

The impact of socioeconomic status on the relationship between obesity and health related quality of life in England

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Abstract

Aims: (1) To investigate the relationship between socioeconomic status (SES) and obesity measures (BMI, $BMI \geq 30 \text{kg/m}^2$). (2) To investigate the relationship between obesity measures and HRQOL (EQ-5D score), and how this varies by SES.

Methods: Data were taken from four rounds of the *Health Survey for England* (2003-2006; $n=61,603$). Banded total household income is regressed against a comprehensive set of SES indicators using interval regression. We use the predicted values from this model as our measure of SES. We regress the obesity measures against SES plus covariates. Then we regress EQ-5D score against the obesity measures plus covariates separately for four groups, stratified by SES.

Preliminary results: (1) Low SES is positively correlated with obesity. (2) Obesity is negatively correlated with EQ-5D score. (3) The impact of obesity on EQ-5D score is more negative in low SES groups compared with high SES groups. The relationship between obesity and EQ-5D score is reduced, but remains significant, when we control for co-morbidities. We also stratify by gender and found evidence of these effects in both men and women, though they are more pronounced in women.

Preliminary conclusions: Socioeconomic status has a significant effect on the relationship between obesity and HRQOL. Low SES groups are more likely to be obese, and the negative effect of obesity on HRQOL is stronger in the low SES group.

Introduction

Obesity is a rapidly increasing problem. In England in 2007, 24% of adults were classified as obese ($BMI \geq 30 \text{kg/m}^2$), which was a substantial increase compared with a prevalence of 15% in 1993 (NHS IC, 2009). This is a cause for concern, first because obesity is a debilitating condition in its own right. Second, it is a major risk factor of a number of debilitating longstanding illnesses including coronary heart disease, non-insulin dependent diabetes mellitus, osteoarthritis, hypertension and stroke (NHLBI, 1998).

The loss in HRQOL associated with obesity has been estimated to be substantial – larger than the losses associated with asthma and cancer (Sach et al., 2006). Further, there is some evidence both that SES is correlated with obesity and that obesity is correlated with HRQOL. Given current policy concerns with socioeconomically-patterned health inequalities and the potential contribution of lifestyle factors to this (House of Commons, Health Committee, 2009), the aim of this paper is to investigate how SES influences the relationship between obesity and HRQOL. We proceed as follows. First, we create a measure of SES based on a prediction of income from a comprehensive set of SES indicators. Second, we examine the correlation between SES and obesity. Third, we investigate the relationship between obesity and HRQOL, and how this varies by SES. We run separate analyses for both genders and investigate the impact of controlling for comorbidities. The analysis is conducted using cross-sectional data from the *Health Survey for England* (HSE; 2003-2006).

In the next section we briefly review current evidence on the relationship between obesity, HRQOL and how this varies by SES.

Previous research

SES and obesity

A number of studies have investigated the impact of SES on obesity. A range of SES measures have been used, capturing various dimensions. These studies generally indicate that there is a negative impact of SES on obesity. Six British studies found this relationship in women, (Demakakos et al., 2008; Langenberg et al., 2003; Sargent and Blanchflower, 1994; Adams & White, 2009; Martikainen and Marmot, 1999; Power et al., 2005; Wardle et al., 2002), and three of these (Adams & White, 2009; Martikainen and Marmot, 1999; Power et al., 2005; Wardle et al., 2002) found similar effects in men.

Obesity measures and HRQOL

Five British papers have investigated the relationship between obesity and HRQOL (Lee et al., 2005; Macran, 2004; Sach et al., 2006).

Lee et al. (2005) use data from the Health Outcomes Data Respiratory (HODAR) to characterize the impact of BMI (measured as a continuous variable) on health related utility for patients with Type 1 and Type 2 diabetes, and for those without diabetes. They regress EQ-5D score against BMI, age and diabetic status using linear regression techniques and

conclude that BMI has a significant negative impact on utility. There was no significant difference in the relationship between the diabetic groups.

Macran (2004) uses data from the 1996 HSE to assess the relationship between BMI (measured as a continuous variable) and EQ-5D score by regressing EQ-5D score against BMI (as a 3 and 5 category variable) controlling for age, gender and longstanding illnesses. She shows a negative relationship between BMI and HRQOL. However, when she controls for age and the presence of longstanding illnesses this relationship is significant only for women.

Sach et al. (2006) asked patients aged 45 years and above to complete the EQ-5D, EuroQol VAS and SF-6D questionnaires. They compared the relationship between BMI (measured as a continuous variable) and HRQOL using the three utility measures. All three instruments showed that, relative to normal BMI, obesity ($BMI \geq 30 \text{kg/m}^2$) is associated with lower HRQOL. After controlling for age, sex, smoking status and comorbidities there was still a significant negative effect of BMI on HRQOL.

Two further British studies (Doll et al., 2005; Lee et al., 2005) have investigated the impact of obesity (measured as a binary variable ($BMI \geq 30 \text{kg/m}^2$) on HRQOL (SF-36 and EQ-5D). They both found a negative impact.

None of the British studies have investigated whether or not the impact of obesity on HRQOL varies SES. Some international studies have investigated this issue, (see, e.g., Zeller and Modi, 2006; Williams et al., 2005), but these studies have been conducted in specific population groups (e.g., children), have used non-generic HRQOL measures (e.g., PedsQL), and have tended to focus on specific dimensions of socioeconomic status (e.g., maternal education).

Our study makes a number of contributions to this literature. First, we consider the relationship between obesity and SES using a comprehensive measure of SES and a large adult British sample. Second, while previous studies have investigated the impact of obesity on HRQOL we stratify our analyses by SES to examine whether or not there is a differential effect by SES group. Third, we run our regression models using a variety of functional forms for BMI. Fourth, the dataset we use allows us to control for a number of covariates likely to affect HRQOL.

Methods

Data and variables

Data source

The analysis is based on data from four rounds (2003-2006) of the *Health Survey for England* (HSE). The HSE is a cross-sectional representative national survey which draws a different sample every year of individuals living in England. Respondents are interviewed on a range of topics including socioeconomic status, health and EQ-5D. The total sample size of the pooled sample is 61 603 individuals. Only participants above the age of 16 completed the EQ-5D questionnaire and are included in this study.

EQ-5D

EQ-5D is a measure of HRQOL, which defines health in terms of five dimensions: mobility, self care; usual activities; pain/discomfort; and, anxiety/depression. Each dimensions has three levels: no problems, moderate problems and severe problems, resulting in 243 possible health states. Two additional health states are also included (unconsciousness and death), giving a total of 245 health states. EQ-5D states are valued using UK population social tariff and the resulting scores, which are reported in the HSE, have a maximum value of unity. These values indicate perfect health, and values of zero indicate health states equivalent to death. Scores below zero indicate health states worse than death (The EuroQol Group, 2009).

Obesity

BMI is calculated by dividing each respondent's weight in kilogram's by their height in meters squared, derived from the height and weight measures obtained during the interviewer visit in the HSE. These measures are not based on self reported data and so the likelihood of systematic error is reduced. We use two obesity measures is based on BMI and a binary variable taking the value of one if the individual has a $BMI \geq 30 \text{kg/m}^2$, and zero otherwise.

Socioeconomic status

SES is measured as a linear prediction of income from a regression model of income against a comprehensive set of SES indicators.

SES indicators

The indicators used to compute the SES variable are: education (measured in seven categories); social class of household response person (HRP; six categories); cars owned by household (four categories); household tenure (five categories); bedrooms in household (five

categories); activity status for last week (11 categories); index of multiple deprivation (SOA level) (five categories); and, if the person is an income support claimant (in two categories).

Other covariates

In our obesity and EQ-5D regression models we also include covariates for: age (as a cubic function); gender; interactions between age and gender; survey year (four categories); marital status (six categories); government office region of residence (nine categories); and, ethnic group (nine categories).

Longstanding illnesses

We hypothesise that BMI might have a negative effect on HRQOL for two reasons. First, because it is a limiting condition in its own right. Second, because it is a risk factor of a number of other diseases. We attempt to disentangle these effects by including controls for a comprehensive set of longstanding illnesses. Respondents in the HSE are asked to provide information about any longstanding illnesses, disabilities or infirmities that had troubled them over a period of time. Each respondent recorded a maximum of six conditions, which were categorised into 14 disease groups. We include indicators for each of these 14 longstanding illnesses, and also for the total number of longstanding illnesses suffered by each respondent (0, 1, 2, 3, 4+). We also include a variable indicating whether or not the longstanding illness(es) limit the activities of the respondents in any way.

Analysis

We undertake a number of analyses, described below.

Measurement of socioeconomic status

An important component of the analysis is the measurement of SES. We wish to capture the multidimensional aspects of SES and our measure is based on the linear prediction of annual total household income based on a comprehensive set of SES indicators. The income variable is measured in 31 categories, including an open-ended top category. This is regressed against the SES indicators described above. Since the income variable is banded we use interval regression. We use the linear predictions from this model as our measure of SES. This variable is divided into four equal sized quartiles, which are used to stratify the analysis.

The relationship between SES and obesity

We use multivariate logistic regression to regress obesity (measured as a binary variable as $BMI \geq 30 \text{kg/m}^2$) against SES plus the covariates described above. Analyses are performed on the whole sample and separately for men and women.

The relationship between obesity and HRQOL, stratified by SES.

We regress EQ-5D scores separately against two sets of obesity measures ($BMI \geq 30 \text{kg/m}^2$, and a quadratic function of BMI) using OLS, conditional on the covariates described above. We run several models of this form. We run separate models for individuals within each SES quartile and then use Chow-type tests to investigate the statistical significance of the difference in the obesity coefficients between the different SES groups. In these models we also control for SES within each quartile. We run separate models for men and women, and for both genders combined. We run separate models with and without the longstanding illness indicators.

Sampling issues

We apply survey weights reported in the HSE to each observation and we adjust for clustering at the primary sampling unit level in every regression.

Results

Summary statistics for the variables used in the analysis are in Appendix Table A1. Table 1 shows the results of the interval regression model of total annual household income against the SES indicators. Most of the variables have the expected sign. Education, social class, number of cars and bedrooms in household are all positively correlated with income. Compared to being in paid employment all other types of economic activity have a negative effect on income. Being on income support is negatively correlated with income. Area deprivation is negatively correlated with income (higher IMD scores indicate more deprived areas). Income varies by housing tenure.

We used these results to generate our predicted SES measure for 33,716 observations. The range of the predictions was $-11,419$ to $94,296$. Respondents were then categorised into SES quartiles with predicted SES values $\leq 18,491$, $18,491-31,588$, $31,588-45,187$ and $\geq 45,187$.

The results of the regressions of obesity against SES group are in Table 2. Full results are in Appendix Table A2. The likelihood of being obese is significantly higher for

individuals in lower SES quartiles. This applies to both men and women, but the gradient is more pronounced for women.

Results for the regressions of EQ-5D score against the obesity variable ($BMI \geq 30 \text{ kg/m}^2$) plus the covariates are in Table 3. The results show the coefficients and t-statistics on the obesity measure in each SES quartile and groups of quartiles. The coefficient on the obesity variable is significant and negative in every quartile. It is more negative in poorer quartiles. Similar results were found for men and women, but the negative effect of obesity is stronger in women than in men in every quartile. All the coefficients with a significance value of 1% are significantly different from zero at the 1% level. The obesity coefficients in the poorest quartile were significantly different from those in the other quartiles (Whole sample: $p < 0.0001$, Men: $p = 0.0018$, Women: $p = 0.0006$).

Similar results are presented in Table 4, but in these models we also control for the type and number of longstanding illnesses. The impact of obesity on EQ-5D score remains significant and negative in all quartiles and for both genders, but the magnitude of effect is reduced. The obesity coefficients in the poorest quartile were significantly more negative than those in the other quartiles ($p = 0.07$).

In Table 5 we examine the proportion of obese people in each SES quartile falling in each WHO obesity classification (Class I, $30 \text{ kg/m}^2 \leq BMI < 34.99 \text{ kg/m}^2$), Class II ($35 \text{ kg/m}^2 \leq BMI < 39.99 \text{ kg/m}^2$) and Class III ($BMI \geq 40 \text{ kg/m}^2$). A higher percentage of people in the poorest quartile are in Class III compared with the other SES quartiles, and a higher percentage in the richest quartile are in Class I. We also report mean EQ-5D score by SES quartile and obesity class. This declines by class and by SES quartile. The results indicate that obesity affects EQ-5D score across the BMI range.

Building on these findings, in Figure 1 we show graphically the results of the OLS regressions of EQ-5D score against BMI, BMI squared and the covariates. The linear predictions of EQ-5D score at each BMI value were computed by setting covariates equal to their mean values. Results are shown for SES quartile 1 (the poorest quartile) and SES quartiles 2-4 combined. The coefficients on the BMI variables are significantly different to zero in every case. The relationship is concave, suggesting that both low and high BMI values are associated with lower EQ-5D scores. Individuals in the poorest quartile have lower EQ-5D scores than those in quartiles 2-4 at all BMI levels, and among obese, the effect of increasing BMI on EQ-5D scores is more negative in the poorest quartile.

As before, we found similar results when we control for the type and number of longstanding illnesses, though the order of magnitude of effect diminishes (Figure 2). An example of these models is in Appendix Table A3.

Discussion

In this paper we use representative health survey data from 2003 to 2006 to investigate the relationship between SES, obesity and HRQOL in England. We create a measure for SES based on an interval regression of total annual household income against a comprehensive set of SES indicators. We use this measure to investigate the relationship between obesity and SES, the effect of obesity on HRQOL, and how this varies by SES.

Previous studies have shown a significant relationship between a number of diverse SES indicators and obesity in women; in men the relationship is less conclusive. Controlling for a comprehensive set of covariates we find in our study that the likelihood of being obese declines significantly with SES. These results are significant for both men and for women, but the effect is more pronounced in women.

We show that obesity has a negative effect on HRQOL, measured using the EQ-5D, for both men and women and after controlling for longstanding illnesses. This is contrary to some previous studies (e.g., Macran, 2004), but not others (e.g., Sach et al, 2006). In addition, we also find that obesity has a more negative effect on HRQOL in low SES groups compared with high SES groups. This finding prevails for both men and women, though it is strongest in women. It also persists after controlling for the type and number of longstanding illnesses. We find these effects when we focus on obesity as a binary indicator and using BMI as a continuous variable.

Why might we observe this differential negative effect of obesity on HRQOL by SES? Hauck et al (2002) offer some possibilities. Based on their work, we posit that the inequalities observed in this paper might arise due to SES-patterned variations in the access to, use of and/or quality of obesity-related public health interventions, or due to similar variations in health productions, which affect individual's ability to produce health. But this is conjecture, and further research is needed.

In summary, we show that SES appears to have a 'double whammy effect' on obesity-related HRQOL. Low SES groups are more likely to be obese and when they are obese the effect of obesity on HRQOL is more negative in lower SES groups.

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Table 1. Interval regression of total annual household income on SES indicators

Variable	Coefficient	Z-score
<i>Education</i>		
Degree or equiv	Base category	
Higher education below degree	-9799 ***	-15.11
NVQ3/GCE A Level equiv	-7685 ***	-10.53
NVQ2/GCE O Level equiv	-10231 ***	-16.31
NVQ1/CSE other grade equiv	-11363***	-14.11
Foreign/other	-13419***	-17.25
No qualification	-10779***	-16.44
<i>Social Class of HRP</i>		
Professional	Base category	
Managerial technical	-4809 ***	-4.42
Skilled non-manual	-13251 ***	-11.51
Skilled manual	-13268 ***	-11.99
Semi-skilled manual	-14341 ***	-12.61
Unskilled manual	-14652 ***	-12.9
<i>Cars owned by household</i>		
Household has no car	Base category	
One	300	0.59
Two	7561 ***	10.79
Three or more	16337 ***	11.54
<i>Household tenure</i>		
Own outright	Base category	
Buying with help of a mortgage or loan	4310 ***	6.59
Pay part rent and part mortgage	-1130	-0.62
Rent	-928	-1.32
Live rent free and/or squatting	-6967 ***	-4.74
<i>Bedrooms in household</i>		
One bedroom	Base category	
Two bedrooms	683	1.12
Three bedrooms	3034 ***	4.55
Four bedrooms	10627 ***	10.63
Five or more bedrooms	25708 ***	12.88
<i>Activity status for last week</i>		
In paid employment or self-employed	Base category	
Going to school or college full time	-10331 ***	-4.51
On a government scheme for employment training	-15454 ***	-6.98
Doing unpaid work for a business that you own, or that a rel	-2156	-0.27
Waiting to take up paid work already obtained	-3446	-0.59
Looking for paid work or a government training scheme	-14299 ***	-14.23
Intending to look for work but prevented by temporary sickness	-14720 ***	-9.99
Permanently unable to work because of long-term sickness	-11422 ***	-15.5
Retired from paid work	-12587 ***	-23.01
Looking after home or family	-10348 ***	-9.87
Doing something else	-19093 ***	-10.11
<i>Index of multiple deprivation (SOA level)</i>		
0.59 -> 8.35 (least deprived)	Base category	
8.35 -> 13.72	-2937 ***	-3.87
13.72 -> 21.16	-3946 ***	-5
21.16 -> 34.21	-5558 ***	-7.2
34.21 -> 86.36 (most deprived)	-6138 ***	-7.96
<i>Income support claimant</i>		
Yes	-2041 **	-2.49
No	Base category	
Constant	47940 ***	31.21
Observations		33,716
Adjusted R-squared		0.077

***p<0.01, **p<0.05, *p<0.1

Table 2. Logistic regressions of obesity against SES group

	Odds Ratio	z
Whole sample		
Q1 (poorest)	2.0 ***	13.3
Q2	1.4 ***	7.9
Q3	1.3 ***	5.6
Q4 (richest) - Base category	1.0	-
Men		
Q1 (poorest)	1.6 ***	6.4
Q2	1.2 **	2.6
Q3	1.3 ***	3.7
Q4 (richest) - Base category	1.0	-
Women		
Q1 (poorest)	2.5 ***	13.4
Q2	1.8 ***	9.5
Q3	1.3 ***	4.8
Q4 (richest) - Base category	1.0	-

***p<0.01, **p<0.05, *p<0.1.

The dependent variable is obesity ($BMI \geq 30 \text{kg/m}^2$). The odds ratios and z scores are for each SES quartile. Covariates are also included but not reported for age, gender, survey year, marital status, government office region and ethnicity (see text).

Table 3. OLS regressions of EQ-5D score against obesity

	Whole sample		Male		Female	
	Coef.	t	Coef.	t	Coef.	t
Q1 (poorest)	-0.072 ***	-9.34	-0.061 ***	-4.68	-0.079 ***	-8.05
Q2	-0.038 ***	-6.49	-0.030 ***	-3.61	-0.044 ***	-5.47
Q3	-0.036 ***	-7.33	-0.024 ***	-3.88	-0.050 ***	-6.29
Q4 (richest)	-0.023 ***	-5.1	-0.016 ***	-2.68	-0.032 ***	-4.42
Q2+Q3+Q4	-0.033 ***	-11.13	-0.023 ***	-5.92	-0.043 ***	-9.64
Q1+Q2+Q3+Q4	-0.043 ***	-14.66	-0.031 ***	-7.53	-0.055 ***	-13.03

***p<0.01, **p<0.05, *p<0.1.

The dependent variable is EQ-5D score. The coefficients and t-statistics are for the obesity variable ($BMI \geq 30 \text{kg/m}^2$) in each SES quartile. Covariates are also included but not reported for age, gender, survey year, marital status, government office region, ethnicity and SES (see text).

Table 4. OLS regressions of EQ-5D score against obesity also controlling for longstanding illnesses

	Whole sample		Male		Female	
	Coef.	t	Coef.	t	Coef.	t
Q1 (poorest)	-0.030 ***	-4.51	-0.021 *	-1.91	-0.035 ***	-4.21
Q2	-0.018 ***	-3.73	-0.012 *	-1.71	-0.023 ***	-3.52
Q3	-0.020 ***	-4.97	-0.013 **	-2.48	-0.029 ***	-4.27
Q4 (richest)	-0.018 ***	-7.09	-0.008	-1.57	-0.022 ***	-3.47
Q2+Q3+Q4	-0.021 ***	-8.46	-0.011 ***	-3.26	-0.025 ***	-6.71
Q1+Q2+Q3+Q4	-0.023 ***	-8.52	-0.013 ***	-3.83	-0.028 ***	-8.03

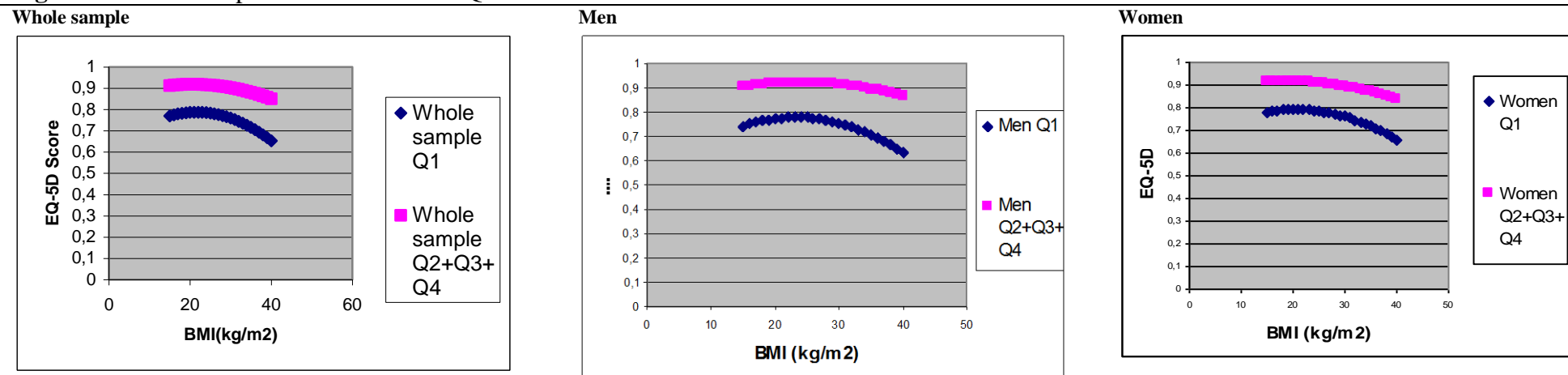
***p<0.01, **p<0.05, *p<0.1.

The dependent variable is EQ-5D score. The coefficients and t-statistics are for the obesity variable ($BMI \geq 30 \text{kg/m}^2$) in each SES quartile. Covariates are also included but not reported for age, gender, survey year, marital status, government office region, ethnicity, SES, type and number of longstanding illnesses (see text).

Table 5. % sample in each obesity category plus mean EQ-5D scores

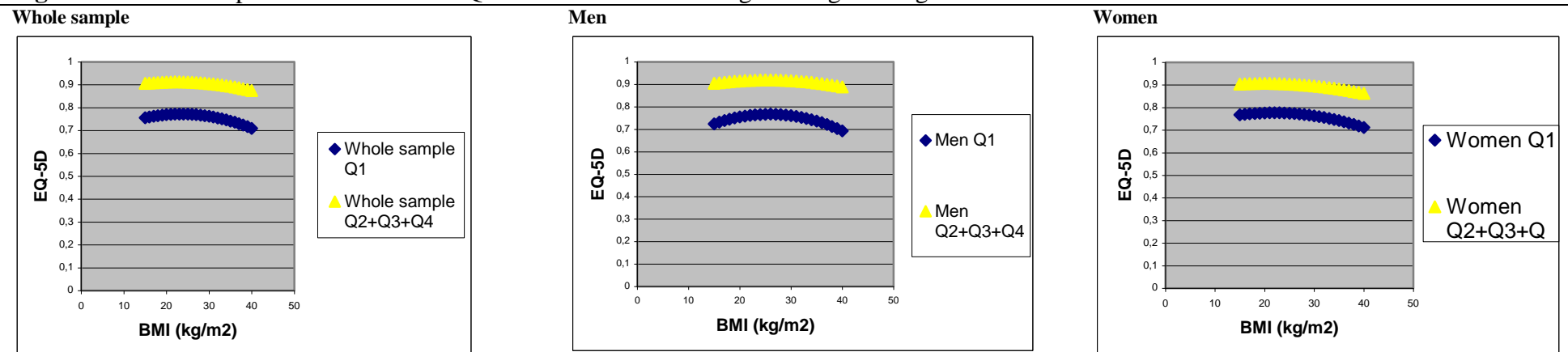
	Q1 (poorest)		Q2		Q3		Q4 (richest)	
	% (n)	Mean EQ-5D	% (n)	Mean EQ-5D	% (n)	Mean EQ-5D	%, (n)]	Mean EQ-5D
Class I ($BMI=30-34.99 \text{kg/m}^2$)	67 (1406)	0.727	71 (1326)	0.854	71 (1233)	0.888	74 (1089)	0.913
Class II ($BMI=35-39.99 \text{kg/m}^2$)	23 (476)	0.663	20 (366)	0.832	22 (385)	0.860	20 (290)	0.894
Class III ($BMI \geq 40 \text{kg/m}^2$)	10 (201)	0.624	10 (179)	0.781	7 (128)	0.859	6 (95)	0.847
Total	100 (2,086)		100 (1,874)		100 (1,746)		100 (1,475)	

Figure 1: Relationship between BMI and EQ-5D score



The dependent variable is EQ-5D score. The lines are derived from the coefficients on BMI and BMI squared in each SES quartile. Covariates are also included for age, gender, survey year, marital status, government office region, ethnicity and SES (see text). The covariates are included in the linear predictions of EQ-5D at their sample mean values.

Figure 2: Relationship between BMI and EQ-5D score also controlling for longstanding illnesses



The dependent variable is EQ-5D score. The lines are derived from the coefficients on BMI and BMI squared in each SES quartile. Covariates are also included for age, gender, survey year, marital status, government office region, ethnicity, SES and longstanding illnesses (see text). The covariates are included in the linear predictions of EQ-5D at their sample mean values.

Appendix

Table A1: Summary statistics for the variables used in the analysis

	Whole sample (n=33 716)	Male (n=15 160)	Female (n=18 556)				
EQ-5D	0.864	0.875	0.855	Bedrooms in household			
BMI				One bedroom	7%	7%	7%
BMI	27	27	27	Two bedrooms	22%	22%	23%
BMI squared	762	766	758	Three bedrooms	49%	49%	49%
Obese (BMI>30)	24%	24%	24%	Four bedrooms	17%	18%	16%
				Five or more bedrooms	5%	5%	5%
SES measures				Activity status for last week			
Predicted income	32574	33762	31604	In paid employment or self-employed	66%	67%	64%
Q1 (poorest)	25%	23%	27%	Going to school or college full time	1%	1%	1%
Q2	25%	25%	25%	On a government sch. for employ. Training	0%	0%	0%
				Doing unpaid work for a business that you own, or that a rel	0%	0%	0%
Q3	25%	26%	24%	Waiting to take up paid work already obtained	0%	0%	0%
Q4 (richest)	25%	27%	24%	Looking for paid work or a govern training sch	1%	1%	1%
				Intending to look for work but prevented by temp. sickness	0%	0%	0%
Education				Permanently unable to work because of long-term sickness	4%	5%	4%
Degree or equiv	19%	21%	17%	Retired from paid work	23%	23%	24%
Higher education below degree	12%	13%	10%	Looking after home or family	4%	2%	6%
NVQ3/GCE A Level equiv	13%	13%	12%	Doing something else	0%	0%	0%
NVQ2/GCE O Level equiv	24%	21%	25%				
NVQ1/CSE other grade equiv	5%	7%	4%	Index of multiple deprivation (SOA level)			
Foreign/other	3%	1%	4%	0.59 -> 8.35	22%	22%	22%
No qualification	26%	24%	28%	8.35 -> 13.72	21%	22%	21%
				13.72 -> 21.16	21%	21%	20%
Social Class of HRP				21.16 -> 34.21	20%	19%	20%
Professional	8%	9%	7%	34.21 -> 86.36	16%	16%	17%
Managerial technical	36%	36%	35%				
Skilled non-manual	15%	12%	18%				
Skilled manual	24%	27%	21%				
Semi-skilled manual	14%	12%	14%				
Unskilled manual	4%	4%	5%				
Cars owned by household							
Household has no car	16%	14%	21%				
One	43%	44%	42%				
Two	31%	33%	30%				
Three or more	8%	9%	7%				

Longstanding Illnesses

No Long-Standing Illnesses	53%	54%	53%
Long-Standing Illnesses	28%	28%	28%
Two Long-Standing Illnesses	12%	12%	12%
Three Long-Standing Illnesses	5%	5%	5%
Four or more Long-standing Illnesses			
Neoplasms & benign growths	2%	2%	2%
Endocrine & metabolic	2%	2%	2%
Mental disorders	8%	7%	8%
Nervous system	4%	3%	4%
Eye complaints	4%	4%	5%
Ear complaints	2%	3%	2%
Heart & circulatory system	2%	3%	2%
Respiratory system	13%	15%	12%
Digestive system	9%	9%	9%
Genito-urinary system	5%	5%	5%
Skin complaints	3%	2%	3%
Musculoskeletal system	2%	2%	2%
Infectious Disease	20%	19%	21%
Blood & related organs	0%	0%	0%
	1%	1%	1%

Income support

Yes	6%	5%	8%
No	94%	95%	92%

Year

2003	35%	35%	35%
2004	16%	15%	16%
2005	17%	18%	17%
2006	32%	32%	32%

Marital status

Single	17%	19%	16%
Married	56%	59%	53%
Separated	2%	2%	3%
Divorced	7%	5%	8%
Widowed	7%	4%	10%
Cohabitees	11%	11%	11%

Household tenure

Own it outright	30%	30%	30%
Buying with help of a mortgage or loan	45%	47%	44%
Pay it part rent and part mortgage	1%	1%	1%
Rent it	23 %	21%	24%
Live rent free and squatting	1 %	1%	1%

Government office region

North East	6%	6%	6%
North West	14%	14%	14%
Yorkshire and the Humber	10%	10%	10%
East Midlands	9%	9%	9%
West Midlands	11%	11%	11%
East of England	12%	13%	12%
London	11%	11%	11%
South West	10%	10%	10%
South East	17%	17%	17%

Year

2003	35%	35%	35%
2004	16%	15%	16%
2005	17%	18%	17%
2006	32%	32%	32%

Table A2: The results of the logistic regressions of obesity against SES group

	Whole sample		Male		Female	
	Odds Ratio	z	Odds Ratio	z	Odds Ratio	Z
SES-Groups						
Quartile one	1.98	13.32	1.59	6.44	2.50	13.35
Quartile two	1.44	7.92	1.18	2.59	1.78	9.46
Quartile three	1.28	5.55	1.25	3.7	1.334	4.78
Quartile four	Base group		Base group		Base group	
Age						
Age	1.08	2.95	1.12	3.82	1.11	3.99
Age2	1.00	-0.98	1.00	-1.68	1.00	-2.03
Age3	1.00	-0.55	1.00	-0.16	1.00	0.42
Gender						
men	0.32	-2.11				
Age*men	1.07	1.82				
Age2*men	1.00	-1.35				
Age3*men	1.00	0.78				
Year						
2003	Base group		Base group		Base group	
2004	1.04	0.78	1.07	1.05	1.01	0.07
2005	1.06	1.22	1.03	0.51	1.07	1.26
2006	1.11	2.77	1.14	2.55	1.07	1.48
Marital status						
Married	Base group		Base group		Base group	
Single	0.76	-4.92	0.71	-4.41	0.83	-2.55
Separated	0.58	-5.15	0.48	-3.94	0.63	-3.59
Divorced	0.70	-5.95	0.66	-4.25	0.71	-4.46
Widowed	0.91	-1.46	1.12	0.94	0.82	-2.52
Cohabitees	0.89	-2.2	0.97	-0.39	0.80	-2.98
Government Office Region						
North East	1.31	3.19	1.24	1.79	1.39	3.17
North West	1.23	2.96	1.20	1.82	1.28	2.71
Yorkshire and The Humber	1.29	3.43	1.30	2.57	1.30	2.73
East Midlands	1.36	3.98	1.35	2.82	1.40	3.4
West Midlands	1.50	5.47	1.42	3.45	1.61	5.04
East of England	1.31	3.77	1.27	2.44	1.37	3.42
London	Base group		Base group		Base group	
South West	1.22	2.66	1.21	1.83	1.26	2.26
South East	1.15	1.92	1.07	0.72	1.24	2.34
Ethnicity						
White	Base group		Base group		Base group	
Black Caribbean	1.31	1.76	0.94	-0.24	1.65	2.94
Black African	1.19	1.04	0.78	-0.97	1.83	2.77
Indian	0.78	-1.87	0.68	-2.15	0.91	-0.47
Pakistani	1.06	0.35	0.88	-0.53	1.36	1.55
Bangladeshi	0.64	-1.32	0.46	-1.5	0.89	-0.3
Chinese	0.24	-2.13	0.21	-2.08	0.29	-1.2
Other Ethnicity	0.85	-1.13	0.77	-1.47	0.97	-0.14
Missing ethnicity	0.21	-1.46	0.56	-0.53		
Number of observations	29616		13601		16007	
Pseudo R2	0.0362		0.0381		0.0395	

Table A3: Results of OLS regressions of EQ-5D score against BMI controlling for longstanding illnesses

	Whole Sample				Men				Women			
	Q1 Coef.	t	Q2, Q3 and Q4 Coef.	t	Q1 Coef.	t	Q2, Q3 and Q4 Coef.	t	Q1 Coef.	t	Q2, Q3 and Q4 Coef.	t
BMI	0.01067	2.62	0.0056	3.16	0.019	2.21	0.0072	2.64	0.0087	1.8	0.004	1.94
BMI squared	-0.00023	-3.3	-0.0001	-4.04	-4E-04	-2.4	-1E-04	-3	-2E-04	-2.48	-0	-2.79
Age												
Age	-0.01597	-4.2	-0.0016	-0.89	-0.024	-4.7	-0.002	-1	-0.015	-4.01	-0	-0.82
Age2	0.00029	3.76	2E-05	0.46	5E-04	4.62	3E-05	0.73	0.0003	3.48	2E-05	0.45
Age3	-1.58E-06	-3.3	-1.6E-07	-0.52	-3E-06	-4.4	-2.3E-07	-0.8	-1.5E-06	-3.02	-1.6E-07	-0.49
Gender												
Men	0.06789	0.76	-0.0072	-0.25								
Age*men	-0.00728	-1.2	0.0005	0.21								
Age2*men	0.00018	1.38	-3.6E-07	-0.01								
Age3*men	-1.22E-06	-1.5	-1.4E-08	-0.03								
Year												
2003-Base group												
2004	-0.01264	-1.4	-0.0029	-0.88	-0.006	-0.4	-0.007	-1.6	-0.017	-1.6	0.002	0.45
2005	0.00522	0.63	-0.0007	-0.26	-0.013	-1	0.0004	0.11	0.0188	1.91	-0	-0.43
2006	-0.00361	-0.5	-0.0002	-0.09	-0.003	-0.2	-4E-04	-0.1	-0.004	-0.42	2E-04	0.05
Marital status												
Married	Base group		Base group		Base group		Base group		Base group		Base group	
Single	0.03727	3.44	0.0009	0.3	0.051	3.28	0.0021	0.5	0.0234	1.65	4E-04	0.09
Separated	0.02198	1.18	-0.0075	-1.05	0.001	0.03	0.0057	0.47	0.0343	1.6	-0.02	-1.85
Divorced	0.00487	0.46	-0.0043	-0.83	0.001	0.06	-0.003	-0.4	0.0064	0.5	-0.01	-0.8
Widowed	0.01082	1.25	0.0003	0.04	-0.009	-0.6	0.0131	1.08	0.0171	1.65	-0.01	-0.65
Cohabitees	0.00149	0.1	0.0035	1.25	0.017	0.82	0.0019	0.5	-0.009	-0.46	0.005	1.17
Government Office Region												
North East	-0.00232	-0.2	-0.0079	-1.37	-0.023	-1.1	-0.006	-0.8	0.0183	0.96	-0.01	-1.09
North West	0.00164	0.14	-0.0021	-0.48	-0.017	-0.9	-0.003	-0.6	0.0181	1.19	-6.5E-04	-0.1
Yorkshire and The Humber	0.01348	1.1	-0.0013	-0.28	-0.006	-0.3	-0.008	-1.4	0.0305	1.9	0.006	0.95
East Midlands	0.02581	1.88	0.0027	0.55	0.012	0.6	-0.003	-0.5	0.0386	2.19	0.008	1.19
West Midlands	0.01006	0.84	-0.0036	-0.76	-0.008	-0.4	-0.01	-1.8	0.0249	1.63	0.003	0.47
East of England	0.02464	2.06	0.0005	0.11	0.017	0.94	-0.004	-0.8	0.0322	2.03	0.005	0.76
London	Base group		Base group		Base group		Base group		Base group		Base group	
South West	0.01835	1.5	0.0025	0.56	0.006	0.29	-0.006	-1.1	0.031	1.86	0.011	1.72
South East	0.02299	1.91	0.0028	0.66	9E-04	0.05	-0.004	-0.8	0.0405	2.67	0.01	1.64
Ethnicity												
White	Base group		Base group		Base group		Base group		Base group		Base group	
Black Caribbean	0.01989	0.66	-0.0209	-2.05	0.007	0.15	-0.015	-1	0.033	1.06	-0.02	-1.56
Black African	-0.00872	-0.3	-0.0051	-0.52	0.009	0.28	-0.008	-0.5	-0.029	-0.6	4E-04	0.03
Indian	-0.03298	-0.9	-0.0102	-1.36	0.004	0.07	-0.014	-1.4	-0.063	-1.15	-0	-0.38
Pakistani	0.03044	1.07	-0.0443	-3.69	0.01	0.28	-0.034	-2	0.0683	2.28	-0.06	-3.18
Bangladeshi	0.00032	0.01	-5.0E-02	-2.54	-0.124	-1.2	-0.073	-2.6	0.107	1.8	-0.02	-1.31
Chinese	-0.00651	-0.1	0.0117	0.93	0.007	0.03	0.0053	0.24	0.0088	0.47	0.019	1.33
Other Ethnicity	-0.02529	-0.9	-0.0172	-2	0.036	1.12	-0.023	-1.8	-0.096	-1.9	-0.01	-1.29
Missing ethnicity	0.13267	5.04	0.0144	0.35	(dropped)		-0.037	-0.6	0.1256	3.9	0.065	1.29
Prediction of income	3.36E-06	5.23	6.2E-07	9.12	3.7E-06	3.68	6.1E-07	6.6	3.2E-06	4.07	6.1E-07	6.49
Longstanding Illnesses												
No Limiting Long-Standing Illness	Base group		Base group		Base group		Base group		Base group		Base group	
Neoplasms & benign growths	-0.00799	-0.4	-0.0421	-3.48	-0.019	-0.6	-0.044	-2.5	-6E-04	-0.03	-0.04	-2.45
Endocrine & metabolic	0.03531	3.14	0.0025	0.46	0.03	1.67	-0.008	-1	0.0386	2.73	0.012	1.53
Mental disorders	-0.12029	-7.3	-0.1277	-10.4	-0.076	-3.1	-0.117	-6	-0.159	-7.33	-0.14	-9.17
Nervous system	-0.06591	-3.6	-0.0493	-5.58	-0.103	-3.3	-0.052	-3.7	-0.035	-1.69	-0.05	-4.29
Eye complaints	0.06094	3.5	0.0252	2.35	0.033	1.15	0.0414	3.22	0.0782	3.84	-0	-0.03
Ear complaints	0.04852	2.58	0.0217	2.22	0.049	1.78	0.0259	2.18	0.0482	2.06	0.015	0.89
Heart & circulatory system	-0.0071	-0.8	-0.0104	-2.14	-0.02	-1.3	-0.011	-1.6	0.0064	0.57	-0.01	-1.52
Respiratory system	-0.01195	-1	0.0092	2.07	-0.011	-0.6	0.0107	1.9	-0.01	-0.68	0.006	0.9
Digestive system	-0.01995	-1.4	-0.0237	-3.28	2E-04	0.01	-0.027	-2.9	-0.027	-1.55	-0.02	-1.79
Genito-urinary system	0.00151	0.08	-0.0135	-1.38	0.018	0.7	-0.009	-0.5	-0.008	-0.29	-0.02	-1.42
Skin complaints	0.01942	0.74	0.0285	3.1	0.04	0.95	0.0116	0.81	0.0127	0.39	0.041	3.68
Musculoskeletal system	-0.12402	-13	-0.0909	-19.3	-0.125	-8.2	-0.076	-12	-0.122	-10.6	-0.11	-15.8
Infectious Disease	-0.04029	-0.6	-0.0544	-1.19	-0.121	-1.7	-0.047	-0.8	0.2223	3.69	-0.07	-1.04
Blood & related organs	0.02552	0.81	-0.0206	-1.21	-0.036	-0.6	0.0435	2.74	0.0608	1.83	-0.05	-2.17
Limiting Longs-standing Illness	-0.19792	-24	-0.1175	-26.3	-0.213	-17	-0.126	-20	-0.184	-18.2	-0.11	-17.1
Two Limiting Long-Standing Illnesses	-0.03777	-3	-0.012	-1.84	-0.041	-2	-0.005	-0.6	-0.04	-2.54	-0.02	-1.89
Three Limiting Long-Standing Illnesses	-0.0975	-4.8	-0.0549	-4.19	-0.094	-2.8	-0.046	-2.6	-0.108	-4.28	-0.06	-3.15
Four or More Limiting Long-Standing Ill	-0.1123	-3.6	-0.1105	-4.79	-0.097	-2	-0.114	-3.1	-0.135	-3.46	-0.1	-3.74
Constant	0.99663	12.3	0.9112	26.98	0.956	7.19	0.8868	21.3	1.0161	11.31	0.926	22.6
Number of obs	6399		22004		2618		10411		3781		11593	
Pseudo R2	0.4104		0.3055		0.22475		0.12795		0.20957		0.3222	