with a proportion of people of ethnic minority that is and the elite (among whom the apart from emergent service proportion is low). Local authorities with above average proportions of the precariat are both urban and rural, and have significantly higher rates of obesity than those with average proportions of them. Local authorities with the highest concentrations of the precariat include Leicester, Lincoln, West Lindsey. mid Devon Local authorities that have concentrations of both the established middle class and the

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precariat include Thurrock, Great Yarmouth, Weymouth and Portland, Tameside, Burnleyand Newcastle under Lyme, half of which are rural, the other half, urban..

The geography of obesity is associated with differing forms of deprivation between postindustrial and more rural areas (8), as well as differences in the proportions of people of different socio-economic position (3). While complex (8), 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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Contributorship statement: The author constructed the database from existing databases, designed the study, undertook the analysis, interpreted the results and drafted the article. There were no competing interests. Ethics approval was not required. No funding, other than the salary of the author from University of Oxford, was required. The decision to submit the article for publication was totally that of the author.

The author was independent from funders.

The author had full access to all of the data in the study and can take responsibility for the

integrity of the data and the accuracy of the data analysis.

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The author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Data sharing: full dataset available from the author.



Figure 1. Obesity rates of adults (males and females combined) 2006-8 by different social class categories, as determined from social, cultural and economic capital (Savage et al 2013)

figure 1 173x130mm (300 x 300 DPI)

Elite:			% obe	nclud	
Category	Z score	Number of local authorities	Mean	ing for use	
1	-1.5 or more	13	26.22	1.82 gg	
2	-0.5 to less than -1.5	64	25.96	2.76 to te	
3	Less than -0.5 to less than 0.5	117	24.96	oaded fron tuperieur ( 2.2 2.1	
4	0.5 to less than 1.5	105	22.83	2.6% in http://t	
5	1.5 or more	21	19.34	3.1 <b>≵</b> trair	
	Total	320	24.15	3.0 <b>8</b>	
ANOVA	F		39.06	com, and s	
Significance: p			<0.00	1 simila	
Scheffe test: post-hoc differences			1v4 (p<0 1v5(p<0. 2v4 (p<0 2v5 (p<0 3v4 (p<0 3v5 (p<0 4v5 (p<0	ar technologies. 001) 001) 001) 001) 001) 001) 001) 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 praetitioners, advertising and public relations directors E

Appe	ndix Table 1.2. Obesity rate al and economic capital (S	es of adults 200 avage et al, 20	06-08 by differe 13).	nt social cla	ss categ	potiestas determined from social,
						0 on
	Established middle class:			% obe	se	or uses
	Category	Z score	Number of local authorities	Mean	SD	2014. Down related to t
	1	-1.5 or more	25	20.34	3.75	lload ext a
	2	-0.5 to less than 1.5	52	22.24	2.60	rieur (Al
	3	Less than -0.5 to less than 0.5	151	24.57	2.60	http://bmjo BES) . BES, Al .
	4	0.5 to less than 1.5	90	25.58	2.57	rpen.bm
	5	1.5 or more	2	24.65	1.77	i.com/ o
		Total	320	24.15	3.09	n llar
	ANOVA	F		26.36	6	Techr 10
	Significance p			p<0.001 1v3 (p<0.001) 1v4(p<0.001) 2v3 (p<0.001) 2v4 (p<0.001)		10log
	Scheffe test: post-hoc differences					5 at Agence Bi
Most represente police officers	ed occupations in this class s, quality assurance and reg	Electrical engi	neers, occupat sionals, town pl	ional therapi anning offici	ists, mid als, spe	ୁ କୁ wiveଙ୍କୁ environmental professiona cial néeds teaching professionals

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	nic capital (Sava	age et al, 2013)	).		04430 on cluding f	
Technical middle class:			% obe	se	13 May 2 Ense or uses i	
Category	Z score	Number of local authorities	Mean	SD	014. Downl ignement S related to te	
1	-1.5 or more	14	26.98	2.99	loade Super Sxt ar	
2	-0.5 to less than 1.5	47	25.47	2.51	ed from Tieur (AE nd data r	
3	Less than -0.5 to less than 0.5	149	24.13	3.17	http://bmjoj 3ES) . nining, Al t	
4	0.5 to less than 1.5	100	23.26	2.95	pen.bmj raining,	
5	1.5 or more	10	23.08	1.11	.com/ or and sirr	
	Total	320	24.15	3.09	ı Jun	
ANOVA	F		8.10		e 10, echn	
Significance p			<0.00	1	2025 ologi	
Scheffe test: post-hoc differences			1v3 (p<0 1v4(p<0 1v5 (p<0 2v4 (p<0	0.05) 001) 0.05) 0.01)	i at Agence Bib ies.	

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New affluent workers:			% obe	se	ofuding
Category	Z score	Number of local authorities	Mean	SD	13 May 201 Enseig
1	-1.5 or more	33	19.12	2.74	14. Do
2	-0.5 to less than 1.5	75	22.75	2.42	ownload ant Supe
3	Less than -0.5 to less than 0.5	125	24.79	1.91	ed from htt rieur (ABEt
4	0.5 to less than 1.5	77	26.18	2.15	p://bmjo S) . ving, Al
5	1.5 or more	10	27.53	3.44	pen.bm
	Total	320	24.15	3.09	j.com
ANOVA	F		73.03	3	simi
Significance p			<0.00	1	June lar te
Scheffe test: post-hoc differences			1v2 (p<0. 1v3(p<0.0 1v4 (p<0.0 1v5 (p<0.0 2v3 (p<0.0 2v4(p<0.0 2v4(p<0.0 2v4 (p<0.0 2v5 (p<0.0 3v4(p<0.0 3v5 (p<0.0 3v5 (p<0.0)	001) 001) 001) 001) 001) 001) 001) 001) 001) 001) 001) 001)	10, 2025 at Agence Bibli

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Traditional working class:			% obe	se	04430 or ncluding	
Category	Z score	Number of local authorities	Mean	SD	n 13 May 20 Enseig for uses re	
1	-1.5 or more	15	21.25	3.74	114. Dov gnemen lated to	
2	-0.5 to less than 1.5	83	22.42	3.09	vnloade t Superi text an	
3	Less than -0.5 to less than 0.5	126	24.25	2.57	d from http: eur (ABES) d data minii	
4	0.5 to less than 1.5	89	25.96	2.42	//bmjop ng, Al tra	
5	1.5 or more	8	25.83	2.55	en.bmj. aining, a	
	Total	321	24.15	3.09	and si	
ANOVA	F		23.00	)	on Ju	
Significance p			<0.00	1	Ine 1	
Scheffe test: post-hoc differences			1v3 (p<0 1v4(p<0. 1v5 (p<0 2v3 (p<0 2v4(p<0. 2v5 (p<0 3v4(p<0.	0.01) 001) 0.01) 0.01) 001) 0.05) 001)	0, 2025 at Agence Biblio Inologies.	

				430 o	
Emergent service workers:			% obes	g for us	
Category	Z score	Number of local authorities	Mean	ay 2014. Do inseigneme es related S	
1	-1.5 or more	14	22.76	2.3 4 5 1	
2	-0.5 to less than 1.5	86	23.70	2.880 nd d	
3	Less than -0.5 to less than 0.5	139	24.65	om http://b ( <del>ABES)</del> . 3.0 <sup>mining</sup> ,	
4	0.5 to less than 1.5	68	24.18	3.46train	
5	1.5 or more	13	23.11	2.1 <b>4</b>	
	Total	320	24.15	3.00 sim	
ANOVA	F		2.48	ilar t	
Significance p			<0.05	e 10,	
Scheffe test: post-hoc differences			none	2025 at Agenc	
L		II		' če Bib	

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

				± -
Precariat;			% obese	Ense pr uses r
Category	Z score	Number of local authorities	Mean	ignemer elated to S
1	-0.5 or more	107	22.91	3.4 3.4 3.4 3.4
2	Less than -0.5 to less than 0.5	126	24.22	ieur (AB divlata r 3.0
3	0.5 to less than 1.5	71	25.49	nigging, /
4	1.5 or more	16	25.86	2.0 <b>6</b>
	Total	320	24.15	3.0 <b>0,</b> a
ANOVA	F		13.13	nd sii
Significance p			<0.001	nilar
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

# Variation in adult obesity rates in England by the new social class schema Stanley J. Ulijaszek **Reporting checklist** Title and abstract 1a The study's design is indicated with a commonly used term in the title 1b Abstract gives an informative and balanced summary of what was done and what was found Introduction Background and rationale scientific background and rationale of investigation is explained Objectives specific objectives are explained **Methods** Study design key elements of study design explained early in the paper Setting The setting is described giving relevant dates and databases used Participants

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6 Not applicable: eligibility criteria and and selection criteria given in publications associated with primary databases used for this analysis

### Variables

7 All outcomes, predictors and potential confounders described

#### Data sources

8 Sources of data and details of measurement given for each variable interest

#### Bias

9 Efforts to address potential sources of bias described

# Study size

10 Explanation of how study size was arrived at is given

# Quantitative variables

11 The way in which quantitative variables are handled in the analysis is explained

# Statistical methods

- 12 a) All statistical methods are described
  - b) Methods used to examine subgroups and interactions are described
  - c) Explanation given of how missing data were addressed
  - d) Sampling strategy considered in publication of original databases

# Results

# Participants

13 Not applicable, since aggregated data used from collated published databases

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Descriptive data

14 Characteristics of study groups given

#### Outcome data

15 Summary measures reported

#### Main results

- 16 a) Unadjusted estimates given
  - b) Category boundaries reported

#### Other analyses

17 No other analyses done

#### Discussion

Key results

18 Key results summarised with reference to study objectives

#### Limitations

19 Limitations of the study discussed

# Interpretation

20 Cautious overall interpretation of results given, considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence

# Generalisability

21 Generalisability of the study results discussed

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