

1 **Socio-economic determinants of anthropometric measures of abdominal adiposity among older**
2 **people in England**

3 **José Luis Iparraguirre^{1,2} and Lam SzeSam³**

4 **Abstract**

5 **Objective:** to look into the socio-economic determinants of levels of three anthropometric measures
6 of abdominal adiposity among older people in England -body mass index, waist circumference (WC),
7 and waist-hip ratio (WHR)- and of changes along two health risk classifications: the World Health
8 Organisation classification based on BMI levels and the WHO combined classification based on BMI
9 and waist circumference measurements..

10 **Design:** quantile regression and multinomial analysis using data from the English Longitudinal Study
11 of Ageing (ELSA), wave 2 (2004-05) and wave 4 (2008-09)

12 **Results:** The quantile analysis on levels led to disparate results depending on the wave, which would
13 question results previously published based on only one wave. However, we found that age tends to
14 present an inverse U-shaped relationship with BMI and WC, smoking is negatively associated with
15 BMI and positively with WC and WHR, alcohol consumption is negatively associated with BMI and
16 WC levels, net total wealth is negatively related with the three anthropometric measures,
17 educational attainment is negatively associated with each measure, and depression is positively
18 associated with each measure. The multinomial analysis found that living in a larger household size
19 increases the likelihood of becoming or remaining unhealthy irrespective of which classification we
20 used. Furthermore, using the BMI-based categorisation, the initial category is highly relevant as a
21 predictor of the category four years later and alcohol consumption would be positively associated
22 with being or becoming obese. From the combined BMI-WC categorisation, we found that net total
23 wealth would be negatively associated with becoming or remaining unhealthy whereas depression is
24 a significant predictor of becoming or remaining unhealthy.

25 **Keywords:** malnutrition, obesity, socio-economic determinants, older people, body mass index,
26 waist circumference, waist-hip ratio.

¹ Chief Economist, Age UK.

Tavis House, 1-6 Tavistock Square, WC1H 9NA, London, United Kingdom

Tel: (+44)(0)20 3033 1482

E-mail: jose.iparraguirre@ageuk.org.uk

² Corresponding author.

³ Tavis House, 1-6 Tavistock Square, WC1H 9NA, London, United Kingdom

Tel: (+44)(0)20 3033 1482

E-mail: szesam.lam@ageuk.org.uk

27

28 **1. Introduction**

29 It is generally accepted that being either underweight or obese are health risk factors amongst the
30 older population and that the former poses greater risk than being obese among older people (ref.
31 1). However, how to define obesity in the older population is a matter of debate (ref. 2).

32 Obesity is measured by a variety of methods⁴. The two field methods most often used in large
33 surveys and epidemiological studies are anthropometry and bioelectrical impedance⁵. The three
34 main anthropometric measures of abdominal adiposity are the body mass index (BMI) –a measure of
35 general adiposity- and the waist circumference and the waist-hip ratio (both measures of central
36 adiposity). Of these, BMI is, by far, the most well-known and widely used indicator of adiposity.
37 Bioelectrical impedance analysis, in turn, estimates body composition by measuring the conductance
38 of low-level electrical current that is passed through the body.

39 *Body Mass Index*

40 There seems to be a U-shaped pattern between BMI and mortality among older people irrespective
41 of sex, with largest risks associated with lower BMI followed by BMI levels denoting obesity, though
42 mortality risk is usually lowest for those with a BMI between 25.0–29.9 kg/m², whom according to
43 the World Health Organisation (WHO) would be classified as overweight (ref. 3; ref. 4; ref.5).⁶

44 The WHO classification has been criticised especially when applied to older people –in particular
45 because of the seemingly healthy consequences amongst the elderly of being overweight. There is
46 less disagreement, though, about the health consequences for older people of qualifying as either
47 underweight or obese under the WHO classification. Albeit not unanimously⁷, it is generally
48 accepted that a BMI value of 20 kg/m² or under is a good measure of underweight among older
49 people⁸ and the WHO guidelines for obesity are also widely used in studies of older people (e.g. ref.
50 8). Consequently, we defined two BMI-related risk health states for older people: malnutrition
51 (BMI<20 Kg/m²) and obesity (BMI>30 Kg/m²).

⁴ See ref. 6 for a short summary and ref. 7 for a book-length exposition.

⁵ Other methods, such as densitometry, dual-energy X-ray absorptiometry, and magnetic resonance imaging, though more precise, are more expensive to administer.

⁶ Ref. 8 argues that studies that focus on mortality would be masking the true relationship between BMI and health status: they found that BMI is positively associated with three biomarkers of health risk: high-sensitivity CRP (mg/dL) (for inflammation), HbA1c (%) (for metabolic function), and HDL cholesterol (mg/dL) (for cardiovascular function).

⁷ Ref. 21

⁸ See, for example, ref. 22. Ref. 23 and ref. 24 also use this guideline in their studies of malnutrition among elderly subjects.

52 Even regardless their relationship with mortality risk, BMI levels have been found to be positively
 53 associated with three biomarkers of health risk: high-sensitivity CRP (mg/dL) (for inflammation),
 54 HbA1c (%) (for metabolic function), and HDL cholesterol (mg/dL) (for cardiovascular function) – see
 55 ref. 9. Furthermore, ref. 10 found that older adults with a BMI under 18.5 Kg/m² were at higher risk
 56 of diabetes than those with BMI levels between 18.5 Kg/m² and 24.9 Kg/m². Similarly, a recent study
 57 among older people in Taiwan (ref. 11) found that BMI was positively associated with undiagnosed
 58 diabetes in men and were significantly associated with impaired fasting glucose in both men and
 59 women. Significant associations have also been found between obesity and mobility disability and
 60 physical impairment among older people (ref. 12; ref. 2; and ref.13). Moreover, about 5.5% of all
 61 cancers in the UK have been attributed to overweight and obesity –an estimated 17,294 excess cases
 62 in 2010 (ref. 14). Finally, the association between BMI and frailty also shows a U-shaped curve, with
 63 greatest risk outside the 25-29.9 Kg/m² BMI levels (ref. 15).

64 *Alternative Anthropometric Measures*

65 BMI is a good predictor of mortality among older people in the US only after adjusting for waist
 66 circumference (ref. 16). The World Health Organisation (ref. 17) produced a combined BMI-waist
 67 circumference classification of adults' relative health risk to type 2 diabetes and cardiovascular
 68 disease (Table 1).

69 **Table 1**
 70 **Risk to type 2 diabetes and cardiovascular disease**
 71 **by combined BMI and Waist Circumference categories**

	Waist circumference (cms.)			
		Low	high	Very High
BMI (kg/m ²)	Males	<94	94-102	>102
	Females	<80	80-88	>88
Normal weight (18.5 to <25)		No increased risk	No increased risk	Increased risk
Overweight (25 to <30)		No increased risk	Increased risk	High risk
Obese (30 to <35)		Increased risk	High risk	Very high risk

72
 73 Source: ref. 17

74 Waist circumference predicts long-term mortality among older people with chronic heart failure,
 75 whereas BMI does not (ref. 18). Waist-hip-ratio is a strong predictor of all-cause mortality in high-
 76 functioning older adults, whereas neither BMI nor waist circumference were associated with
 77 mortality (ref. 19). In the same vein, mortality risk among people aged 75 and over is associated with

78 waist-hip ratio whereas the BMI measure tends to overestimate this risk; in turn, waist
79 circumference is not related to mortality risk (ref. 20).

80 Lisko et al. investigated the predictive power of mortality of BMI, waist circumference and waist-hip
81 ratio among people aged 90 and over and found that low BMI and a low waist circumference were
82 positively associated with mortality among men, whilst for women waist-hip ratio adjusted for BMI
83 was the only statistically significant predictor of mortality (ref. 25). Contrastingly, ref. 26 found that
84 excess deaths were similarly attributable to BMI and a number of alternative anthropometric
85 measures, including waist circumference and waist-hip ratio, among US adults. Similarly, among
86 older people higher BMI levels (both for men and women) and waist circumference and waist-to-hip
87 measures (in men) were significantly associated with increased survival (ref. 27).

88 Waist circumference is significantly associated with increased risks of major depressive symptoms
89 among US adults (ref. 28). In contrast, Ho et al. (ref. 29) found that BMI was inversely associated
90 with depressive symptoms among older people in China, but did not find any significant association
91 between depressive symptoms and either waist circumference or waist-hip ratio.

92 Given the disparate findings in the literature, in this paper we use BMI, waist circumference and the
93 waist-hip ratio as measurements of underweight and obesity.

94 Goya Wannamethee et al. (ref. 30) recommended a composite measure of waist circumference and
95 mid-arm muscle circumference (a measure of muscle mass) as a proxy for body composition among
96 older subjects. We have not included any electrical impedance measures, because they are not
97 incorporated in the HES/ELSA surveys. In addition, Nishiwaki et al. (ref. 31) suggested that BMI
98 would overestimate the prevalence of obesity among older people because it does not allow for
99 spine curvature (i.e. kyphosis)⁹ and therefore alternative measures, such as armspan¹⁰ or demi-
100 span¹¹, have been proposed instead of height. However, no measures of mid-arm circumference,
101 armspan or demi-span are included in HSE or ELSA, and therefore, we could not use any of such
102 alternative measures.¹²

103 Socio-economic position (SEP), social roles and circumstance, and cultural aspects have a bearing on
104 the nutritional and healthy/unhealthy weight status among older people (ref. 32-34).

⁹ See, for example, ref. 31.

¹⁰ See, for example, ref. 35-36.

¹¹ Ref. 37

¹² Incidentally, the prevalence of kyphosis or lordosis in the UK is not high: they made up only 0.0029% of the primary diagnosis of all finished consultant episodes (increasing to 0.0035% amongst people aged 75 or over) and 0.00002% of all outpatient attendances in NHS Hospitals and NHS commissioned activity in the independent sector in England in 2010-11. (Source: ref. 38).

105 A number of papers have studied socio-economic determinants of obesity and/or malnutrition, or
106 both, for different countries and time periods (e.g. ref. 38-43¹³). However, only a handful looked
107 specifically into older people as opposed to merely introducing age as an explanatory factor in
108 models spanning the entire adult population.

109 Costa-Font, Fabbri and Gil (ref. 44) analysed the differences in BMI distributions between Spain and
110 Italy and looked in particular into three cohorts: those people aged between 18-39, 40-59, and 60-
111 75. Among the latter group, the BMI gap between both countries remained relatively constant for
112 both sexes.

113 Costa-Font, Fabbri and Gil (ref. 45) report the contribution of different independent variables on the
114 BMI gap by age cohorts (defined as ages 18-35, 36-50, and 51-65) between Spain and Italy. Among
115 men aged between 51 and 65 years old, the obesity gap between these countries is explained by the
116 influence of eating habits and peer effects, whereas among women in this age cohort peer effects is
117 the only significant variable accounting for the difference in BMI levels between both countries.

118 Pieroni and Salmasi looked into the British Household Panel Survey datasets for 2004 and 2006 to
119 study the socio-economic determinants of body weight by means of quantile regressions. Compared
120 to the complete sample, they did not find significant differences in the coefficients of the covariates
121 affecting the weight distribution of people aged over 50, except for age in central quantiles (ref. 46).

122 Lee et al. (ref. 47) studied the association between mortality risk and changes in weight and body
123 composition among older men in the US. They found a higher risk of mortality for men with weight,
124 total lean mass and total fat loss, as well as a slightly higher risk among those who had gained total
125 fat mass.

126 We seek to answer two research questions:

- 127 • which socio-economic variables have been associated with each of the three main
128 anthropometric measures of abdominal adiposity of older people between 2005 and 2009;
129 and
- 130 • which socio-economic variables are associated with the transitions between three categories
131 of BMI-related risk health and with transitions between combined BMI-Waist Circumference
132 risk health categories among older people between 2004/06 and 2008/09.

133 This paper is structured as follows. Section 2 describes the data and Section 3 explains the
134 econometric approaches. Section 4 presents and discusses the results whilst Section 5 concludes.

¹³ See ref. 48 for a survey of economic causes of obesity.

135

136 **2. Data**

137 We used the English Longitudinal Study of Ageing (ELSA), wave 2 (which corresponds to years 2004-
138 05) and wave 4 (2008-09). ELSA is a representative annual cross-sectional survey of people aged 50
139 years and over, living in private households in England¹⁴ –the sample is drawn from households that
140 previously responded to the Health Survey of England (HSE)¹⁵.

141 Figures 1 to 3 present the average BMI levels and the incidence of underweight (BMI<20 Kg/m²) and
142 of obesity (BMI>30 Kg/m²) for men and women aged 50 and over between 1998 and 2009,
143 respectively, using data from the HSE. Over this period, obesity has increased for both men and
144 women, whereas the prevalence of underweight has stayed more or less constant at around 1.3 per
145 cent for men and 3.1 per cent for women.

146 <Insert here Figures 1, 2 & 3>

147

148

149

150 We included the following variables as covariates (see Annex for a description of each variable):

- 151 • Age and age squared
- 152 • Total net (non-pension) wealth. We included total net (non-pension) wealth because it is
153 deemed preferable to income in ELSA-based studies (ref. 49-50).
- 154 • Highest Educational Qualification. Recently, using different statistical approaches, both ref.
155 51 for 10 European countries and ref. 52 in France found that higher measures of BMI and
156 waist circumference in adults are associated with lower educational levels.
- 157 • Economic activity. We defined it as a dichotomous variable with economic activity=1 for
158 being in employment and economic activity=0 for being unemployed or inactive.
- 159 • Household size
- 160 • Ethnicity. We defined it as a dichotomous variable with ethnicity=1 for being white and
161 ethnicity=0 for being Asian, Black, or Mixed.
- 162 • Marital status. We defined it as a dichotomous variable with marital status=1 for being
163 married or in cohabitation (and status=0 for being single, divorced, separated or widowed).

¹⁴ For a description of ELSA Wave 2, see ref. 53, and ref. 54 for a description of Wave 4.

¹⁵ For a description of the HSE, see ref. 55.

- 164 • Smoking. The effects of smoking on body weight remain unclear. For example, whilst Fang et
165 al. (ref. 56) found negative effects of smoking among underweight individuals whilst non-
166 significant effects among obese subjects, ref. 57 found positive effects of smoking along the
167 whole BMI distribution: it increases BMI at low and moderate BMI levels and decreases BMI
168 at high BMI levels.
- 169 • Alcohol consumption. The association between alcohol consumption and BMI levels seems
170 to be conditional on gender. A study of adult higher level drinkers across 10 European
171 countries found that females were more likely to have a lower BMI whereas male drinkers
172 generally weighed more than male abstainers (ref. 58). Similarly, ref. 59 and ref. 60 found
173 that moderate alcohol consumption was associated with a lower risk of obesity in older
174 women. In turn, ref. 61 found that alcohol consumption is associated with lower risk of
175 obesity among older men.
- 176 • Digestive system condition. Obesity and underweight are associated with a number of
177 digestive disorders such as gastro oesophageal reflux disease, Barrett's oesophagus,
178 precancerous polyps and cancer in the colon, acute pancreatitis, fatty liver disease, etc. We
179 included the HES question on digestive system problems to control for these
180 gastroenterological conditions¹⁶.
- 181 • Loneliness. Whilst mixed results have been found regarding the relationship between
182 loneliness and BMI among young cohorts (ref. 62), loneliness is generally more accepted as a
183 predictor of malnutrition among older people (ref. 63-64).
- 184 • Depression, which has been found to be associated with low appetite and malnutrition in
185 older people (ref. 65).
- 186 • Sitting height ratio (SHR). A number of authors have recommended incorporating this
187 variable as a covariate in nutritional studies given that the BMI indicator might overestimate
188 the prevalence of overweight and obesity among adults (e.g. ref. 66,67¹⁷, 68). Moreover, a
189 study among Chinese older people found SHR a predictor of systolic blood pressure, pulse
190 pressure, fasting blood glucose, LDL and HDL cholesterol, and diabetes even when
191 differences in BMI levels were accounted for (ref. 69), giving more weight to the inclusion of
192 SHR as a confounder.
- 193 On the other hand, we also checked whether an SHR-adjusted BMI would be significant
194 different from the observed BMI indicator. For this test, we followed the procedure
195 recommended in Norgan and Jones (ref. 70) and ran a univariate regression model between

¹⁶ Unfortunately, we could not control for diabetes as the HES datasets do not include the variable "doctor-diagnosed diabetes excluding pregnant" in 2007 and 2008. However we included this variable in an extended model for 2009, whose results we report.

¹⁷ Although see ref. 71 for a contrasting finding to ref. 67.

216 BMI and the SHR (at each wave) and obtained the SHR-adjusted BMI as the sum of the
 217 predicted BMI for the mean SHR and the residuals of the regression. Similarly to Bouças
 218 Ribeiro et al. (ref. 72) we failed to find any statistically significant differences between both
 219 metrics ($r^2=0.9874$ at wave 2 and $r^2=0.9868$ at wave 4). Hence, we kept SHR as a covariate in
 220 our model but used the observed BMI measurements as dependent variable.

221

222 To investigate changes over time, we defined two additional variables to operationalise the
 223 transitions:

- 224 • BMI risk category. We defined BMI risk categories given that, as mentioned earlier, being
 225 underweight or obese constitute health risk factors among older people. Because being
 226 underweight poses a higher risk than being obese, we distinguished between these two
 227 unhealthy categories. Hence, we have the three following possible BMI risk categories:
 228 – Unhealthy underweight (BMI < 20.0 9 kg/m²)
 229 – Unhealthy obese (BMI > 29.9 kg/m²)
 230 – Healthy: normal or overweight (BMI >20.0 and <29.9 kg/m²)

231 These three categories at each wave leads to nine possible transitions between waves. Table 2
 232 presents the movers in and stayers¹⁸ between each BMI risk category between both waves:

233 **Table 2**
 234 **Transitions between BMI Risk Categories**
 235 **ELSA Waves 2 and 4**
 236

Transitions	Cases
Underweight - Underweight	57
Underweight -Normal/Overweight	18
Underweight -Obese	1
Normal/Overweight - Underweight	29
Normal/Overweight -Normal/Overweight	2,149
Normal/Overweight -Obese	176
Obese-Normal/Overweight	123
Obese-Obese	783
Total	3,366

237

238

- 239 • WHO combined BMI-waist circumference risk category. We used the WHO classification as
 240 shown in Table 1, but we added BMI < 18.5 Kg/m² as a measure of underweight -and, hence,
 241 of risk. Table 3 presents the transitions across the categories between Wave 2 and Wave 4:

¹⁸ We did not use the movers-stayers Markov chain approach because we only had two periods (See ref. 73). For other recent longitudinal studies, see ref. 74-75.

222
223
224
225
226

Table 3
Transitions between WHO combined Risk Categories
(including Underweight)

No increased risk to No increased risk	786
No increased risk to Increased risk	194
No increased risk to High or Very High risk	73
Increased risk to No increased risk	94
Increased risk to Increased risk	302
Increased risk to High or Very High risk	271
High or Very High risk to No increased risk	38
High or Very High risk to Increased risk	132
High or Very High risk to High or Very High risk	1,419
Underweight to Underweight	11
Underweight to No increased risk	8
No increased risk to Underweight	8
Total[*]	3,336

[\[*\] There have been no instances of transitions between being underweight in one wave and being at increased or higher risk though not underweight in the other wave –or vice versa.](#)

227
228
229
230
231

ELSA Waves 2 and 4 Table 4 presents a summarised classification of the previous table, which we used in our model. The only healthy outcome is a combination of BMI and waist circumference that poses no increased risk.

232
233
234
235

Table 4
Transitions between WHO combined Risk Categories
(including Underweight)

Healthy to Healthy	786
Healthy to Unhealthy	275
Unhealthy to Healthy	140
Unhealthy to Unhealthy	2,135
Total	3,336

236
237
238
239

3. Econometric techniques

240 To analyse the socio-economic determinants of BMI, waist circumference and waist-hip ratio we
241 carried out a cross-sectional analysis with data from each wave to study the socio-economic
242 determinants of obesity. We ran quantile regression models by gender for each wave –that is, two
243 models per dependent variable per wave; twelve models in total. (Before running the quantile
244 regressions, we checked for equivalence of the coefficients across selected quantiles -0.05, 0.10,
245 0.50, 0.75, 0.90 and 0.95- using the Wald test to see whether the quantile regression approach was

246 justified.¹⁹ We found that some covariates were significantly different from each other across some
 247 of the quantiles in each of the models, which led us to reject of the null hypothesis of equivalence
 248 and, consequently, to the adoption of quantile regressions²⁰).

249 Quantile regression models are increasingly used in statistical analyses of obesity and malnutrition²¹
 250 because they allow for given socio-economic or clinical covariate to have different impacts along the
 251 BMI distribution. Quantile regression models are preferable to least-squares regression models
 252 when the statistical relationship between the independent variable and the covariates varies across
 253 conditional quantiles –that is, across segments of the sample defined according to conditional
 254 covariates (ref. 76). If this is the case, results from the conditional means are not informative
 255 enough, and are actually misleading when generalised to the whole distribution.

256 It is well-known that unlike least-squares regression, where the focus is on the conditional mean
 257 function that relates the mean changes in a dependent variable with the vector of covariates of one
 258 independent variables, quantile regression focuses on the quantiles of the conditional distribution of
 259 the dependent variable expressed as functions of the observed covariates of independent variables
 260 (ref. 77-78). The θ^{th} quantile of a sample ($0 < \theta < 1$) may be defined as the minimum of:

$$\left[\sum_{e \in \{e | y_e \geq b\}} \theta |y_e - b| + \sum_{e \in \{e | y_e < b\}} (1 - \theta) |y_e - b| \right]$$

261
 262
 263 where $\{y_t = 1, 2, \dots, T\}$ is a random sample on a random variable Y and b is a parametric function –in
 264 our case, a linear function of parameters.

265 We computed the confidence intervals by using the Hall-Sheather bandwidth rule (ref. 78, ch. 3). We
 266 have also applied the bootstrapped standard errors of the quantile regression coefficients obtained
 267 by the Parzen, Wei and Ying (ref. 83) method after setting the number of replicates at 600 (following
 268 ref. 84)²², but to save space we only report the results from the former method, as both have
 269 rendered similar results.

¹⁹ Intriguingly, most papers which use quantile regressions do not report whether equivalence tests have been carried out before choosing quantile regression over least-squares or not. We understand that formally testing for the equivalence of the estimates across quantiles (and reporting the results in terms of the rejection or not of the equivalence hypothesis) should be considered best practice.

²⁰ Results can be requested from the corresponding author.

²¹ Recent examples include ref. 79-82.

²² We used the quantreg package (ref. 86) in R (ref. 87).

270 Secondly, we look into the socio-economic determinants of the changes across unhealthy and
271 healthy BMI levels over time. For this, we made use of the longitudinal character of ELSA: we used a
272 balanced panel excluding those respondents in wave 2 who were not interviewed in wave 4 as well
273 as the new sample members added at wave 4.²³

274 As defined in the previous section, both BMI risk and the WHO combined categories are
275 polychotomous (or polytomous) categorical variables; consequently, we ran multinomial logit
276 regression models²⁴ to analyse their association with the socio-economic covariates.²⁵

277

278 **4. Results**

279 *Socio-economic determinants of BMI, waist circumference and waist-hip ratio levels*

280 It is well-known that cross-sectional data analysis does not allow for age or cohort²⁶ effects (ref. 85).
281 The associations between the covariates and the dependent variables would remain fairly constant
282 over time, at least in terms of signs and statistical significance, in the absence of these effects.
283 However, if any of these confounding factors are present, different results from cross-sectional data
284 for different time periods may be observed.

285 We observed differences in the statistical significance and/or signs of the coefficients of some
286 variables in the cross-sectional quantile regressions for men.

287 An inferential procedure such as quantile regressions applied to data from the same source (the HES
288 survey in this case) but for different years should render confidence intervals with similar probability
289 coverage and same signs –except that:

- 290 - the relationship between the covariates and the dependent variable changed over time
- 291 - some methodological problems embedded in the data source (for example, sample size or
292 changes in the definitions of certain variables) turned impossible to make inferences from
293 cross-sectional results for different time periods
- 294 - there were confounding age and cohort effects, or a combination of these, which were not
295 or could not be disentangled given the cross-sectional nature of the data

²³ We only looked into waves 2 and 4 because some key variables were not collected at waves 1 and 3.

²⁴ For an introduction to multinomial logit models, see ref. 88 (chapter 7).

²⁵ An alternative approach for BMI would be to look into changes in its levels; however, we were interested in the transitions into and out of risk levels rather than in changes in the levels in themselves.

²⁶ Also known as ‘generation effects’ (see, for example, ref. 89, chapter 11).

296 There are no theoretical reasons to assume that the association between socio-economic factors
297 and any of the three anthropometric measures of abdominal adiposity we used as dependent
298 variables has changed in England between the years under study.

299 With regards to methodological issues, the documentation of the HES, on which ELSA data are
300 based, does not report of any major changes which might affect the consistency of the results.

301 Hence we have to assume that the disparate results are to do with confounding age and cohort
302 effects. Moreover, in their longitudinal study using two waves of the British Household Panel Survey,
303 Pieroni and Luca (ref. 90) added a time dummy variable, which was significant across all the
304 quantiles (and in the OLS model). This led these authors to conclude that there would exist
305 “unobserved time heterogeneity of individuals born in different periods” (op. cit., p. 7). We
306 attempted to reduce this heterogeneity by running the cross-sectional quantile regressions on the
307 balance panel samples –that is, we included the same individuals in both waves.

308 Furthermore, with regards to age effects, by introducing age and age squared as covariates in all the
309 models we only accounted for possible age difference effects within each sample, but we cannot be
310 certain of having controlled for age changes effects (ref. 91, chapter 13). This should lead to some
311 caution in inferring results from cross-sectional analysis of socio-economic determinants of
312 nutritional status. With this caveat, Tables 5-7 present the results for selected quantiles, as well as
313 the OLS results, for BMI, Waist Circumference and Waist-Hip ratio, respectively.

314 *Results for BMI (table 5)*

315 Once adjusted for sitting height ratio, we found the following statistical associations for BMI levels:

- 316 • Age, where significant, presents an inverse U-shaped relationship with BMI.
- 317 • Smoking is negatively associated with BMI for some quantiles, and the same applies to
318 alcohol consumption (here the relation is stronger).
- 319 • Being white increases the likelihood of being obese for men, whereas for women it increases
320 the chance of being underweight.
- 321 • Living in a larger household would be related with being overweight or obese among men,
322 but would have positive health effects among underweight women (as the larger the
323 household, the larger the BMI measurement within this group).
- 324 • We obtained disparate findings for net total wealth, but generally speaking it is negatively
325 related with BMI levels.
- 326 • Being married or in cohabitation might be associated with BMI levels among underweight
327 women, but the direction of the association is unclear.

- 328 • Being in employment has almost no significant association with BMI.
- 329 • When significant, depression is positively associated with BMI.
- 330 • Loneliness is not related to BMI levels.
- 331 • A higher educational qualification is negatively related with BMI levels, particularly in the
- 332 bottom half of the BMI distribution

333

334 *Results for Waist Circumference (table 6)*

- 335 • Age: Only in wave two we found any significant coefficients, which showed the inverse U-
- 336 shaped pattern
- 337 • Smoking, when significant, was positively related with waist circumference measurements
- 338 • Alcohol consumption, when significant, showed an inverse relationship with waist
- 339 circumference measurements, especially among the top 25 per cent of the distribution
- 340 • Being white is positively associated with waist circumference measurements among men in
- 341 the two 25 per cent of the distribution, but negatively associated among women
- 342 • Living in a larger household is positively related with waist circumference measurement
- 343 among men in the top half of the distribution but for women the association, though also
- 344 positive, only holds in the bottom half of the distribution
- 345 • Net total wealth was strongly and negatively correlated with waist circumference
- 346 measurement among women
- 347 • Marital status is hardly associated with waist circumference measures
- 348 • Being in employment is negatively associated with waist circumference measures among
- 349 women
- 350 • We found a strong and positive relationship between being depressed and waist
- 351 circumference measurement
- 352 • We found divergent regression results for loneliness, though it could be positively associated
- 353 with waist circumference measurement in the top 10 per cent of the distribution (and also
- 354 negatively associated in the bottom 10 per cent for men)
- 355 • Educational attainment is negatively associated with waist circumference measurement

356

357 *Results for Waist-Hip Ratio (table 7)*

358 For waist-hip ratio we found the most disparate results. The most consistent findings are:

- 359 • Smoking is positively associated with waist-hip ratio for both men and women for along
- 360 most of the distribution
- 361 • Net total wealth is negatively associated in Wave 2, but not in Wave 4
- 362 • When significant, being depressed is positively associated with waist-hip ratio
- 363 • Educational attainment is negatively associated with waist-hip ratio

364

365 *Socio-economic determinants of the changes across unhealthy and healthy categories*

366 *BMI-based classification (table 8)*

- 367 • Considering that Wave 2 correspond to data from 2004-05 and Wave 4 to data from 2008-
- 368 09, it is hardly surprising that being underweight or obese in Wave 2 is a very strong
- 369 predictor of remaining in the same category by Wave 4 –except that we failed to find any
- 370 statistical significance in the relationship between being underweight in Wave 2 and being
- 371 obese in Wave 4. It is more (less) likely for someone to be underweight in Wave 4 if they
- 372 underweight (obese) in Wave 2, as opposed to of normal weight. However, even though we
- 373 found that it is more likely to be obese in Wave 4 if the person was already obese in Wave 2
- 374 –as opposed to of normal weight-, being underweight in Wave 2 does not reduce the
- 375 probability of being obese in Wave 4 compared to being of normal weight in Wave 2.
- 376 • The BMI-health risk category in Wave 2 is the only predictor for being underweight in Wave
- 377 4. However, being or becoming obese by Wave 4 is positively related to two other
- 378 covariates: living in a larger household and alcohol consumption. Furthermore, we found
- 379 that the sitting height ratio measure in Wave 2 is also positively related to being or
- 380 becoming obese in Wave 4.

381

Table 8

382

Multinomial logistic regression

383

Dependent variable: Transitions between BMI Health Risk Categories

384

ELSA Waves 2 and 4

Base category = Normal or Overweight in Wave 4				
Underweight in Wave 4				
	Estimate	Robust Std. Err.	t	P> t
Sex	0.381	0.39	0.98	0.329
Marital Status	0.091	0.649	0.14	0.888
Underweight in Wave 2	5.579	0.405	13.79	0
Obese in Wave 2	-13.621	0.251	-54.23	0
Loneliness	-0.082	0.116	-0.71	0.478
Depression	0.072	0.125	0.57	0.565
Age	-0.112	0.329	-0.34	0.734
Age2	0.001	0.002	0.44	0.663
Household Size	-0.122	0.492	-0.25	0.805
Smoking	-0.442	0.35	-1.26	0.207
Economic Status	-0.058	0.401	-0.14	0.886
Wealth	0	0	-1.2	0.23
Alcohol consumption	-0.003	0.088	-0.03	0.973
Sitting Height Ratio	7.933	7.13	1.11	0.266
Constant	-5.362	12.922	-0.41	0.678
Obese in Wave 4				
	Estimate	Robust Std. Err.	t	P> t
Sex	0.148	0.136	1.09	0.274
Marital Status	-0.154	0.186	-0.83	0.408
Underweight in Wave 2	-0.476	1.07	-0.44	0.656
Obese in Wave 2	4.365	0.136	31.98	0
Loneliness	0.066	0.048	1.38	0.169
Depression	0.036	0.054	0.67	0.502
Age	0.148	0.126	1.17	0.241
Age2	-0.001	0.001	-1.49	0.135
Household Size	0.242	0.134	1.8	-0.072
Smoking	0.055	0.137	0.4	0.69
Economic Status	-0.153	0.169	-0.91	0.365
Wealth	0	0	-1.24	0.214
Alcohol consumption	-0.059	0.033	-1.79	-0.073
Sitting Height Ratio	7.508	4.251	1.77	-0.077
Constant	-10.73	4.585	-2.34	-0.019
N= 3,273				
Wald chi2(28) = 12,691.30				
Prob > chi2 = 0.0000				
Log pseudolikelihood = -1078.6997				
Pseudo R2 = 0.5194				

385

386 Combined BMI-Waist Circumference categories (table 9)

- 387
- Living in a larger household size increases the likelihood of becoming or remaining
- 388 unhealthy.

- 389
- In contrast, net total wealth is negatively associated with becoming or remaining unhealthy.
- 390
- Age shows an inverse U-shaped relationship with remaining within a BMI-waist
- 391
- circumference unhealthy combination. The same holds for being depressed: people who
- 392
- were classified as unhealthy in terms of their BMI-waist circumference category and were
- 393
- also depressed in Wave 2 were more likely to remain within the unhealthy category by Wave
- 394
- 4 compared to those who were not depressed in Wave 2.

Table 9
Multinomial logistic regression
Dependent variable: Transitions between WHO combined BMI-Waist Circumference Risk Categories
ELSA Waves 2 and 4 (reduced version - see Table 4)

Base transition = From Healthy to Healthy												
	Healthy-Unhealthy				Unhealthy-Healthy				Unhealthy-Unhealthy			
	Coef.	Robust Std. Err.	z	P> z	Coef.	Robust Std. Err.	z	P> z	Coef.	Robust Std. Err.	z	P> z
Sex	-0.047	0.153	-0.31	0.759	0.235	0.205	1.15	0.25	-0.03	0.092	-0.32	0.748
Marital Status	-0.045	0.211	-0.21	0.831	-0.286	0.301	-0.95	0.342	-0.006	0.135	-0.04	0.965
Loneliness	0.013	0.052	0.25	0.806	-0.079	0.078	-1.01	0.312	-0.001	0.033	-0.03	0.978
Depression	0.007	0.07	0.1	0.921	0.063	0.087	0.73	0.467	0.078	0.04	1.96	-0.049
Age	0.197	0.123	1.61	0.108	0.143	0.152	0.94	0.345	0.315	0.082	3.86	0
Age 2	-0.001	0.001	-1.63	0.103	-0.001	0.001	-0.91	0.363	-0.002	0.001	-3.91	0
Household Size	0.34	0.159	2.15	-0.032	0.292	0.23	1.27	0.205	0.257	0.102	2.51	-0.012
Smoking	0.074	0.13	0.57	0.568	0.244	0.146	1.68	-0.094	-0.048	0.083	-0.57	0.568
Economic Statu	0.019	0.192	0.1	0.921	-0.219	0.256	-0.85	0.393	-0.148	0.119	-1.24	0.216
Wealth	0	0	-2.38	-0.017	0	0	-0.23	0.815	0	0	-2.84	-0.005
Alcohol consum	-0.032	0.037	-0.88	0.377	-0.011	0.047	-0.23	0.817	-0.031	0.022	-1.39	0.165
Constant	-8.076	4.245	-1.9	-0.057	-6.781	5.371	-1.26	0.207	-9.786	2.81	-3.48	0
<p><i>N</i> = 3,273</p> <p>Wald $\chi^2(33) = 61.93$</p> <p>Prob > $\chi^2 = 0.0017$</p> <p>Log pseudolikelihood = - 2967.7182</p> <p>Pseudo R2 = 0.0113</p>												

Nature Precedings : hdl:10101/npre.2012.6897.1 : Posted 17 Feb 2012

395
396
397
398
399
400

401

402 5. Conclusions

403 This paper has looked into the socio-economic determinants of three anthropometric measures of
404 abdominal adiposity -body mass index, waist circumference and waist-hip ratio- among people aged
405 50 or over in England in 2004-05 (ELSA Wave 2) and 2008-09 (ELSA Wave 4), and also into the
406 transitions across health risk categories between these years.

407 With regards to the socio-economic determinants of levels of BMI, waist circumference or waist-hip
408 ratio, we found disparate results depending on the wave, even though we ran our models using a
409 balanced panel –that is, with data from the same individuals in both waves. This leads us to conclude
410 that researchers should be more cautious when reporting results regarding socio-economic
411 determinants of nutrition or obesity from one cross-sectional dataset. Despite these differing
412 results, we can draw the following general conclusions:

- 413 • Age tends to present an inverse U-shaped relationship with BMI and Waist Circumference
- 414 • Smoking is negatively associated with BMI and positively with WC and WHR
- 415 • Alcohol consumption is negatively associated with BMI and WC levels
- 416 • Net total wealth is negatively related with the three anthropometric measures.
- 417 • Educational attainment is negatively associated with each measure.
- 418 • Depression is positively associated with each measure.

419
420 The transitional element of this paper allowed us to obtain some results with regards to the
421 probability of remaining or becoming healthy or unhealthy according to two classifications
422 developed by the World Health Organisation –one based on BMI levels and the other one on the
423 combination between BMI and WC.

424 We found that living in a larger household size increases the likelihood of becoming or remaining
425 unhealthy irrespective of which classification we used. Other conclusions depend on the
426 classification adopted (and therefore on the definition of healthy/unhealthy):

427 Using the BMI-based categorisation, we found that the initial category is highly relevant as a
428 predictor of the category four years later and that alcohol consumption would be positively
429 associated with being or becoming obese.

430 From the combined BMI-WC categorisation, we found that net total wealth would be negatively
431 associated with becoming or remaining unhealthy whereas depression is a significant predictor of
432 becoming or remaining unhealthy.

433 One limitation of this study, and of its data source, is that it only considered non-institutionalised
434 subjects. For example, in a study of older residents in institutionalised and non-institutionalised
435 settings in India obesity was found more prevalent among non-institutionalised older people (ref.
436 92). Also for India, malnutrition was more prevalent among older people in residential and nursing
437 homes than those living at home (ref. 93).

438

439 **Conflict of interest:** The authors declare no conflict of interest.

440

441 **References**

- 442 1. Gulsvik A, Thelle D, Mowé M, and Wyller T. Increased mortality in the slim elderly: a 42 years
443 follow-up study in a general population, EUR J EPIDEMIOLOG 2009; **24**: 683-690.
- 444 2. Zamboni M, Turcato E, Santana H, Maggi S, Harris T, Pietrobelli A, Heymsfield S, Micciolo R,
445 and Bosello O. The relationship between body composition and physical performance in
446 older women, JAGS 1999; **47**(12): 1403-1408.
- 447 3. Corrada M, Kawas C, Mozaffar F, and Paganini-Hill A. Association of Body Mass Index and
448 Weight Change with All-Cause Mortality in the Elderly, AM J EPIDEMIOLOG 2006; **163**(10): 938-
449 949.
- 450 4. Kulminski A, Arbeev K, Kulminskaya I, Ukraintseva S, Land K, Akushevich I, and Yashin A.
451 Body mass index and nine-year mortality in disabled and nondisabled older U,S, individuals
452 JAGS 2008; **56**: 105-110.
- 453 5. Flicker L McCaul K Hankey G Jamrozik K Brown W Byles J Almeida O. Body Mass Index and
454 Survival in Men and Women Aged 70 to 75, JAGS 2010 **58**(2): 234-241.
- 455 6. Heymsfield S, Hoffman D, Testolin C, and Wang Z. Evaluation of Human Adiposity. In:
456 Bjorntorp P. (Ed.) *International Textbook of Obesity*, John Wiley & Sons Ltd. 2001, Chapter 5.
- 457 7. Heyward V, and Wagner D. *Applied Body Composition Assessment*, 2nd edn, Human Kinetics,
458 2004.
- 459 8. Ruhm C. Current and Future Prevalence of Obesity and Severe Obesity in the United States.
460 FHEP 2007; **10**(2): 1-26.
- 461 9. Zajacova A, Dowd J, and Burgard S. Overweight Adults May Have the Lowest Mortality - Do
462 They Have the Best Health? AM J EPIDEMIOLOG 2011; **4**(173m): 430-437.
- 463 10. Sairenchi T, Iso H, Irie F, Fukasawa N, Ota H, and Muto T. Underweight as a Predictor of
464 Diabetes in Older Adults, A large cohort study. Diabetes Care 2008; **31**(3): 583-584.
- 465 11. Li C, Chen S, Lan C, Pan W, Chou H, Bai Y, Tzeng M, Lee M, Lai J. The effects of physical
466 activity body mass index (BMI) and waist circumference (WC) on glucose intolerance in older
467 people: A nationwide study from Taiwan. Arch. Gerontol. Geriatr. 2011; **52**: 54-59.

- 468 12. Launer L, Harris T, Rumpel C, and Madans J. Body mass index weight change and risk of
469 mobility disability in middle-aged and older women, JAMA 1994; **271**(14): 1093-1098.
- 470 13. Houston D, Ding J, Nicklas B, Harris T, Lee J, Nevitt M, Rubin S, Tylavsky F, and Kritchevsky S.
471 Overweight and Obesity over the Adult Life Course and Incident Mobility Limitation in Older
472 Adults, The Health Aging and Body Composition Study. AM J EPIDEMIOL 2009; **169**(8): 927-
473 936.
- 474 14. Parkin D, and Boyd L. Cancers attributable to overweight and obesity in the UK in 2010. Br. J.
475 Cancer 2011; **105**: S34-S37.
- 476 15. Hubbard R, Lang I, Llewellyn D, and Rockwood K. Frailty Body Mass Index and Abdominal
477 Obesity in Older People. J Gerontol A Biol Sci Med Sci 2010; **65A**(4): 377-381.
- 478 16. Janssen I, Katzmarzyk P, and Ross R. Body Mass Index is Inversely Related to Mortality in
479 Older People after Adjustment for Waist Circumference JAGS 2005; **53**(12): 2112-2118.
- 480 17. WHO. *Obesity: preventing and managing the global epidemic, Report of a WHO*
481 *Consultation*. WHO Technical Report Series 894[3] i-253, World Health Organisation, 2000.
- 482 18. Testa G, Cacciatore F, Galizia G, Della-Morte D, Mazzella F, Langellotto A, Russo S, Gargiulo
483 G, De Santis D, Ferrara N, Rengo F, and Abete P. Waist Circumference but Not Body Mass
484 Index Predicts Long-Term Mortality in Elderly Subjects with Chronic Heart Failure. JAGS
485 2010; **58**(8): 1433-1440.
- 486 19. Srikanthan P, Seeman T, and Karlamangla A. Waist-hip-ratio as a predictor of all-cause
487 mortality in high-functioning older adults. ANN EPIDEMIOL 2009; **19**(10): 724-731.
- 488 20. Price G, Uauy R, Breeze E, Bulpitt C, Fletcher A. Weight shape and mortality risk in older
489 persons: elevated waist-hip ratio not high body mass index is associated with a greater risk
490 of death. AM J CLIN NUTR 2006; **84**(2): 449-60.
- 491 21. Cook Z, Kirk S, Lawrenson S, and Sandford S. Use of BMI in the assessment of undernutrition
492 in older subjects: reflecting on practice. Proc Nutr Soc. 2005; **64**: 313-317.
- 493 22. Sergi G, Perissinotto E, Pisent C, Buja A, Maggi S, Coin A, Grigoletto F, and Enzi G. An
494 Adequate Threshold for Body Mass Index to Detect Underweight Condition in Elderly
495 Persons: The Italian Longitudinal Study on Aging (ILSA). J. Gerontol. A Biol. Sci. Med. Sci.
496 2005; **60A**(7): 866-871.

- 497 23. Lupoli L, Sergi G, Coin A, Perissinotto E, Volpato S, Busetto L, Inelmen E, and Enzi G. Body
498 composition in underweight elderly subjects: reliability of bioelectrical impedance analysis.
499 CLIN NUTR 2004; **23**: 1371-1380.
- 500 24. Corish C, Flood P, and Kennedy N. Comparison of nutritional risk screening tools in patients
501 on admission to hospital. J HUM NUTR DIET 2004; **17**(2): 133-139.
- 502 25. Lisko I, Tiainen K, Stenholm S, Luukkaala T, Hervonen A, and Jylhä M. Body Mass Index Waist
503 Circumference and Waist-to-Hip Ratio as Predictors of Mortality in Nonagenarians: The
504 Vitality 90+ Study. J Gerontol A Biol Sci Med Sci 2011; **66A**(11):1244-1250.
- 505 26. Flegal K, and Graubard B. Estimates of excess deaths associated with body mass index and
506 other anthropometric variables. AM J CLIN NUTR 2009; **89**(4): 1213-1219.
- 507 27. Reis J, Macera C, Araneta M, Lindsay S, Marshall S, and Wingard D. Comparison of Overall
508 Obesity and Body Fat Distribution in Predicting Risk of Mortality. Obesity 2009; **17**(6) 1233-
509 1239.
- 510 28. Zhao G, Ford E, Li C, Tsai J, Dhingra S, and Balluz L. Waist circumference, abdominal obesity,
511 and depression among overweight and obese U.S. adults: national health and nutrition
512 examination survey 2005-2006. BMC Psychiatry 2011, **11**:130, e-pub ahead of print
513 doi:10.1186/1471-244X-11-130.
- 514 29. Ho R, Niti M, Kua E, and Ng T. Body mass index waist circumference waist-hip ratio and
515 depressive symptoms in Chinese elderly: a population-based study. INT J GERIATR PSYCH
516 2008; **23**(4): 401-408.
- 517 30. Goya Wannamethee S, Shaper G, Lennon L, Whincup P. Decreased muscle mass and
518 increased central adiposity are independently related to mortality in older men. AM J CLIN
519 NUTR 2007; **86**: 1339-46.
- 520 31. Nishiwaki Y, Michikawa T, Eto N, and Takebayashi T. Body mass index misclassification due
521 to kyphotic posture in Japanese community-dwelling adults aged 65 years and older. J
522 GERONTOL 2001; **66A**(3): 326-331.
- 523 32. Bennett G, Wolin K, and Duncan D, (2008), Social Determinants of Obesity in: *Obesity*
524 *Epidemiology* F, Hu (Ed,) Chapter 17, Oxford University Press, Oxford, UK.

- 525 33. Aballay L Osella A Celi A Díaz M, Overweight and obesity: Prevalence and their association
526 with some social characteristics in a random sample population-based study in Córdoba city
527 Argentina. *Obes Res Clin Pract* 2009; **3**: 75-83.
- 528 34. Ball K, and Crawford D. The role of socio-cultural factors in the obesity epidemic. In:
529 Crawford D, Jeffery R, Ball K, and Brug J. (eds,) *Obesity Epidemiology: From Aetiology to*
530 *Public Health* Oxford University Press, 2010, Chapter 8.
- 531 35. Kwok T, and Whitelaw M. The use of armspan in nutritional assessment of the elderly. *JAGS*
532 1991; **39**(5): 492-6.
- 533 36. de Lucia E, Lemma F, Tesfaye F, Demisse T, and Ismail S. The use of armspan measurement
534 to assess the nutritional status of adults in four Ethiopian ethnic groups. *EUR J CLIN NUTR*
535 2002; **56**(2): 91-5.
- 536 37. Weinbrenner T, Vioque J, Barber X, and Asensio L. Estimation of height and body mass index
537 from demi-span in elderly individuals. *Gerontology* 2006; **52**(2): 275-281.
- 538 38. ONS. The Health and Social Care Information Centre, HES Analysis, Office for National
539 Statistics, 2011.
- 540 39. Chow S, Grossman M, and Saffer H. An economic analysis of adult obesity: results from the
541 Behavioral Risk Factor Surveillance System. *J HEALTH ECON* 2004; **23**: 565-587.
- 542 40. Ball K, and Crawford D. Socioeconomic status and weight change in adults: a review. *SOC SCI*
543 *MED* 2005; **60**: 1987-2010.
- 544 41. Costa-Font J, and Gil J. What lies behind socio-economic inequalities in obesity in Spain? A
545 decomposition approach. *Food Policy* 2008; **33**: 61-73.
- 546 42. Baum C, and Ruhm C. Age socioeconomic status and obesity growth. *J HEALTH ECON* 2009;
547 **28**: 635-648.
- 548 43. Johar M, and Katayama H. Quantile regression analysis of body mass and wages. *Health*
549 *Economics* 2001; e-pub ahead of print; doi: 10.1002/hec,1736.
- 550 44. Costa-Font J, Fabbri D, and Gil J. Decomposing body mass index gaps between
551 Mediterranean countries: A counterfactual quantile regression analysis. *Econ Hum Biol* 2009;
552 **7**(3): 351-365.

- 553 45. Costa-Font J, Fabbri D, and Gil J. Decomposing cross-country differences in levels of obesity
554 and overweight: does the social environment matter? Working paper No: 12/2008 LSE
555 Health; The London School of Economics and Political Science, 2008.
- 556 46. Pieroni L, and Salmasi L. Body weight and socio-economic determinants: quantile
557 estimations from the British Household Panel Survey. MPRA Paper 26434 Munich Personal
558 RePEc Archive University Library of Munich, Germany 2010. Available online on
559 <http://ideas.repec.org/p/prapa/mprapa/26434.html>
- 560 47. Lee C, Boyko E, Nielson C, Stefanick M, Bauer D, Hoffman A, Dam T, Lapidus J, Cauthon P,
561 Ensrud K, Orwoll E. Mortality Risk in Older Men Associated with Changes in Weight Lean
562 Mass and Fat Mass. JAGS 2011; **59**(2): 233-240.
- 563 48. Rosin O. The economic causes of obesity: a survey. J ECON SURV 2008; **22**(4): 617-647.
- 564 49. Demakakos P, Nazroo J, Breeze E, and Marmot M. Socioeconomic status and health: the role
565 of subjective social status. Soc Sci Med. 2008; **67**(2) 330-340.
- 566 50. Demakakos P Nunn A, and Steptoe A, (2010), Well-being in older age a multidimensional
567 perspective. In: Banks J, Lessof C, Nazroo J, Rogers N, Stafford M, and Steptoe A. (eds)
568 *Financial circumstances health and well-being of the older population in England: The 2008*
569 *English Longitudinal Study of Ageing (Wave 4)*. The Institute for Fiscal Studies, London, UK,
570 2010, pp 115-177.
- 571 51. Hermann S, Rohrmann S, Linseisen J, May A, Kunst A, Besson H, *et al*. The association of
572 education with body mass index and waist circumference in the EPIC-PANACEA study. BMC
573 Public Health 2011; **11**(19): 1-12.
- 574 52. Leal C, Bean K, Thomas F, and Chaix B. Are Associations Between Neighborhood
575 Socioeconomic Characteristics and Body Mass Index or Waist Circumference Based on
576 Model Extrapolations? Epidemiology 2011; **22**(5): 1-10.
- 577 53. Cheshire H, Cox K, Lessof C, and Taylor R. Methodology. In: Banks J, Breeze E, Lessof C, and
578 Nazroo J. (eds,) *Retirement health and relationships of the older population in England: The*
579 *2004 English Longitudinal Study of Ageing (Wave 2)*. The Institute for Fiscal Studies, London,
580 UK, 2006, pp 374-383.
- 581 54. Hussey D, Lessof C, Ward K, and Wood N. Methodology. In: Banks J, Lessof C, Nazroo J,
582 Rogers N, Stafford M, and Steptoe A. (eds) *Financial circumstances health and well-being of*

- 583 *the older population in England: The 2008 English Longitudinal Study of Ageing (Wave 4).*
584 The Institute for Fiscal Studies, London, UK, 2010, pp 386-409.
- 585 55. Joint Health Surveys Unit. *Health Survey for England, Health and lifestyles '09, User Guide. A*
586 *survey carried out on behalf of the Information Centre, Joint Health Surveys Unit, National*
587 *Centre for Social Research and Department of Epidemiology and Public Health University*
588 *College London, UK Data Archive Study Number 6732, 2009.*
- 589 56. Fang H, Ali Mir M, and Rizzo, J. Does smoking affect body weight and obesity in China? *Econ*
590 *Hum Biol*, **7**(3): 334-350.
- 591 57. Wehby G, Murray J, Wilcox A, and Lie R. Smoking and body weight: Evidence using genetic
592 instruments. *EC HUM BIOL* 2011, e-pub ahead of print 24 September 2011, ISSN 1570-677X
593 10,1016/j,ehb,2011,09,002.
- 594 58. Sieri E, Krogh V, Saieva C, Grobbee C, Bergmann M, Rohrmann S, *et al.* Alcohol consumption
595 patterns diet and body weight in 10 European countries. *EJCN* 2009; **63**: S81-S100.
- 596 59. Kleiner K, Gold M, Frostpineda K, Lenzbrunsmann B, Perri M, and Jacobs W. Body Mass Index
597 and Alcohol Use. *J ADDICT DIS* 2004; **23**(3): 105-118.
- 598 60. Wang L, Lee I, Manson J, Buring J, and Sess H. Alcohol Consumption Weight Gain and Risk of
599 Becoming Overweight in Middle-aged and Older Women. *Arch Intern Med* 2010; **170**(5):
600 453-461.
- 601 61. Wakabayashi I. Age-Dependent Inverse Association between Alcohol Consumption and
602 Obesity in Japanese Men. *Obesity* 2011; **19**(9): 1881-1886.
- 603 62. Hawkey L, and Cacioppo J. Aging and Loneliness, Downhill Quickly? *CURR DIR PSYCHOL SCI*
604 2007; **16**(4): 187-191.
- 605 63. Morley J. Anorexia of aging: physiologic and pathologic. *AM J CLIN NUTR* 1997; **66**(4): 760-
606 73.
- 607 64. Ramic E, Pranjić N, Batic-Mujanović O, Karić E, Alibasić E, and Alic A. The Effect of Loneliness
608 on Malnutrition in Elderly Population. *Medical Archives* 2011; **65**(2): 92-95.
- 609 65. Engel J, Siewerdt F, Jackson R, Akobundu u, Wait C, and Sahyoung N. Hardiness Depression
610 and Emotional Well-Being and Their Association with Appetite in Older Adults. *JAGS* 2011;
611 **59**(3), e-pub ahead of print 10 March 2011, doi: 10,1111/j,1532-5415,2010,03274,x.

- 612 66. Norgan N. Relative sitting height and the interpretation of the body mass index. ANN HUM
613 BIOL 1994; **21**(1): 79-82.
- 614 67. Charbonneau-Roberts G, Saudny-Unterberger H, Kuhnlein H, and Egeland G. Body mass
615 index may overestimate the prevalence of overweight and obesity among the Inuit. IJCH
616 2005; **64**(2): 163-169.
- 617 68. Bogin B, and Beydoun N. The Relationship of Sitting Height Ratio to Body Mass Index and
618 Fatness in The United States 1988-1994. HUM ECOL 2007; **15**: 1-8.
- 619 69. Schooling C, Jiang Ch, Lam T, Thomas G, Heys M, Lao X, *et al.* Height Its Components and
620 Cardiovascular Risk Among Older Chinese: A Cross-Sectional Analysis of the Guangzhou
621 Biobank Cohort Study. AM J PUBLIC HEALTH 2007; **97**(10): 1834-1841.
- 622 70. Norgan N, and Jones P. The effect of standardising the body mass index for relative sitting
623 height. Int J Obes Relat Metab Disord 1995; **19**(3): 206-8.
- 624 71. Galloway T, Chateau-Degat M, Egeland G, Young T. Does sitting height ratio affect estimates
625 of obesity prevalence among Canadian Inuit? Results from the 2007-2008 Inuit Health
626 Survey. AM J HUM BIOL 2011; **23**(5): 655-63.
- 627 72. Bouças Ribeiro A, Godoy Agostinho Gimeno S, Andreoni S, and Gouveia Ferreira S. Should
628 body mass index be adjusted for relative sitting height in cross-sectional studies of chronic
629 diseases in Japanese-Brazilians? Cad. Saude Publica 2007; **22**(8): 1691-1697.
- 630 73. Vermunt J. Mover-stayer model. In: Lewis-Beck M, Bryman A, and Liao T. (eds), *The Sage*
631 *Encyclopedia of Social Sciences Research Methods*. Thousand Oakes CA: Sage Publications,
632 2004, pp 665-666.
- 633 74. Østbye T, Malhotra R, and Landerman L. Body mass trajectories through adulthood: results
634 from the National Longitudinal Survey of Youth 1979 Cohort (1981–2006). INT J EPIDEMIOLOG
635 2011; **40**: 240-250.
- 636 75. Botosaneanu A, and Liang J. Social Stratification of Body Weight Trajectory in Middle-Age
637 and Older Americans: Results from a 14-Year Longitudinal Study. J. Aging Health 2011; **23**(3):
638 454-480.
- 639 76. Koenker R, and Hallock K. Quantile Regression. JEP 2011; **15**(4): 143-156.
- 640 77. Koenker R, and Bassett G. Regression Quantiles. Econometrica 1978; **46**: 36-50.

- 641 78. Koenker R. *Quantile Regression*, Econometric Society Monograph No 38, Cambridge
642 University Press, Cambridge, UK, 2005.
- 643 79. Popkin B. Recent dynamics suggest selected countries catching up to US obesity. *AM J CLIN*
644 *NUTR* 2010; **91**(1): 284S-288S.
- 645 80. Shankar B Obesity in China: The Differential Impacts of Covariates along the BMI Distribution.
646 *Obesity* 2010; **18**(8): 1660-1666.
- 647 81. Khang Y, and Yung S. Trends in General and Abdominal Obesity among Korean Adults:
648 Findings from 1998 2001 2005 and 2007 Korea National Health and Nutrition Examination
649 Surveys. *J Korean Med Sci* 2010; **25**(11): 1582-1588.
- 650 82. Osella A, del Pilar Diaz M, Cozzolongo R, Leandro G, Elba S, Petruzzi J, *et al.* Overweight and
651 obesity: prevalence and their association with some social and life-style characteristics in a
652 random sample population-based study in Southern Italy. *J. Community. Health* 2011; **65**(1):
653 A285-A285.
- 654 83. Parzen M, Wei L, and Ying Z. A resampling method based on pivotal estimating functions"
655 *Biometrika* 1994; **81**: 341-350.
- 656 84. Andrews D, and Buchinsky M. A three-step method for choosing the number of bootstrap
657 repetitions *Econometrica* 2000; **68**: 23-52.
- 658 85. Rafferty A, and Walthery P. *Analysing Change over Time: A guide to ESDS microdata*
659 *resources*, ESDS Government Economic and Social Data Service Version: 1,4, 2011. Available
660 on <http://www.esds.ac.uk/government/docs/analysingchange.pdf>
- 661 86. Koenker R. Package 'quantreg', (Available on [http://cran,r-](http://cran.r-project.org/web/packages/quantreg/)
662 [project.org/web/packages/quantreg/](http://cran.r-project.org/web/packages/quantreg/)) 2011.
- 663 87. R Development Core Team. *R: A Language and Environment for Statistical Computing*, R
664 Foundation for Statistical Computing, Vienna, Austria, 2011 (url: [http://www,R-project.org](http://www.R-project.org)),
- 665 88. Cramer J. *Logit Models from Economics and Other Fields*, Cambridge University Press,
666 Cambridge, UK, 2003.
- 667 89. Bordens K, and Abbott B. *Research design and methods: a process approach* 8th Ed, McGraw-
668 Hill, 2011.

- 669 90. Pieroni L, and Salmasi L. Body weight and socio-economic determinants: quantile
670 estimations from the British Household Panel Survey. MPRA Paper 26434, Munich Personal
671 RePEc Archive, University Library of Munich, Germany, 2010. Available on:
672 http://mpra.ub.uni-muenchen.de/26434/1/MPRA_paper_26434.pdf
- 673 91. Baltes P, Reese H, and Nesselroade J. *Life-span developmental psychology: Introduction to*
674 *research methods*, Lawrence Erlbaum Associates, 1988.
- 675 92. Tyagi R. Body composition and nutritional status of the institutionalized and non
676 institutionalized senior citizens, Paper presented at the Intensive Course in Biological
677 Anthropology 1st Summer School of the European Anthropological Association 16–30 June
678 2007 Prague Czech Republic, EAA Summer School eBook 1: 225-231, Available on
679 http://eaa.elte.hu/Renu_Tyagi.pdf
- 680 93. Pai M. Comparative study of nutritional status of elderly population living in the home for
681 aged vs those living in the community. INDIAN J MED RES-B 2011; **22**(1): 120-126.
- 682
- 683
- 684
- 685
- 686
- 687
- 688
- 689
- 690
- 691
- 692
- 693

694
695
696

Table 5
Quantile Regression Coefficients
Dependent Variable: Body Mass Index

Males - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		OLS	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	1.4	2.27	1.76	4.38	2.27	4.96	1.94	6.6	1.27	2.16	2.19	3.64	1.69	3.18	2.21	8.4
Age			0.03	3.49												
Age Sq			0	-3.97											0	-2.12
Smoking					-0.02	-2.72					0.03	2.45				
Alcohol							-0.01	-2.63	-0.01	-2.49			-0.01	-2.58	0	-2
Ethnicity											0.15	3.06	0.09	3.68		
Sitting Height Ratio	1.16	3.03			1.11	3.38	2.18	6.35	2.03	10.92	1.81	3.14	1.76	6.9	1.31	6.07
Household Size									0.04	2.18	0.03	2.19	0.04	2.86	0.02	2.2
Net Total Wealth	0	2.52	0	-2.34												
Married																
Employment																
Depression							0.02	2.59	0.02	4.78	0.02	2.36	0.02	2.1	0.01	3.76
Loneliness																
Educational attainment																

697
698
699
700
701
702

703

Table 5 (cont'd)

Males - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	73.72	2.12	50.66	2.32	76.17	2.2	74.43	7.44	73.24	2.55					2.76	13.87
Age							0.33	2.01								
Age Sq							0	-2.35								
Smoking							-0.07	-2.56	-0.26	-7.12	-0.29	-8.05				
Alcohol	0.98	2.51									-1.14	-3.17	-1.04	-2.09		
Ethnicity											8.76	2.81				
Sitting Height Ratio							28.2	3.16							0.81	4.1
Household Size					1.64	2.2					2.96	2.2			0.03	3.74
Net Total Wealth									0	-2.57	0	-4.57				
Married																
Employment																
Depression									1.91	4.06						
Loneliness																
Educational attainment							-0.58	-2.98	-1.71	-4.65					-0.01	-2.88

704

705

706

707

708

709

710

Nature Precedings : hdl:10101/hpre.2012.6897.1 : Posted 17 Feb 2012

711

Table 5 (cont'd)

Females - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		OLS	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	1.81	4.24	1.52	4.46	1.79	3.57			1.82	3.62	2.05	4.57	1.39	2.39	1.85	6.5
Age			0.02	4.52	0.03	2.25					0.03	2.43	0.05	4.16	0.02	2.76
Age Sq			0	-5.16	0	-2.23					0	-2.79	0	-4.5	0	-2.87
Smoking																
Alcohol					-0.01	-2.16	-0.02	-3.76	-0.01	-3.71	-0.01	-3.94	-0.02	-5.07	-0.01	-3.31
Ethnicity	-0.07	-2.35	-0.11	-4.21									-0.11	-3.34		
Sitting Height Ratio	1.78	4.98	1.69	4.34	1.36	4.13	3.4	5.78	1.57	4.29	1.26	2.94	1.47	2.97	1.68	6.41
Household Size	0.03	5.36			0.03	2.58									0.02	2.62
Net Total Wealth	0	-4.7	0	-5.24	0	-3.44	0	-3.46	0	-3.5	0	-4	0	-3.66	0	-5.98
Married	-0.02	-3.17														
Employment																
Depression																
Loneliness																
Educational attainment	-0.01	-2.67	-0.01	-2.21			-0.01	-3.02							-0.01	-2.21

712

713

714

715

716

717

718

Table 5 (cont'd)

Females - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value				
Intercept	2.43	8.83	2.48	8.34	2.24	3.42	1.69	3.26	3.08	5.92	3.15	5.67	3.01	3	2.74	12.48
Age																
Age Sq																
Smoking			-0.01	-2.15	-0.04	-3.48					-0.03	-2.24			-0.03	-3.18
Alcohol					-0.01	-2.23	-0.02	-3.81	-0.01	-2.84	-0.02	-4.21	-0.02	-2.86	-0.01	-3.29
Ethnicity			-0.1	-6.7			0.16	2.21								
Sitting Height Ratio	0.86	4.8	0.9	2.61	1.25	3.19	2.46	3.63	1.29	4.75	1.14	3.1			1.32	6.35
Household Size	0.03	2.76	0.02	2.45	0.03	2.61									0.02	2.27
Net Total Wealth	0	-2.18	0	-4.48	0	-16.11									0	-4.61
Married	0.01	2.49	0.01	2.64									0.01	2.95		
Employment					-0.03	-2.1	-0.05	-2.2							-0.03	-2.36
Depression			0.01	2.56	0.01	2.49	0.03	3.36	0.02	3.39	0.02	3			0.01	3.43
Loneliness																
Educational attainment			-0.01	-2.99	-0.01	-2.57	-0.02	-3							-0.01	-3.46

Note: we only report coefficients statistically significant at 10 percent of confidence level.

725
726
727

Table 6
Quantile Regression Coefficients
Dependent Variable: Waist Circumference

Males - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value		
Intercept					47.25	2.06	89.04	4.3	79.04	2.71			125.39	3.95	71.61	3.89
Age	1.56	2.88			1.4	2.17										
Age Sq	-0.01	-3.05			-0.01	-2.18										
Smoking											2.35	5.53	1.37	3.75		
Alcohol											-0.67	-2.92	-0.64	-2.38		
Ethnicity											9.81	3.9	9.16	5.05		
Household Size					1.65	2.11					2.71	2.37	2.93	3.17	1.37	2.27
Net Total Wealth									0	-2.51						
Married																
Employment													2.97	2.29		
Depression					0.95	2.56	1.21	3.39	1.47	5.11	0.8	2.02			0.93	3.57
Loneliness	-1.25	-4.35	-0.72	-2.8					0.71	2.56			0.95	2.59		
Educational attainment								-0.51	-2.64	-0.48	-2.25				-0.32	-2

728

Table 6 (cont'd)

Males - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		OLS	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept			78.45	3.85	93.42	4.42	100.07	7.23	95.04	5.07	89	4.23	86.67	3.21	93	7.08
Age																
Age Sq																
Smoking									-0.17	-5.56						
Alcohol											-0.59	-2.31				
Ethnicity											11.59	5.01	3.71	2.06		
Household Size			1.59	2.29					1.96	2.4	2.66	3.06	3.65	2.46	1.6	2.71
Net Total Wealth					0	9.16					0	-10.64				
Married																
Employment													4.2	2.34		
Depression									1.04	3.16	1.12	2.54	2.06	2.98		
Loneliness																
Educational attainment								-0.69	-3.5	-1.21	-5.11				-0.52	-3.13

Nature Precedings : hdl:10101/hpre.2012.6897.1 : Posted 17 Feb 2012

Table 6 (cont'd)

Females - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value		
Intercept							63.41	3.85	88.75	4.38	89.64	4.42	73.22	2.26	52.98	3.16
Age			1.9	2.32	1.24	2.37	0.82	2.09					1.71	2.08	1.18	2.53
Age Sq			-0.01	-2.09	-0.01	-2.18	-0.01	-2.29			-0.01	-2.52	-0.02	-2.68	-0.01	-2.61
Smoking							1.33	2.19			1.48	2.85				
Alcohol									-0.63	-3.4	-0.61	-3.07			-0.27	-2
Ethnicity			-2.69	-2.06												
Household Size	1.7	2.91	2.36	2.64	1.92	3.95									1.3	2.07
Net Total Wealth	0	-2.31	0	-2.39	0	-5.4	0	-5.82	0	-9.04	0	-14.11	0	-3.43	0	-5.46
Married																
Employment									-2.65	-2.42	-4.34	-3.6	-4.95	-2.07		
Depression							0.71	2.61	1.1	3.49	0.88	2.83			0.61	2.69
Loneliness																
Educational attainment			-0.47	-2.69	-0.7	-4.13									-0.39	-2.38

Table 6 (cont'd)

Females - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		OLS	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	78.07	2.36	65.34	2.51	87.7	4.5	107.13	8.43	125.77	13.01	129.92	5.37	134.08	6.34	98.63	7.69
Age																
Age Sq																
Smoking																
Alcohol									-0.74	-3.6	-0.9	-4.77	-1.39	-3.97	-0.39	-2.88
Ethnicity											-9.05	-5.33	-13.08	-4.61		
Household Size			2.06	3.03							1.82	2.19				
Net Total Wealth	0	-2.58	0	-10.19	0	-3.07					0	-23.85			0	-4.2
Married											0.83	4.19	0.85	2.7		
Employment					-2.06	-2.13	-2.91	-2.97			-3.5	-3.39			-2.31	-2.89
Depression					0.64	2.08	0.72	2.37	0.66	2.05					0.68	2.9
Loneliness											0.87	3.3	0.99	2.23		
Educational attainment	-0.7	-2.6	-0.73	-3.69	-0.68	-3.61	-0.61	-2.77	-0.55	-2.2					-0.51	-3.01
<p><i>Note: we only report coefficients statistically significant at 10 percent of confidence level.</i></p>																

736
737
738

Table 7
Quantile Regression Coefficients
Dependent Variable: Waist-Hip Ratio

Males - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		OLS	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	0.48	3.62	0.6	2.83	0.63	5.04	0.81	7.23	1.04	7.28	1.01	8.57	1.04	3.82	0.84	8.14
Age	0.01	3.34														
Age Sq	0	-3.43														
Smoking									0.02	3.26	0.02	5.07			0.01	3.9
Alcohol											0	-3.32				
Ethnicity					0.04	7.02	0.01	2.82			0.02	2.05				
Household Size											0.01	2.13				
Net Total Wealth	0	-2.16			0	-2.35	0	-2.7			0	-2.66				
Married	-0.01	-2.57									-0.02	-2.28				
Employment																
Depression					0.01	2.35	0	2.79	0.01	2.97	0.01	4.87	0.01	2.43	0	3.39
Loneliness			-0.01	-3.03												
Educational attainment					0	-2.12	0	-3.15	0	-2.65			-0.01	-2.64	0	-3.35

739
740

Nature Precedings : hdl:10101/hpre.2012.6897.1 : Posted 17 Feb 2012

Table 7 (cont'd)

Males - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value		
Intercept	0.99	4.77	0.94	6.13	0.99	10.49	0.9	7.91	0.87	12.3	1.05	8.22	0.85	7.9	0.94	13.24
Age									0	2.02			0.01	2.13		
Age Sq									0	-2.02			0	-2.6		
Smoking	0	5.18	0	8.88	0	6.22					0	8.79			0	2.3
Alcohol																
Ethnicity																
Household Size																
Net Total Wealth																
Married											0	2.16				
Employment																
Depression									0.01	3.17	0	4.16				
Loneliness																
Educational attainment			-0.01	-3.26	-0.01	-4.1	-0.01	-5.14	-0.01	-3.87	-0.01	-3.95	-0.01	-3.03	0	-5.44

Table 7 (cont'd)

Females - Wave 2	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	0.59	4.38	0.69	4.45	0.7	7.86	0.65	5.83	0.77	5.63	0.58	2.36			0.72	8.21
Age																
Age Sq																
Smoking	0.02	3.65	0.01	5.13	0.01	3.93	0.02	4.73	0.01	3.19	0.01	3.91			0.01	4.8
Alcohol																
Ethnicity	0.03	3.34	0.02	2.81												
Household Size																
Net Total Wealth			0	-7.45			0	-2.22	0	-4.63	0	-5.15			0	-3.81
Married																
Employment																
Depression	0.01	2.4			0	3.15					0.01	2.18			0	2.84
Loneliness	0	-2.11														
Educational attainment			0	-2.86	0	-4.24	0	-3.82	0	-2.27					0	-3.78

744

745

746

747

748

749

750

751

Nature Precedings : hdl:10101/npre.2012.6897.1 : Posted 17 Feb 2012

Table 7 (cont'd)

Females - Wave 4	Percentile														OLS	
	-5		-10		-25		-50		-75		-90		-95		Coef.	t-value
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Intercept	0.66	10.63	0.74	9.02	0.72	16.02	0.82	8.82	1.03	10.32	1.08	8.34	1.14	6.37	0.87	12.77
Age																
Age Sq																
Smoking			0.02	3.36	0.01	2.79	0.01	5.46							0.01	2.09
Alcohol	0	3.14									0	-3.13	-0.01	-3.01		
Ethnicity	0.05	5.47														
Household Size																
Net Total Wealth									0	-10.61					0	-2.65
Married																
Employment																
Depression	0.01	2.83	0.01	2.72	0.01	3.31										
Loneliness	0	-2.74														
Educational attainment	-0.01	-3.84	-0.01	-4.8	0	-3.56			0	-2.47					0	-3.49
<p><i>Note: we only report coefficients statistically significant at 10 percent of confidence level.</i></p>																

755 **Annex – Variables used from the English Longitudinal Study of Ageing (ELSA)**

Variable in our revised model	Definition of the variable in our revised model	Original Variable	Original Description in HSE	Coding Under the HSE_08		Coding Under our Revised Model	
indager	Age	indager	Definitive age variable collapsed at 90 plus	Numeric (for those who aged more than 90, the code is 99).		Numeric (However, 90 for all aged over 90).	
fqethnr	Ethnicity	fqethnr	Ethnicity recoded into white and non-white	Value = 1	Label = White	Value = 0	Label = White
				Value = 2	Label = Non-white	Value = 1	Label = Non-white
heskb	Extent of smoking	heskb	Number of cigarettes smoke per weekday	Numeric		Value = 0	Label = 0
						Value = 1	Label = 0<x<=10
						Value = 2	Label = 10<x<=20
						Value = 3	Label = x>20
wpdes	Economic Status	wpdes	Best description of current situation	Value = 1	Label = Retired	Value = 0	Label = Retired/Sick/Unemployed
				Value = 2	Label = Employed		
				Value = 3	Label = Self-employed		
				Value = 4	Label = Unemployed		
				Value = 5	Label = Permanently sick or disabled	Value = 1	Label = Employed
				Value = 6	Label = Looking after home or family		

756
757

758

Annex (cont'd)

Variable in our revised model	Definition of the variable in our revised model	Original Variable	Original Description in HSE	Coding Under the HSE_08		Coding Under our Revised Model	
marstat	Marital Status	dimar	Respondent current marital status	Value = 1	Label = Single, that is never married	Value = 0	Label = Single/Widowed/Separated
				Value = 2	Label = Married, first and only marriage		
				Value = 3	Label = Remarried, second or later marriage		
				Value = 4	Label = Legally separated	Value = 1	Label = Married/Remarried
				Value = 5	Label = Divorced		
				Value = 6	Label = Widowed		
Loneliness	Loneliness	scfeela+scfeelb+scfeelc+scfeeld	scfeela: How often respondent feels they lack companionship	Value = 1	Label = Hardly ever or never	Numeric 4<= x <=12	
				Value = 2	Label = Some of the time		
				Value = 3	Label = Often		
			scfeelb: often respondent feels left out	Value = 1	Label = Hardly ever or never		
				Value = 2	Label = Some of the time		
				Value = 3	Label = Often		
			scfeelc: How often respondent feels isolated from others	Value = 1	Label = Hardly ever or never		
				Value = 2	Label = Some of the time		
				Value = 3	Label = Often		
			scfeeld: How often respondent feels in tune with the people around them	Value = 1	Label = Hardly ever or never		
				Value = 2	Label = Some of the time		
				Value = 3	Label = Often		

Annex (cont'd)

Variable in our revised model	Definition of the variable in our revised model	Original Variable	Original Description in HSE	Coding Under the HSE_08		Coding Under our Revised Model
				Value = 1	Label = Yes	
depression	Depression	Psceda+ Pscedb + Pscedc + Pscedd + Pscede + Pscedf + Pscedg + Pscedh	PScedA: Whether respondent has felt depressed much of the time during the past week	Value = 1	Label = Yes	Numeric 0<=x<=8
				Value = 2	Label = No	
			PScedB: Whether respondent felt everything they did during the past week was an effort	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedC: Whether respondent felt their sleep was restless during the past week	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedD: Whether respondent was happy much of the time during the past week	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedE: Whether respondent felt lonely much of the time during the past week	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedF: Whether respondent enjoyed life much of the time during the past week	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedG: Whether respondent felt sad much of the time during the past week	Value = 1	Label = Yes	
				Value = 2	Label = No	
			PScedH: Whether respondent could not get going much of the time during the week	Value = 1	Label = Yes	
				Value = 2	Label = No	

Annex (cont'd)

Variable in our revised model	Definition of the variable in our revised model	Original Variable	Original Description in HSE	Coding Under the HSE_08		Coding Under our Revised Model	
hhtot	Number of household	hhtot	Number of people in household/ computed	Numeric		Value = 1	Label = 1
						Value = 2	Label = 2
						Value = 3	Label = 3 or above
sex	sex	sex	Sex	Value = 1	Label = Male	Value = 0	Label = Male
				Value = 2	Label = Female	Value = 1	Label = Female
bmival_wave	bmival at wave	bmival	Valid BMI - inc estimated>130kg	Numeric		Numeric	
nettotw_bu_v	BU total (non-pension) wealth at wave	nettotw_bu	BU total net (non-pension) wealth	Numeric		Numeric	
shratio2	Sitting height ratio	sithgt/htval	sithgt = Sitting height measurement (cm) htval = Valid height (cm)	Numeric		Numeric	

