

# 1 Social capital, deprivation and self-rated health: does 2 reporting heterogeneity play a role? Results from the English 3 Longitudinal Study of Ageing

## 4 5 **Abstract**

6 Self-rated health (SRH) is commonly assessed in large surveys, though responses can be  
7 influenced by different individuals' perceptions of and beliefs about health. Therefore,  
8 instead of providing evidence of 'true' health disparities across groups, findings may actually  
9 reflect reporting heterogeneity.

10 Using data from participants aged 50 years and older from the English Longitudinal  
11 Study of Ageing (ELSA) Wave 3 (2006/07; participation rate =73%), associations between  
12 three dimensions of social capital (local area & trust, social support and social networks),  
13 deprivation and SRH were examined using the vignette methodology in 2341 individuals  
14 who completed both the self-report and at least one of the 18 vignettes. Analysis employed  
15 a hierarchical probit model (HOPIT).

16 Individuals expressing low local area & trust social capital (beta= -0.276, p<0.001)  
17 and those with poor social networks (beta= -0.280, p<0.001) were more likely to report poor  
18 SRH in HOPIT models accounting for reporting heterogeneity, but unadjusted ordered probit  
19 analyses still correctly show a negative relationship between low local area & trust social  
20 capital (beta= -0.243, p<0.001) and those with poor social networks (beta= -0.210, p<0.01),  
21 though they somewhat tend to underestimate its strength. Neither social support nor  
22 deprivation appeared to have any effect on SRH regardless of reporting heterogeneity.

23 Anchoring vignettes offer a relatively uncomplicated and cost-effective way of  
24 identifying and correcting for reporting heterogeneity to improve comparative validity of  
25 self-report measures of health. This analysis underlines the need for caution when using  
26 unadjusted self-reported measures to study the effects of social capital on health.

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28 **Keywords**

29 Social capital; self-rated health; ageing; vignettes; health disparities; deprivation

30 **Word count:** 7988

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## 47 **Introduction**

48           Empirical evidence has consistently demonstrated a relationship between social  
49 capital and self-rated health (SRH) (Chen and Meng, 2015; Giordano et al., 2012; Kawachi et  
50 al., 1999; Kawachi and Berkman, 2014; Koutsogeorgou et al., 2015; Nieminen et al., 2013,  
51 2010), but because there is no 'gold standard' of how to measure social capital, the strength  
52 of the association is uncertain. A simple definition of social capital is: the “resources that are  
53 accessed by individuals as a result of their membership of a network or a group” (Kawachi  
54 and Berkman, 2014). While there is a debate around the conceptualisation of social capital  
55 (Kawachi et al., 2004; Poortinga, 2006; Szreter and Woolcock, 2004) most agree that it is  
56 multidimensional and that it carries different interpretations depending on who defines it  
57 and on their disciplinary traditions.

58           Social capital has been suggested to improve health through norms and attitudes  
59 that influence healthy behaviours, and psychosocial networks that increase access to health  
60 care and mechanisms that enhance self-esteem (Kawachi et al., 1999; Kawachi and  
61 Berkman, 2014; Lindström, 2008). Conversely, social capital can also have a negative impact  
62 on health, including the promotion (but also cessation) of risky behaviours (e.g. smoking),  
63 exchanging wrong information, the exclusion of ‘outsiders’, and downward-levelling norms  
64 (Burt, 1992; Campos-Matos et al., 2016; Christakis and Fowler, 2008; Kawachi and Berkman,  
65 2014; Rosenquist et al., 2011). Interventions have been conducted to evaluate social  
66 capital’s impact on health with varying success(Coll-Planas et al., 2016).

67           While the literature is vast on the health effects of individual level disadvantage,  
68 area level deprivation can affect health by increasing an individual’s sense of being deprived  
69 of status, resulting in frustration, shame and stress, which in turn may lead to adverse  
70 health consequences. On the other hand areas which are least deprived may be wealthier

71 and thus have more local facilities and resources which can have a positive impact on health  
72 (Glymour et al., 2014; Zhang et al., 2013). However, rather than using instruments designed  
73 for a specific purpose (Sánchez-Santos et al., 2013), different methods to measure  
74 deprivation at area-level have been employed, making the strength of associations  
75 uncertain. The Index of Multiple Deprivation (IMD) is a measure of deprivation at the lower  
76 super output area (LSOA) which has been used in the UK since 2000 and is an instrument  
77 specifically designed for such a purpose (Noble et al., 2004). It is based on the idea of  
78 distinct dimensions of deprivation which can be recognised and measured separately, but  
79 combined into an overall score.

80         To measure health in large cohort surveys, it is common that a subjective measure  
81 based on self-report is employed, preferably in combination with the use of objective  
82 measures. However, the latter may be too expensive to implement in large population  
83 surveys. Nevertheless SRH has been shown to have robust associations with “hard”  
84 outcomes such as mortality (Barger et al., 2016). Many international cohort studies have  
85 employed measures of SRH collected sequentially over time, including the English  
86 Longitudinal Study of Ageing (ELSA) (Stephens et al., 2013). However, the primary issue with  
87 using such self-reports alone is that different individuals may have different beliefs and  
88 perceptions about the concept of health. The comparability of self-reported information can  
89 vary across social groups (within countries) or across countries because of: unequal access  
90 to medical providers or health information; diagnosis avoidance (inadvertent or intentional  
91 avoidance of medical screening/testing); or interpersonal incomparability across groups if  
92 they use different reference groups or interpret questions or concepts differently (Burgard  
93 and Chen, 2014). Researchers also usually have little insight as to what individuals are  
94 actually thinking of when they assess their health (Au and Johnston, 2014). Therefore,

95 instead of providing evidence of 'true' health disparities, findings may actually reflect  
96 *reporting heterogeneity*.

97 To help overcome the problems of interpersonal incomparability of subjective  
98 measures, such as self-reports, King et al. 2004 proposed a technique using anchoring  
99 vignettes(King et al., 2004). The vignettes were presented as a way to alleviate problems  
100 which occur when different groups of participants understand and use the Likert scales for  
101 self-reports in different ways (e.g. 1=very bad health to 5=very good health). This  
102 heterogeneity in reporting styles is also known as differential item functioning (DIF).  
103 Graphically, this problem is illustrated in Figure 1. Previous research has been conducted  
104 into the use of anchoring vignettes to assess group differences in SRH (Au and Lorgelly,  
105 2014; Grol-Prokopczyk et al., 2015, 2011; Peracchi and Rossetti, 2012; Xu and Xie, 2015), but  
106 to our knowledge, only one so far has specifically used the anchoring vignettes technique to  
107 improve comparability of SRH and social capital (Chen and Meng, 2015).

108 As outlined above, studies have demonstrated associations between social capital  
109 and SRH. However, these studies did not take into account the possibility of reporting  
110 heterogeneity distorting SRH disparities associated with social capital. Therefore, using  
111 nationally representative data, we aim to better estimate the relationship between social  
112 capital and SRH among English adults aged 50 years and older. By improving the  
113 interpersonal comparability of SRH, we can conduct simulations to illustrate the potential  
114 magnitude of the effect of reporting heterogeneity in estimating the distribution of SRH  
115 from self-reported survey data.

116

## 117 **Methods**

### 118 *Population*

119 ELSA is a panel study of a representative cohort of men and women living in England  
120 aged 50 years and older, and their partners of any age. It was designed as a sister study to  
121 the Health and Retirement Study in the US and follows many of the same principles. The  
122 study commenced in 2002, and the sample has been followed up every two years using  
123 computer-assisted personal interviews and self-completion questionnaires, with an  
124 additional nurse visit for the assessment of biomarkers every four years (main interview).  
125 More detailed information on the design of ELSA can be found elsewhere(Steptoe et al.,  
126 2013). Data for this current study is from ELSA Wave 3 (2006/07). The participation rate in  
127 Wave 3 was 73% (total individual respondents to wave 3 divided by total individuals eligible  
128 for wave 3). After excluding partners aged <50 years (n=428), 9343 main interviews were  
129 completed. 2341 individuals also completed a module on self-completion health vignettes  
130 (at least one of the 18 vignettes answered; covering the health domains pain, sleeping,  
131 mobility, memory, breathing and depression) and a self-rated health question using a similar  
132 five-point Likert scale.

133

#### 134 *Self-rated health assessment*

135 SRH was collected during the main interview. Individuals were asked to rate their  
136 own general health on a five-point Likert scale ('Would you say your health is...') which was  
137 reverse coded to be increasing in good health (1= very poor to 5=very good).

138

#### 139 *Social capital assessment*

140 The framework adopted by the Office for National Statistics (ONS) (Siegler, 2014)  
141 and introduced by the Organisation for Economic Co-operation and Development (OECD)  
142 (Scrivens and Smith, 2013) was used as a basis to select 21 different variables within ELSA

143 that could be used to represent social capital. In this framework, there are four different  
144 aspects of social capital: [1] personal relationships; [2] social network support; [3] civic  
145 engagement; and [4] trust and cooperative norms. Of the 21 variables selected, only two  
146 mapped onto 'civic engagement' (member of at least one organisation, club or society and  
147 voluntary work). Therefore, the 21 variables were reduced to three social capital dimensions  
148 using factor analysis. The three dimensions were [1] local area & trust, [2] social support and  
149 [3] social networks. Factor loadings  $\geq 0.3$  were retained. The factor loadings and dimensions  
150 are outlined in Table S1 in the Online Supplementary Material.

151         The three dimensions created align well with the ONS framework. [1] "Local area &  
152 trust" matches the concepts of trust and cooperative norms or shared values that shape the  
153 way people behave towards each other and as members of society (nine factors; all found in  
154 the same section of ELSA questionnaire - local area), [2] "social support" is closely related to  
155 the level of resources or support that a person can draw from in their personal relationships  
156 (six factors; all in reference to spouse/partner, children, family and friends), and [3] "social  
157 networks" incorporates aspects of both "personal relationships" and "civic engagement" (six  
158 factors). It includes variables which refer to both the structure and nature of people's  
159 personal relationships (number of close relationships, meet ups/communication) and the  
160 actions and behaviours that can be seen as contributing positively to the collective life of a  
161 community or society (member of an organisation and volunteering). The composite  
162 reliability {a test of internal consistency - measures the overall reliability of a collection of  
163 heterogeneous but similar items} (Colwell, 2016) of the dimensions of social capital were  
164 0.84 (local area & trust), 0.81 (social support) and 0.66 (social networks).

165         The three factor scores were divided into quintiles. The top quintile included persons  
166 with high levels of social capital with regard to the dimension in question. Respectively, the

167 bottom quintile included those with the least social capital in that dimension. For the  
168 purposes of this analysis, we created two separate dichotomised variables for each  
169 dimension. High social capital coded as 1=top quintile and 0=bottom four quintiles. Low  
170 social capital coded as 1=bottom quintile and 0=top four quintiles.

171

## 172 *Deprivation assessment*

173 ELSA deprivation data was obtained separately via an application process which was  
174 approved by the NatCen Data Release Panel. IMD2004 is a measure of multiple deprivation  
175 at the lower super output area (LSOA) (Noble et al., 2004). IMD2004 is based on the idea of  
176 distinct dimensions of deprivation which can be recognised and measured separately.  
177 People may be counted as deprived in one or more of the domains depending on the  
178 number of types of deprivation that they experience. IMD2004 is conceptualised as a  
179 weighted area level aggregation of these specific dimensions of deprivation: [1] income  
180 deprivation; [2] employment deprivation; [3] health deprivation and disability; [4]  
181 education, skills and training deprivation; [5] barriers to housing and services; [6] living  
182 environment deprivation; [7] crime. Each dimension index consists of a score which is then  
183 ranked. The higher the score, the more deprived is the LSOA. The IMD2004 scores were  
184 provided from NatCen as quintiles. The top quintile included persons who were most  
185 deprived. Respectively, the bottom quintile included those who were least deprived. For the  
186 purposes of this analysis, we created two separate dichotomised variables. Most deprived  
187 coded as 1=top quintile and 0=bottom four quintiles. Least deprived coded as 1=bottom  
188 quintile and 0=top four quintiles.

189

## 190 *Vignette assessment*



191           The 18 vignettes within the health self-completion questionnaire are outlined in the  
192 Online Supplementary Material. They cover several different health domains, including pain,  
193 sleeping, mobility, memory, breathing and depression (three vignettes each). Briefly,  
194 individuals were asked to rate the health limitations of various hypothetical persons who  
195 experience different circumstances related to health on a five-point Likert scale. Possible  
196 responses, once reverse coded to be increasing in good health, ranged from 1= extreme  
197 health problem to 5=no health problem. Individuals were asked to assume that each of the  
198 hypothetical persons had the same age and background as their own. Anchoring vignettes  
199 are designed to take into account the fact that people of different countries, sex, age bands  
200 and socio-economic groups may rate similar circumstances differently. Further detailed  
201 information on anchoring vignettes can be found elsewhere (Jones et al., 2013).

202

### 203 *Covariates assessment*

204           Health behaviours and other covariates were recorded during the main interviews.  
205 Four health behaviours included smoking, alcohol, physical activity and sleeping. Smoking  
206 status was coded as current vs. not current smoker. Alcohol frequency, but not consumption  
207 volume was available and was coded as low/moderate (once or twice per week to once or  
208 twice per year), high (almost every day to three or four times per week) and abstainer (not  
209 at all in last 12 months). Physical activity was coded as active (moderate to high physical  
210 activity) vs. low/sedentary. Sleeping was coded as restless during past week vs. not restless.

211           Other covariates included age, sex, living arrangements, education and household  
212 income. Age was classified into four categories: 50-59, 60-69, 70-79 and 80+ years old.  
213 Living arrangements were classified into two categories: living alone and  
214 cohabiting/married. Education was classified into three categories: basic (no/basic

215 qualifications), secondary (higher education but below a degree), and higher (degree or  
216 above). Income was included as a continuous variable which was based on the sum of  
217 employment, state benefit, state and private pension, asset, and other income; each  
218 member of the benefit unit was assigned the total benefit unit level income. The OECD  
219 equivalence scale was used (assigned a weight of 1 to the household head, 0.5 to second  
220 adults and dependent children aged 14 and over and a weight of 0.3 to children under 14  
221 years of age) (39) and total income was scaled by a factor of £1000.

222

### 223 **Statistical methods**

224 All statistical analysis was performed using STATA IC V.13.1 (StataCorp, Texas, USA).

225 A standard ordered probit model was used as a baseline model with which we could  
226 compare our more flexible specification which does not impose the assumption of reporting  
227 homogeneity, to assess the extent to which this assumption biases the estimated health  
228 effects.

229 Individuals rated the vignettes describing the hypothetical cases similar to how they  
230 rated their own SRH. As they represent fixed levels of health, individual variation in vignette  
231 ratings characterise reporting heterogeneity (DIF). This 'external' vignette information can  
232 therefore be used to model the cut-points on the Likert scale (which are assumed fixed in  
233 the ordered probit model) as functions of the individual's characteristics. These cut-points  
234 can then be used to purge reporting heterogeneity from the SRH, making it possible to  
235 identify 'true' health effects. This is achieved through the use of a hierarchical probit model  
236 (HOPIT).

237 The HOPIT model has two components. The vignette component models the cut-  
238 points as functions of the covariates allowing for reporting heterogeneity. To relax the

239 restriction of parallel cut-point shift (covariates affect all cut-points by the same magnitude)  
240 in this component, a generalised ordered probit model is used. The health component  
241 represents the relationship between SRH and covariates, with the cut-points determined by  
242 the vignette component, linking individual's SRH to the observed severity categories.  
243 Further detailed information on these models can be found elsewhere (Jones et al., 2013).  
244 The reference scale used in the HOPIT approach is arbitrary as it is the group represented by  
245 the omitted categories in the generalised ordered probit. By applying any reference scale of  
246 interest, it is possible to conduct simulations to illustrate the potential magnitude of the  
247 effect of reporting heterogeneity in estimating the distribution of SRH. This is achieved by  
248 reclassifying all responses and making them consistent with that scale (Heiland and Yin,  
249 2015). For example, the predicted distribution of health categories can be visualised by  
250 applying a HOPIT correction for self-reporting heterogeneity *and* reclassifying all responses  
251 in accordance with the inferred response scales of people with either high or low social  
252 capital, for each dimension of interest.

253

## 254 **Results**

255 Table 1 represents descriptive statistics for sociodemographic variables, health behaviours  
256 and vignette ratings for the whole sample, and for the sub-groups of high and low social  
257 capital within each of the three dimensions and deprivation. The main results are for all  
258 individuals who answered at least one of the 18 health vignettes and the SRH question  
259 (whole sample;  $n_{\max}=2,341$  individuals contributing a maximum of 42,138 observations  
260 [person-vignettes]). Those individuals with high social capital in any of the dimensions were  
261 generally older (not statistically significant for social networks), married females. Those with  
262 good social networks tended to be highly educated ( $P<0.01$ ) whereas the opposite was seen

263 in those with good social support ( $P < 0.001$ ). As for health behaviours, those with low local  
264 area & trust social capital and good social networks tended to be non-smokers ( $P = 0.01$  and  
265  $P < 0.001$ , respectively). Those with good social networks were more likely to be drinkers  
266 ( $P = 0.02$ ). Those with high local area & trust social capital and good social networks reported  
267 higher physical activity ( $P = 0.05$  and  $P < 0.001$ , respectively). Individuals with high social  
268 capital in any of the dimensions reported better sleep (borderline statistically significant for  
269 social networks,  $P = 0.06$ ). Those with high social capital in any of the dimensions also rated  
270 their SRH higher. Individuals who were least deprived tended to be married and more highly  
271 educated (both  $P < 0.001$ ). They tended not to be current smokers but drank alcohol more  
272 frequently (both  $P < 0.001$ ). However, they were more physically active ( $P < 0.001$ ) and  
273 reported better sleep ( $P < 0.01$ ). They rate their own SRH higher than the most deprived.

274 Table 2 compares the estimated coefficients in the latent health index implied by the  
275 different specifications of the ordered probit model and HOPIT. Two different models are  
276 shown: Model 1 includes all our dimensions of social capital (local area and trust, social  
277 support and social networks) and deprivation simultaneously with age and sex, and Model 2  
278 is similar to Model 1 except it also includes the sociodemographic and health behaviours. A  
279 model including only one dimension of social capital (e.g. social support only) or deprivation  
280 at a time, along with age and sex and the vignette dummies was also derived, though the  
281 results were similar to those seen in model 1 (data not shown). For direct comparisons to be  
282 made between the two specifications, the scale of the estimated sigma in the HOPIT needs  
283 to be close to 1 because the scale in the ordered probit is normalised to 1, while it is  
284 estimated (up to the normalisation of scale in the vignette component) in the HOPIT. The  
285 estimated sigma in this analysis for model 1 was 1.16, but was 1.02 in model 2. Therefore,  
286 making direct comparisons between the two specifications in the fully adjusted model

287 (model 2) is not problematic, but caution needs to be taken when making direct  
288 comparisons between the two specifications in model 1. Thus, the following results are in  
289 reference to model 2. The ordered probit is the most restricted specification that disregards  
290 any reporting heterogeneity. Individuals expressing low local area & trust social capital (beta  
291 = -0.243,  $p < 0.001$ ) and those with poor social networks (beta = -0.210,  $p < 0.01$ ) were more  
292 likely to report poorer SRH. These findings remained evident when allowing for non-parallel  
293 cut-point shift (HOPIT), though ignoring reporting heterogeneity tended to marginally  
294 underestimate the detrimental effect on SRH of having low local area & trust social capital  
295 (Beta = -0.276,  $p < 0.001$ ) and poor social networks (Beta = -0.280,  $p < 0.001$ ). Post-estimation  
296 tests (using “suest” command in STATA which tests for intra-model and cross-model  
297 hypotheses) between the betas in the ordered probit versus the HOPIT model were not  
298 statistically significant for low local area & trust ( $p=0.61$ ) or poor social networks ( $p=0.28$ ).

299         Neither social support nor deprivation appeared to have any effect on SRH  
300 regardless of DIF. However, in model 1, a significant negative coefficient for low social  
301 support (beta = -0.209,  $p < 0.01$ ) and for the most deprived group (beta = -0.186,  $p < 0.05$ ),  
302 and a significant positive coefficient for the least deprived (beta = 0.308,  $p < 0.001$ ) lost  
303 statistical significance once adjusted for sociodemographic variables and health behaviours  
304 (model 2). Males reported poorer SRH in both the ordered probit (beta = -0.200,  $p < 0.001$ )  
305 and HOPIT models (beta = -0.261,  $p < 0.001$ ). The age categories were negatively associated  
306 with SRH (model 2) and these effects remained non-significant, except for age 70-79 which  
307 became statistically significant when reporting heterogeneity was accounted for (beta = -  
308 0.185,  $p < 0.05$ ).

309         Table S2 in the Online Supplementary Material compares the estimated coefficients  
310 of the ordered probit model and HOPIT for each of the six domains of health that were also

311 asked in the self-completion questionnaire. The same covariates used in Model 2, Table 2  
312 were used. Overall, these individual results align well with our main analysis using SRH to  
313 represent an overall indicator of general health; the negative effect of low social capital is  
314 greater for the majority of the six health domains and all three measures of social capital  
315 when reporting heterogeneity is accounted for. Post-estimation tests between the betas for  
316 social capital in the ordered probit versus the HOPIT models were statistically significant at  
317 the 5% level across three domains of health and statistically significant at the 10% level  
318 across four domains (emboldened in Table S2).

319         The response scales inferred from vignette classifications made by respondents of  
320 high and low social capital within each of our three dimensions, and deprivation, can be  
321 useful to researchers who rely on self-reported measures. Table S3 in the Online  
322 Supplementary Material shows the results of the generalised ordered probit model of  
323 individuals' rating of the vignettes' health (vignette component of the HOPIT model). This  
324 model accommodates the potential for a non-parallel cut-point shift, allowing the covariates  
325 to affect each of the cut-points differently. The coefficients vary considerably across cut-  
326 points, and in many cases, the effects are not monotonic. Two model specifications were  
327 performed similar to Table 2. A positive coefficient implies a rightwards shift in the cut-  
328 point, suggesting that, on average, individuals from the corresponding group characterize  
329 the health problems presented in the vignette as more severe. Likewise, a negative  
330 coefficient implies a leftwards shift in the cut-point.

331         Figure 2 displays simulations to illustrate the potential magnitude of the effect of  
332 reporting heterogeneity in estimating the distribution of SRH. The top graph shows the  
333 empirical (unadjusted) distribution of SRH among ELSA participants aged 50 years and older  
334 who answered at least one of the 18 health vignettes. The second graph represents a

335 predicted distribution of SRH using HOPIT procedures without any correction for reporting  
336 heterogeneity (similar to an ordered probit model). In the latent (own) health index, the  
337 same set of covariates as in Model 2 were included (age, sex, sociodemographic variables  
338 and health behaviours).

339 By applying any reference scale of interest in the HOPIT specification, we can  
340 reclassify all responses and make them consistent with that response scale. The bottom  
341 graphs in Figure 2 display the predicted distribution of SRH after applying a HOPIT correction  
342 for reporting heterogeneity and reclassifying all responses in accordance with the reference  
343 scale of interest: response scales of high and low social capital within each of our three  
344 dimensions or in accordance with the response scales of least/most deprived. The predicted  
345 distributions are consistent with the findings reported in Table S2 and differ mainly from the  
346 second graph at the threshold good vs. very good health. For example, when the scales  
347 inferred for the groups with poor social networks were used, the predicted distributions  
348 were more concentrated at the category “very good health”, consistent with Model 2, Table  
349 S2. They have a lower threshold to what constitutes very good health compared to those  
350 with good social networks.

351

## 352 **Discussion**

353 SRH is a subjective measure often used as an indicator of general health in large  
354 cohort studies, and is regarded as a robust predictive measure of mortality, morbidity &  
355 physical functioning (Grol-Prokopczyk et al., 2011). The conceptual framework for health  
356 supports the view that it is best represented as a multidimensional set of domains (Salomon  
357 et al., 2003). The World Health Organisation (WHO) developed a set of core health domains  
358 that best describe different aspects of health status directly (Sadana et al., 2002; Salomon et

359 al., 2003). The 18 vignettes used in ELSA covered six health domains: pain, sleeping,  
360 mobility, memory, breathing and depression, which are included as part of the WHO's core  
361 domains of health. There were three vignettes per domain listing the health condition (e.g.  
362 pain) in increasing severity. Furthermore, studies have consistently shown associations  
363 between poor SRH and physical health (pain, sleeping, breathing and mobility), whether or  
364 not it relates to limitations (e.g. our vignettes ask about health problems/limitations), and  
365 mental health (Borim et al., 2014; Chang-Quan et al., 2010; Latham and Peek, 2013).  
366 Therefore, it was felt that this set of six health domains covered by the vignettes would be  
367 sufficiently exhaustive to capture the most common dimensions of SRH in our main analysis.

368         What our results show is that low local area & trust and poor social networks are  
369 associated with poorer SRH in HOPIT models accounting for reporting heterogeneity, but  
370 while ordered probit analyses still correctly show a negative relationship between these  
371 social capital dimensions and SRH, they somewhat underestimate its strength. Moreover,  
372 our simulations illustrate the potential magnitude of reporting heterogeneity in estimating  
373 the distribution of SRH by demonstrating the impact of different response scales. In  
374 particular, the distribution at the cut-point good vs. very good health tended to differ  
375 (across social capital and deprivation categories) after applying a HOPIT correction for self-  
376 reporting heterogeneity and reclassifying all responses in accordance with the chosen scale.  
377 Also, the bad and very bad self-reported health distribution was greatly diminished after  
378 applying the HOPIT correction and reclassification. Our analysis highlights the caution that  
379 needs exercised when using unadjusted self-reported measures to study the effects of social  
380 capital and deprivation on health.

381         Social capital, as highlighted in the introduction, is a multidimensional concept which  
382 can have both positive and negative effects on health. When we applied the most flexible



383 model incorporating the hypothetical health vignettes and accommodating for non-parallel  
384 cut-point shift (HOPIT) arising from reporting heterogeneity, we demonstrated that those  
385 individuals with low local area & trust social capital and poor social networks were less likely  
386 to report good health. These results are consistent with the literature.

387         Having a higher opinion of your local area and a greater sense of trust, and belonging  
388 to broader social networks can bring certain benefits and resources that would not  
389 otherwise be available. These resources are not all necessarily at an individual level but can  
390 be garnered via the group-level dynamics within such environments (Kawachi and Berkman,  
391 2014). Individual health benefits secured by virtue of membership include social support  
392 (exchange of affective support), social influence (promotion of healthy behaviours), social  
393 control (status and rewards) and social participation (opportunities to learn new skills, self-  
394 esteem and promotion of belongingness). Additional benefits to health include access to  
395 material resources such as health services, job opportunities and finance (Eriksson, 2011;  
396 Kawachi et al., 1999; Kawachi and Berkman, 2014; Lindström, 2008). Collective health  
397 benefits secured through norms and collective efficacy include trust, solidarity and  
398 reciprocity, which promotes a health-enabling environment through attitudes that influence  
399 healthy behaviours, diffusion of knowledge and information (social contagion) and the  
400 potential to influence political and community decisions/resources (Eriksson, 2011; Kawachi  
401 and Berkman, 2014). The availability and distribution of such resources will have an impact  
402 on how individual's not only rate their own SRH, but may modify their judgement of what  
403 constitutes good and bad health in the hypothetical vignettes.

404         Contrary to previous research which has found detrimental health effects of  
405 deprivation (Diez Roux and Mair, 2010; Roux et al., 2001; Stafford and Marmot, 2003), the  
406 current study found no evidence of an effect on SRH of living in a deprived neighbourhood

407 in both the ordered probit and HOPIT model specifications when adjusted for  
408 sociodemographic variables and health behaviours. This could be due, at least in part, to  
409 how deprivation is measured. The conceptual framework behind IMD2004 uses LSOA data  
410 to construct an aggregate area based score and is agnostic with respect to the causes of  
411 deprivation. Therefore, a LSOA scored as relatively deprived by the index may contain large  
412 numbers of people who are not deprived, and conversely, LSOA which are relatively less  
413 deprived might contain people experiencing significant disadvantage. Nevertheless we  
414 acknowledge that both area level and individual level attributes contribute to deprivation  
415 and we may not have been able to fully separate their effects. Therefore, caution is  
416 warranted when interpreting our findings for deprivation, especially as the data is cross-  
417 sectional in nature.

418 We originally hypothesised that relying on SRH alone without accounting for  
419 reporting heterogeneity would underestimate the detrimental effect of low social capital on  
420 SRH. Unadjusted ordered probit analyses still correctly demonstrated a negative  
421 relationship between some of the social capital dimensions and SRH, though they somewhat  
422 underestimated its strength (Table 2). It was also hypothesised that those with low social  
423 capital might use lower response thresholds for what constitutes a health problem when  
424 responding to the hypothetical vignettes (Table S3). Our simulations illustrate the impact of  
425 these response thresholds on standard measures of SRH when reclassifying all responses in  
426 accordance with high and low social capital (for each dimension) and deprivation.

427 Overall, this study demonstrates the importance of accounting for reporting  
428 heterogeneity when conducting comparative studies, either between sub-groups or across  
429 whole countries. Anchoring vignettes offer a relatively uncomplicated and cost-effective  
430 way of identifying and correcting for DIF to improve comparative validity of self-reported

431 measures such as SRH. Future research is needed to improve vignette methodology while  
432 retaining its simplicity with respect to survey operation and anchoring performance,  
433 especially with large scale population surveys in which resources are limited.

434

#### 435 **Strengths and Limitations**

436 Anchoring vignettes have a number of advantages over earlier methods of  
437 identifying and correcting for DIF. They are less error-prone and can both identify DIF and  
438 statistically correct for it (HOPIT); they are relatively cheap to implement in that they only  
439 require a small number of additional survey items and be given to a proportion of the whole  
440 sample; and they may allow a means of improving comparative validity of self-reported  
441 measures. Health vignettes thus have the potential to serve a valuable role in health  
442 research, enabling more accurate empirical work and more rigorous honing of theory (Grol-  
443 Prokopczyk et al., 2011). However, the use of anchoring vignettes comes with potential  
444 limitations. The assumptions of vignette equivalence and response consistency may not  
445 always hold true in the HOPIT models. For example, given the complex multidimensional  
446 nature of health, vignette descriptions are likely to be incomplete, and individuals may call  
447 upon their own experience to impute the missing information (lack of vignette equivalence)  
448 (van Soest et al., 2011). Similarly, individuals may report their own situation with a certain  
449 strategic consideration that is absent from vignette assessment (failure of response  
450 consistency) (d’Uva et al., 2011). The precise wording of the cut-points used in the current  
451 study between the SRH and the health vignettes varied somewhat though it was generally  
452 thought to impart the same understanding (e.g. ‘no health problem’ in vignette equivalent  
453 to ‘very good health’ in the SRH). A few researchers have attempted to test these  
454 assumptions separately (d’Uva et al., 2011; Grol-Prokopczyk et al., 2015), but rigorous tests

455 of these assumptions require extra data such as valid and reliable objective health  
456 measures, which were not collected at Wave 3 of ELSA. Additionally, as with SRH, there may  
457 be reporting heterogeneity in the social capital variables, but to our knowledge no  
458 nationally representative study, including ELSA, has developed social capital vignettes.  
459 Therefore, we could not take into account reporting heterogeneity in these measures.  
460 However, the present study is a first step towards a better understanding of the effects of  
461 reporting heterogeneity and the utility of anchoring vignettes in survey data on the social  
462 capital and deprivation disparities in health. Other limitations of the current study are the  
463 potential for unmeasured covariates and residual confounding and the fact that the health  
464 vignettes module was only completed once at Wave 3 (2006/07). Therefore, we could not  
465 analyse vignettes longitudinally, incorporating changes in perceptions and reporting of  
466 health into the models. However, with 18 vignettes in total, covering six different health  
467 domains, we have a very comprehensive data set in a large, representative sample of  
468 individuals aged 50 years and older throughout England.

469

#### 470 **Avenues for Future Research**

471 These results may be more indicative of 'true' health disparities or may be the result of  
472 diverging 'attitudes' between social capital groupings. Overall, policy solutions require an  
473 overarching approach by addressing the social determinants of health that are inclusive of  
474 all sectors of the community. High quality research is required to identify how best to tackle  
475 health inequalities and policy solutions for each group might be quite different.

476

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623 **Figure 1.** Reporting of health across two groups illustrating reporting heterogeneity

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625 A hypothetical vignette person with the same objective degree of health (represented by  
626 the dotted vertical line) is classified as having an extreme health problem by individuals with  
627 high social capital, while individuals with low social capital may characterise the same  
628 person as having a severe health problem.

629

630 **Figure 2.** Simulations illustrating the potential magnitude of the effect of reporting  
631 heterogeneity in estimating the distribution of health problem severity from self-reported  
632 survey data using the ELSA Wave 3 (2006/07) cohort, men and women aged 50 years and  
633 older

634

635 “Empirical distribution” refers to the distribution of self-rated health among the whole  
636 sample who have answered at least one of the 18 health vignettes and the self-report.

637 “Estimated distribution without adjusting for reporting heterogeneity” refers to the  
638 distribution of self-rated health estimated using the HOPIT procedure but without adjusting  
639 reporting heterogeneity, which is similar to an ordered probit model. “Reclassification using  
640 high social capital/least deprived” and “Reclassification using low social capital/most  
641 deprived” refers to the distribution of self-rated health adjusted for reporting heterogeneity  
642 in accordance with the estimated scales (based on Model 2, Table S2) for high and low social  
643 capital with regard to the dimension in question/least and most deprived.

**Table 1** Descriptive statistics for analytic sample in the ELSA Wave 3 (2006/07) cohort, men and women aged 50 years and older<sup>a</sup>

	Local area & trust						Social support				Social networks				Index of Multiple Deprivation 2004			
	Whole sample		High <sup>b</sup>		Low <sup>b</sup>		High		Low		High		Low		Least deprived <sup>c</sup>		Most deprived <sup>c</sup>	
	( <i>n</i> <sub>max</sub> = 2341) ( <i>obs</i> <sub>max</sub> = 42,138)		( <i>n</i> <sub>max</sub> = 418) ( <i>obs</i> <sub>max</sub> = 7524)		( <i>n</i> <sub>max</sub> = 403) ( <i>obs</i> <sub>max</sub> = 7254)		( <i>n</i> <sub>max</sub> = 417) ( <i>obs</i> <sub>max</sub> = 7506)		( <i>n</i> <sub>max</sub> = 431) ( <i>obs</i> <sub>max</sub> = 7758)		( <i>n</i> <sub>max</sub> = 408) ( <i>obs</i> <sub>max</sub> = 7344)		( <i>n</i> <sub>max</sub> = 410) ( <i>obs</i> <sub>max</sub> = 7380)		( <i>n</i> <sub>max</sub> = 616) ( <i>obs</i> <sub>max</sub> = 11,088)		( <i>n</i> <sub>max</sub> = 285) ( <i>obs</i> <sub>max</sub> = 5130)	
	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD	Percent / Mean	SD
Age	65.40	10.10	66.74	10.22	62.96	9.80	66.92	10.12	63.21	9.78	65.50	9.30	64.81	10.30	65.18	10.12	65.66	10.04
50-59	0.35	0.48	0.32	0.47	0.45	0.50	0.30	0.46	0.44	0.50	0.33	0.47	0.39	0.49	0.36	0.48	0.32	0.47
60-69	0.30	0.46	0.27	0.44	0.28	0.45	0.28	0.45	0.30	0.46	0.31	0.46	0.29	0.45	0.30	0.46	0.31	0.46
70-79	0.24	0.43	0.29	0.46	0.20	0.40	0.29	0.46	0.17	0.38	0.27	0.45	0.22	0.42	0.23	0.42	0.27	0.45
80+	0.11	0.31	0.12	0.32	0.07	0.25	0.12	0.33	0.09	0.28	0.08	0.28	0.10	0.31	0.11	0.31	0.09	0.29
Male	0.44	0.50	0.40	0.49	0.48	0.50	0.40	0.49	0.49	0.50	0.38	0.49	0.54	0.50	0.45	0.50	0.41	0.49
<b>Living arrangements</b>																		
Living alone	0.28	0.45	0.27	0.44	0.33	0.47	0.25	0.43	0.37	0.48	0.25	0.43	0.33	0.47	0.22	0.41	0.44	0.50
Cohabit/married	0.72	0.45	0.73	0.44	0.67	0.47	0.75	0.43	0.63	0.48	0.75	0.43	0.67	0.47	0.78	0.41	0.56	0.50
<b>Education<sup>d</sup></b>																		
Basic	0.43	0.49	0.40	0.49	0.42	0.49	0.53	0.50	0.32	0.47	0.27	0.44	0.45	0.50	0.30	0.46	0.64	0.48
Secondary	0.40	0.49	0.45	0.50	0.38	0.49	0.39	0.49	0.42	0.49	0.49	0.50	0.39	0.49	0.47	0.50	0.27	0.45
Higher	0.17	0.38	0.15	0.36	0.19	0.39	0.08	0.27	0.26	0.44	0.24	0.43	0.16	0.37	0.23	0.42	0.08	0.28
Current smoker	0.14	0.35	0.12	0.33	0.18	0.39	0.18	0.38	0.14	0.34	0.06	0.24	0.20	0.40	0.09	0.28	0.28	0.45
<b>Drinking frequency<sup>e</sup></b>																		
Low / moderate	0.53	0.50	0.53	0.50	0.55	0.50	0.54	0.50	0.51	0.50	0.54	0.50	0.51	0.50	0.51	0.50	0.61	0.49
High	0.35	0.48	0.35	0.48	0.32	0.47	0.33	0.47	0.38	0.49	0.38	0.48	0.35	0.48	0.42	0.49	0.21	0.41
Abstainer	0.12	0.32	0.12	0.33	0.13	0.34	0.13	0.33	0.11	0.31	0.08	0.27	0.13	0.34	0.07	0.26	0.19	0.39
Physical activity; active	0.72	0.45	0.73	0.44	0.67	0.47	0.69	0.46	0.73	0.44	0.81	0.39	0.65	0.48	0.80	0.40	0.54	0.50
No complaint sleeping	0.59	0.49	0.66	0.47	0.50	0.50	0.62	0.49	0.53	0.50	0.65	0.48	0.59	0.49	0.64	0.48	0.55	0.50
Self-rated health <sup>f</sup>	3.89	0.88	4.00	0.83	3.66	0.88	3.92	0.91	3.84	0.85	4.04	0.80	3.68	0.96	4.05	0.79	3.52	0.97
Vignette: Pain	3.04	1.06	3.02	1.06	3.03	1.04	3.01	1.08	3.10	1.01	2.99	1.05	3.05	1.06	3.05	1.04	2.98	1.07
Vignette: Sleep	2.59	0.85	2.54	0.82	2.59	0.85	2.60	0.83	2.65	0.82	2.50	0.81	2.62	0.87	2.57	0.81	2.58	0.85
Vignette: Mobility	2.68	1.00	2.66	0.99	2.66	0.98	2.62	1.00	2.72	0.98	2.63	0.99	2.66	0.97	2.66	0.98	2.66	0.97
Vignette: Memory	3.11	1.00	3.10	1.02	3.12	0.98	3.07	1.02	3.18	0.98	3.14	1.00	3.09	0.98	3.15	0.99	3.05	0.97
Vignette: Breathing	2.17	0.95	2.17	0.94	2.18	0.93	2.17	0.98	2.17	0.92	2.13	0.90	2.19	0.96	2.16	0.92	2.15	0.89
Vignette: Depression	2.60	1.04	2.58	1.05	2.59	1.02	2.59	1.07	2.62	1.02	2.55	1.03	2.65	1.05	2.55	1.01	2.55	1.01

<sup>a</sup> Excludes those aged <50 years, did not participate in health self-completion questionnaire (no vignette responses) ) or no self-rated health reported

<sup>b</sup> High = top quintile of factor-analysis score for social capital dimension; Low = bottom quintile of factor-analysis score for social capital dimension

<sup>c</sup> Least = bottom quintile of IMD2004; Most = top quintile of IMD2004

<sup>d</sup> Basic = no/basic qualifications; Secondary = higher education but below a degree; Higher = degree or above

<sup>e</sup> Low/moderate = 2 times per week or less; High = 3+ times per week; Abstainer = no times in previous 12 months

<sup>f</sup> Five-point Likert scale (1 = very bad/extreme problems to 5 = very good/no problems)

**Table 2** Ordered probit and HOPIT regressions of self-rated health in the ELSA Wave 3 (2006/07) cohort, men and women aged 50 years and older<sup>a</sup>

	Ordered probit		HOPIT		Ordered probit		HOPIT	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
	Model 1				Model 2			
<b>Local area &amp; trust</b>								
High <sup>b</sup>	-0.012	(0.064)	-0.005	(0.078)	0.028	(0.067)	0.055	(0.073)
Low <sup>b</sup>	-0.363***	(0.065)	-0.433***	(0.078)	-0.243***	(0.068)	-0.276***	(0.073)
<b>Social support</b>								
High	-0.040	(0.066)	-0.147	(0.080)	0.024	(0.070)	-0.063	(0.076)
Low	-0.099	(0.063)	-0.209**	(0.076)	-0.027	(0.066)	-0.119	(0.071)
<b>Social networks</b>								
High	0.034	(0.065)	0.088	(0.080)	-0.044	(0.069)	0.003	(0.076)
Low	-0.272***	(0.064)	-0.407***	(0.076)	-0.210**	(0.067)	-0.280***	(0.071)
Least deprived <sup>c</sup>	0.154**	(0.056)	0.308***	(0.068)	0.003	(0.059)	0.110	(0.064)
Most deprived <sup>c</sup>	-0.275***	(0.080)	-0.186*	(0.096)	-0.047	(0.086)	0.155	(0.092)
Age 60-69	-0.156**	(0.060)	-0.265***	(0.072)	-0.066	(0.063)	-0.133	(0.069)
Age 70-79	-0.371***	(0.064)	-0.520***	(0.077)	-0.130	(0.072)	-0.185*	(0.078)
Age 80+	-0.542***	(0.089)	-0.674***	(0.108)	-0.099	(0.106)	-0.131	(0.114)
Male	-0.040	(0.049)	-0.083	(0.059)	-0.200***	(0.053)	-0.261***	(0.057)
Vignette dummies	No		Yes		No		Yes	
Socio-demographic dummies	No		No		Yes		Yes	
Health dummies	No		No		Yes		Yes	
<i>N</i>	2046		2046		1926		1926	

<sup>a</sup> Excludes those aged <50 years, did not participate in health self-completion questionnaire (no vignette responses) or no self-rated health reported

<sup>b</sup> High = top quintile of factor-analysis score for social capital dimension; Low = bottom quintile of factor-analysis score for social capital dimension

<sup>c</sup> Least = bottom quintile of IMD2004; Most = top quintile of IMD2004

Model 1: All dimensions of social capital (local area & trust, social support and social networks) & IMD2014 simultaneously

Model 2: All dimensions of social capital (local area & trust, social support and social networks), IMD2014, the socio-demographic covariates (education, living arrangements and income), and health behaviours (smoking, alcohol, physical activity and sleep) simultaneously

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

Figure 1: 1.5 columns

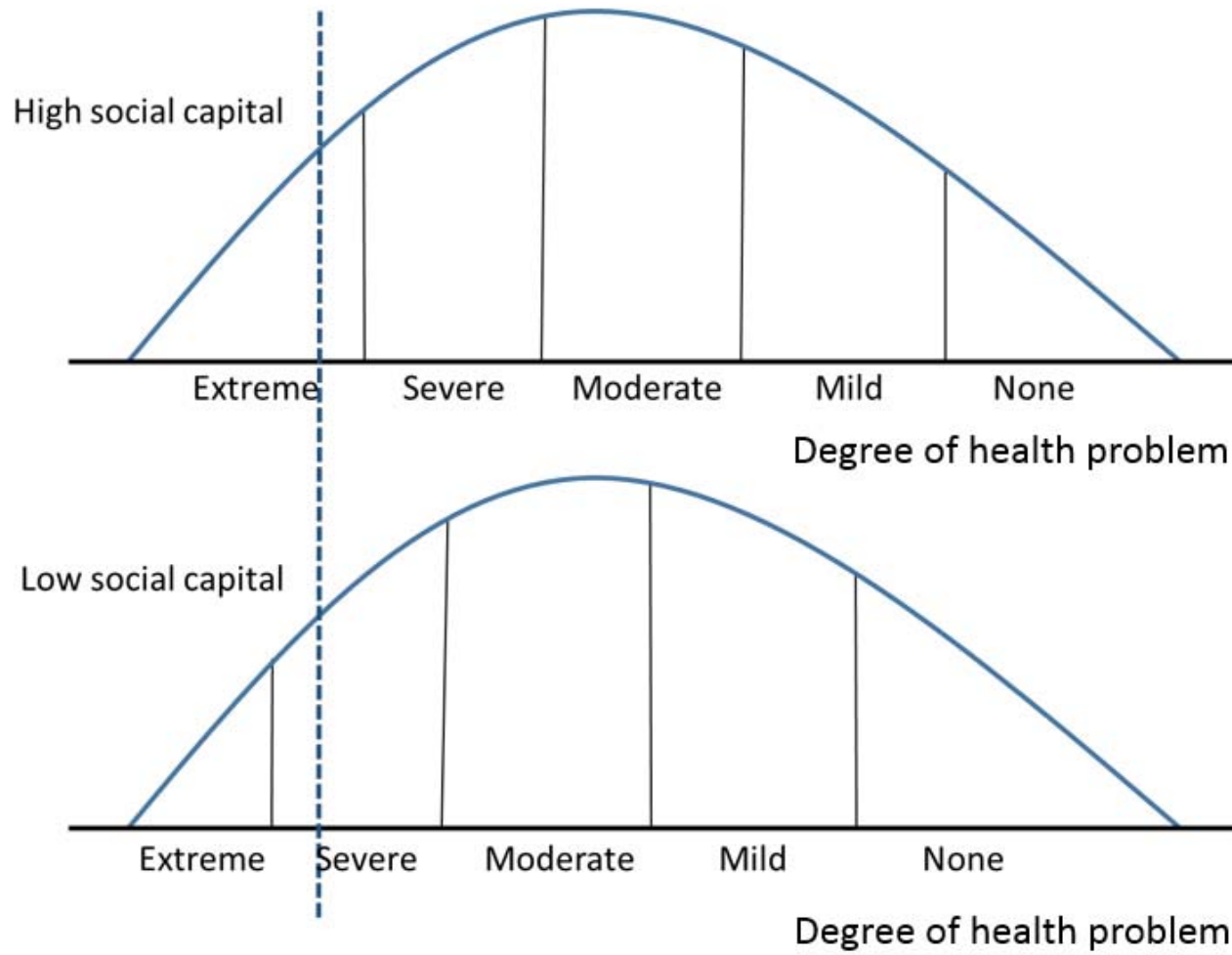
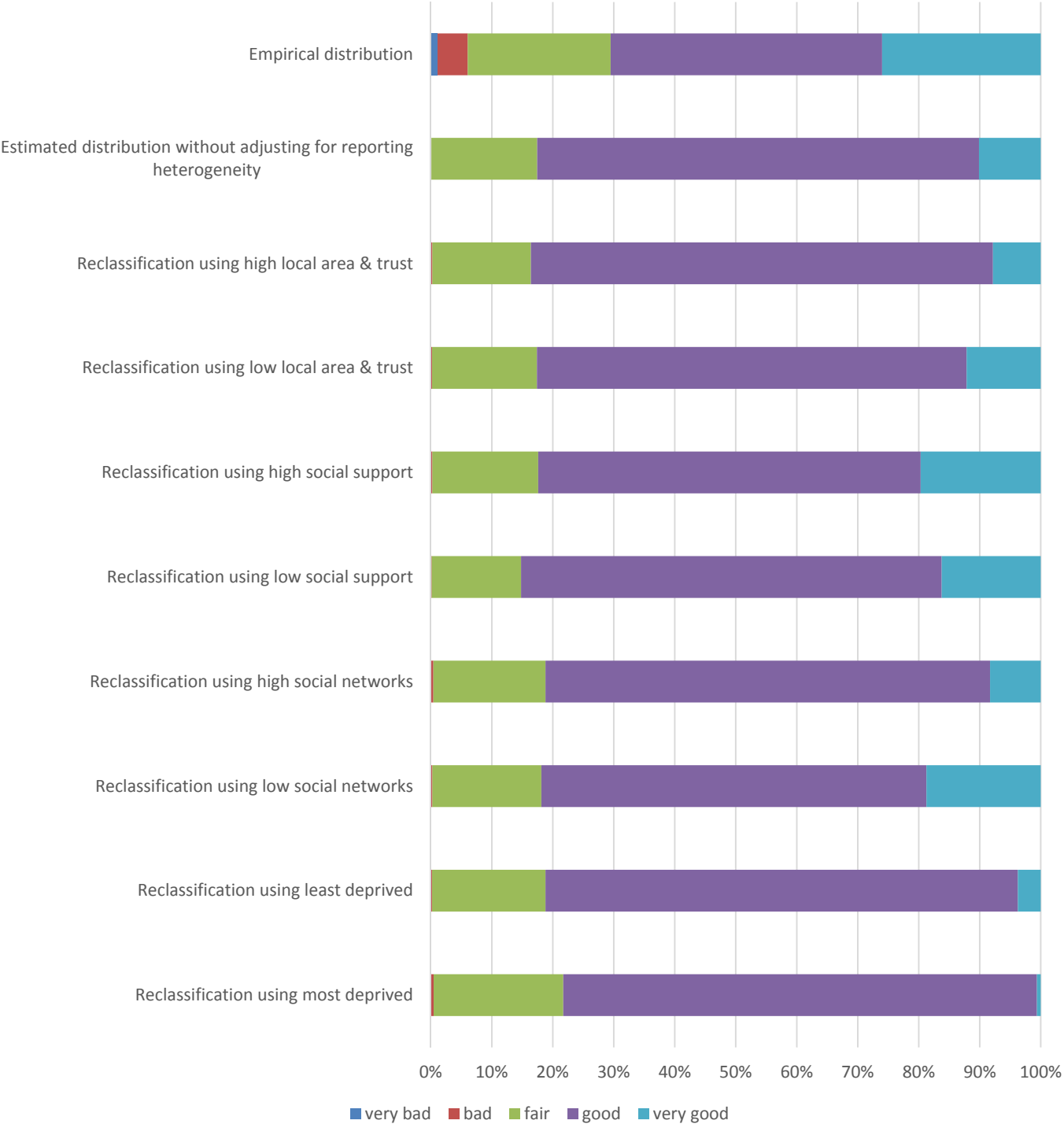


Figure 2: 2 columns



## Supplementary Material

**Table S1.** Rotated (oblique promax) three-factor structure (correlations)<sup>a</sup>

Variable	Factor 1 <i>Local area &amp; trust</i>	Factor 2 <i>Social Support</i>	Factor 3 <i>Social Networks</i>
<i>Member of at least one organisation, club or society (1=yes)</i>	-	-	0.3962
<i>Eat out of the house (1=never to 6=twice a month or more)</i>	-	-	0.3480
<i>How often do you do any voluntary work? (1=never to 6=twice a month or more)</i>	-	-	0.4032
<i>Really feels part of this area (1=strongly disagree to 7=strongly agree)</i>	0.5529	-	-
<i>Vandalism/graffiti are a big problem in this area (1=strongly agree to 7=strongly disagree)</i>	0.5419	-	-
<i>Often feels lonely living in this area (1=strongly agree to 7=strongly disagree)</i>	0.3947	-	-
<i>Most people in this area can be trusted (1=strongly disagree to 7=strongly agree)</i>	0.7350	-	-
<i>Afraid to walk alone after dark in this area (1=strongly agree to 7=strongly disagree)</i>	0.4980	-	-
<i>Most people in this area are friendly (1=strongly disagree to 7=strongly agree)</i>	0.7445	-	-
<i>People in this area will take advantage of you (1=strongly agree to 7=strongly disagree)</i>	0.7351	-	-
<i>This area is kept very clean (1=strongly disagree to 7=strongly agree)</i>	0.6162	-	-
<i>If in trouble, there are lots of people in this area who would help you (1=strongly disagree to 7=strongly agree)</i>	0.6236	-	-
<i>Number of close relationships (spouse/partner, children, family &amp; friends) (1=none to 3=3 or more)</i>	-	-	0.5201
<i>Understands the way the respondent feels about things (spouse/partner, children, family &amp; friends) (1=not at all to 3=a lot)</i>	-	0.6078	-
<i>Respondent can rely on their (spouse/partner, children, family or friends) if they have a problem (1=not at all to 3=a lot)</i>	-	0.5877	0.4273
<i>Respondent can open up to their (spouse/partner, children, family or friends) if they need to talk (1=not at all to 3=a lot)</i>	-	0.6131	0.3118
<i>How much the (spouse/partner, children, family or friends) criticises the respondent (1=a lot to 3=not at all)</i>	-	0.5750	-0.3368
<i>How much the (spouse/partner, children, family or friends) lets the respondent down (1=a lot to 3=not at all)</i>	-	0.7537	-
<i>How much the (spouse/partner, children, family or friends) gets on the respondents nerves (1=a lot to 3=not at all)</i>	-	0.6929	-0.3095
<i>How often respondent meets up face-to-face (spouse/partner, children, family or friends) (1=twice or less a year to 3=once a week or more)</i>	-	-	0.5261
<i>How often respondent speaks on phone (spouse/partner, children, family or friends) (1=twice or less a year to 3=once a week or more)</i>	-	-	0.6046

<sup>a</sup> Excludes those aged <50 years; number of cases used to generate the matrix = 6944; - represent factor loadings <0.3



**Table S2.** Ordered probit and HOPIT regressions of self-rated dimensions of health in the ELSA Wave 3 (2006/07) cohort, men and women aged 50 years and older<sup>a</sup>

	Pain				Sleep				Mobility			
	Ordered probit		HOPIT		Ordered probit		HOPIT		Ordered probit		HOPIT	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
<b>Local area &amp; trust</b>												
High <sup>b</sup>	0.097	(0.066)	0.177	(0.102)	<b>0.177**</b>	(0.068)	<b>0.290**</b>	(0.094)	0.069	(0.079)	0.124	(0.133)
Low <sup>b</sup>	-0.157*	(0.068)	-0.183	(0.103)	-0.116	(0.069)	-0.175*	(0.089)	-0.195**	(0.075)	-0.284*	(0.126)
<b>Social support</b>												
High	0.0643	(0.069)	0.086	(0.106)	0.025	(0.071)	-0.040	(0.095)	0.145	(0.081)	0.217	(0.135)
Low	<b>-0.085</b>	(0.065)	<b>-0.220*</b>	(0.100)	<b>-0.107</b>	(0.066)	<b>-0.239**</b>	(0.086)	-0.003	(0.074)	-0.135	(0.124)
<b>Social networks</b>												
High	-0.143*	(0.068)	-0.105	(0.105)	0.029	(0.070)	0.112	(0.095)	0.209*	(0.083)	0.339*	(0.14)
Low	-0.055	(0.066)	-0.114	(0.100)	0.060	(0.068)	-0.044	(0.088)	-0.091	(0.073)	-0.115	(0.123)
Least deprived <sup>c</sup>	0.023	(0.058)	0.0829	(0.089)	-0.027	(0.059)	0.099	(0.080)	0.024	(0.068)	0.168	(0.116)
Most deprived <sup>c</sup>	-0.198*	(0.085)	-0.119	(0.129)	-0.013	(0.087)	0.185	(0.115)	-0.120	(0.093)	-0.026	(0.157)
Age 60-69	-0.055	(0.062)	-0.088	(0.096)	-0.075	(0.063)	-0.225**	(0.085)	-0.164*	(0.074)	-0.357**	(0.125)
Age 70-79	-0.193**	(0.071)	-0.290**	(0.109)	-0.003	(0.073)	-0.188	(0.097)	-0.399***	(0.082)	-0.712***	(0.138)
Age 80+	-0.354***	(0.105)	-0.536***	(0.160)	-0.225*	(0.106)	-0.461***	(0.138)	-0.628***	(0.113)	-1.091***	(0.191)
Male	0.123*	(0.052)	0.150	(0.080)	0.236***	(0.053)	0.151*	(0.071)	-0.026	(0.061)	-0.031	(0.102)
Vignette dummies	Yes		Yes		Yes		Yes		Yes		Yes	
Socio-demographic dummies	Yes		Yes		Yes		Yes		Yes		Yes	
Health dummies	Yes		Yes		Yes		Yes		Yes		Yes	
N	1904		1904		1906		1906		1904		1904	

	Memory				Breathing				Depression			
	Ordered probit		HOPIT		Ordered probit		HOPIT		Ordered probit		HOPIT	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
<b>Local area &amp; trust</b>												
High <sup>b</sup>	0.080	(0.070)	0.070	(0.098)	0.086	(0.089)	0.072	(0.138)	0.148	(0.077)	0.238	(0.134)
Low <sup>b</sup>	-0.158*	(0.071)	-0.243*	(0.097)	-0.141	(0.082)	-0.340**	(0.129)	-0.102	(0.073)	-0.254*	(0.123)
<b>Social support</b>												
High	0.099	(0.073)	0.047	(0.101)	<b>-0.029</b>	(0.088)	<b>-0.279*</b>	(0.136)	0.188*	(0.080)	0.096	(0.134)
Low	<b>-0.162*</b>	(0.067)	<b>-0.282**</b>	(0.094)	-0.103	(0.082)	-0.141	(0.129)	<b>-0.378***</b>	(0.069)	<b>-0.511***</b>	(0.119)
<b>Social networks</b>												
High	0.034	(0.072)	0.061	(0.102)	0.076	(0.091)	0.161	(0.149)	<b>0.227**</b>	(0.079)	<b>0.461**</b>	(0.141)
Low	-0.055	(0.069)	-0.050	(0.095)	-0.120	(0.080)	-0.256*	(0.125)	<b>-0.165*</b>	(0.072)	<b>-0.389**</b>	(0.120)
Least deprived <sup>c</sup>	-0.005	(0.061)	-0.013	(0.086)	0.071	(0.079)	0.152	(0.124)	-0.062	(0.065)	0.103	(0.113)
Most deprived <sup>c</sup>	-0.033	(0.089)	0.046	(0.123)	-0.187	(0.099)	0.114	(0.160)	-0.022	(0.094)	0.220	(0.160)
Age 60-69	-0.072	(0.066)	-0.065	(0.092)	<b>-0.350***</b>	(0.083)	<b>-0.465***</b>	(0.135)	0.099	(0.070)	-0.017	(0.120)
Age 70-79	<b>-0.346***</b>	(0.074)	<b>-0.266*</b>	(0.103)	<b>-0.406***</b>	(0.093)	<b>-0.636***</b>	(0.146)	0.031	(0.080)	-0.152	(0.135)
Age 80+	<b>-0.619***</b>	(0.108)	<b>-0.546***</b>	(0.148)	<b>-0.649***</b>	(0.123)	<b>-0.758***</b>	(0.197)	0.159	(0.116)	0.140	(0.198)
Male	-0.070	(0.055)	-0.083	(0.079)	-0.057	(0.067)	<b>-0.328**</b>	(0.106)	<b>0.229***</b>	(0.059)	0.153	(0.100)
Vignette dummies	Yes		Yes		Yes		Yes		Yes		Yes	
Socio-demographic dummies	Yes		Yes		Yes		Yes		Yes		Yes	
Health dummies	Yes		Yes		Yes		Yes		Yes		Yes	
N	1902		1902		1907		1907		1902		1902	

<sup>a</sup> Excludes those aged <50 years, did not participate in health self-completion questionnaire (no vignette responses) or no self-rated dimension reported

<sup>b</sup> High = top quintile of factor-analysis score for social capital dimension; Low = bottom quintile of factor-analysis score for social capital dimension

<sup>c</sup> Least = bottom quintile of IMD2004; Most = top quintile of IMD2004

All dimensions of social capital (local area & trust, social support and social networks), IMD2014, the socio-demographic covariates (education, living arrangements and income), and health behaviours (smoking, alcohol, physical activity and sleep) simultaneously

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001, post-estimation (ordered probit vs. HOPIT) **bold** = p<0.01, **bold italic** = p<0.05

**Table S3.** Estimation results in generalised ordered probit model of respondents' rating of vignettes' health in the ELSA Wave 3 (2006/07) cohort, men and women aged 50 years and older<sup>a</sup>

	<b>mu1</b>	<b>mu2</b>	<b>mu3</b>	<b>mu4</b>
	<b>Extreme ≥ Severe</b>	<b>Severe ≥ Moderate</b>	<b>Moderate ≥ Mild</b>	<b>Mild ≥ None</b>
<b>Model 1</b>				
<b>Local area &amp; trust</b>				
High <sup>b</sup>	0.012 (0.027)	0.010 (0.021)	-0.045 (0.023)	0.021 (0.037)
Low <sup>b</sup>	-0.007 (0.028)	-0.017 (0.021)	0.002 (0.024)	-0.050 (0.037)
<b>Social support</b>				
High	0.075** (0.028)	0.013 (0.021)	0.003 (0.024)	-0.217*** (0.036)
Low	-0.171*** (0.028)	-0.124*** (0.020)	-0.106*** (0.023)	-0.091* (0.036)
<b>Social networks</b>				
High	0.062* (0.028)	0.035 (0.021)	0.031 (0.024)	0.071 (0.039)
Low	-0.011 (0.028)	-0.005 (0.021)	-0.002 (0.023)	-0.198*** (0.034)
<b>Index of Multiple Deprivation 2004</b>				
Least deprived <sup>c</sup>	-0.039 (0.024)	-0.007 (0.018)	0.040 (0.020)	0.217*** (0.033)
Most deprived <sup>c</sup>	0.056 (0.034)	0.046 (0.026)	0.072* (0.030)	0.274*** (0.050)
Age 60-69	-0.146*** (0.025)	-0.051** (0.019)	-0.012 (0.022)	-0.150*** (0.034)
Age 70-79	-0.236*** (0.027)	-0.083*** (0.020)	-0.003 (0.023)	-0.185*** (0.036)
Age 80+	-0.474*** (0.043)	-0.176*** (0.029)	-0.02 (0.033)	-0.014 (0.055)
Male	0.070*** (0.021)	0.055*** (0.016)	0.022 (0.018)	-0.132*** (0.028)
Constant	-3.571*** (0.037)	-2.053*** (0.032)	-0.769*** (0.033)	0.713*** (0.041)
Vignette dummies	Yes	Yes	Yes	Yes
Socio-demographic dummies	No	No	No	No
Health dummies	No	No	No	No
Obs <i>N</i>	36,295	36,295	36,295	36,295
<b>Model 2</b>				
<b>Local area &amp; trust</b>				
High	0.018 (0.028)	0.014 (0.021)	-0.037 (0.024)	0.045 (0.038)
Low	0.016 (0.029)	-0.008 (0.022)	-0.004 (0.025)	-0.067 (0.038)
<b>Social support</b>				
High	0.048 (0.029)	0.004 (0.022)	0.002 (0.025)	-0.188*** (0.038)
Low	-0.179*** (0.029)	-0.122*** (0.021)	-0.093*** (0.024)	-0.099** (0.037)
<b>Social networks</b>				
High	0.071* (0.029)	0.038 (0.022)	0.038 (0.025)	0.049 (0.041)

	<b>mu1</b>	<b>mu2</b>	<b>mu3</b>	<b>mu4</b>
	<b>Extreme ≥ Severe</b>	<b>Severe ≥ Moderate</b>	<b>Moderate ≥ Mild</b>	<b>Mild ≥ None</b>
Low	-0.014 (0.029)	0.004 (0.021)	0.012 (0.024)	-0.176*** (0.036)
<b>Index of Multiple Deprivation 2004</b>				
Least deprived	-0.034 (0.025)	-0.001 (0.019)	0.043* (0.021)	0.190*** (0.034)
Most deprived	0.081* (0.036)	0.060* (0.027)	0.115*** (0.032)	0.382*** (0.054)
Age 60-69	-0.142*** (0.026)	-0.048* (0.020)	0.004 (0.023)	-0.114** (0.036)
Age 70-79	-0.237*** (0.030)	-0.086*** (0.023)	0.007 (0.026)	-0.082* (0.041)
Age 80+	-0.488*** (0.051)	-0.169*** (0.034)	-0.003 (0.038)	0.015 (0.062)
Male	0.088*** (0.022)	0.053** (0.017)	0.012 (0.019)	-0.170*** (0.030)
Constant	-3.620*** (0.054)	-2.103*** (0.044)	-0.886*** (0.046)	0.458*** (0.065)
Vignette dummies	Yes	Yes	Yes	Yes
Socio-demographic dummies	Yes	Yes	Yes	Yes
Health dummies	Yes	Yes	Yes	Yes
Obs N	34,187	34,187	34,187	34,187

<sup>a</sup> Excludes those aged <50 years, did not participate in health self-completion questionnaire (no vignette responses) or no self-rated health reported

<sup>b</sup> High = top quintile of factor-analysis score for social capital dimension; Low = bottom quintile of factor-analysis score for social capital dimension

<sup>c</sup> Least = bottom quintile of IMD2004; Most = top quintile of IMD2004

Model 1: All dimensions of social capital (local area & trust, social support and social networks) & IMD2014 simultaneously

Model 2: All dimensions of social capital (local area & trust, social support and social networks), IMD2014, the socio-demographic covariates (education, living arrangements and income), and health behaviours (smoking, alcohol, physical activity and sleep) simultaneously

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

## ELSA health vignette questions

**Response for all:** In the last 30 days, how much difficulty/of a problem/to what degree did X have with [the condition outlined in vignette]?

None                      Mild                      Moderate                      Severe                      Extreme

**Pain vignettes:**

1. Paul has a headache once a month that is relieved after taking a pill. During the headache he can carry on with his day-to-day affairs.
2. Henry has pain that radiates down his right arm and wrist during his day at work. This is lightly relieved in the evenings when he is no longer working on his computer.
3. John has pain in his knees, elbows, wrists and fingers, and the pain is present almost all the time. Although medication helps, he feels uncomfortable when moving around, holding and lifting things.

**Sleep vignettes:**

4. Carol takes about two hours to fall asleep every night. She wakes up once or twice a night feeling panicked and takes more than an hour to fall asleep again.
5. Margaret wakes up almost once every hour during the night. When she wakes up in the night, it takes around 15 minutes for her to go back to sleep. In the morning she does not feel well-rested.
6. Alice falls asleep easily at night, but two nights a week she wakes up in the middle of the night and cannot go back to sleep for the rest of the night.

**Mobility vignettes:**

7. Tom has a lot of swelling in his legs due to his health condition. He has to make an effort to walk around his home as his legs feel heavy.
8. David does not exercise. He cannot climb stairs or do other physical activities because he is obese. He is able to carry the groceries and do some light household work.
9. Robert is able to walk distances of up to 200 metres without any problems but feels tired after walking one kilometre or climbing more than one flight of stairs. He has no problems with day-to-day activities, such as carrying food from the market.

**Memory vignettes:**

10. Mary can concentrate while watching TV, reading a magazine or playing a game of cards or chess. Once a week she forgets where her keys or glasses are, but finds them within five minutes.
11. Sue is keen to learn new recipes but finds that she often makes mistakes and has to reread them several times before she is able to do them properly.
12. Eve cannot concentrate for more than 15 minutes and has difficulty paying attention to what is being said to her. When she starts a task, she never manages to finish it and often forgets what she was doing. She is able to learn the names of people she meets.

**Breathing vignettes:**

13. Eric has no problems with walking slowly. He gets out of breath easily when climbing uphill for 20 metres or a flight of stairs.
14. Michael suffers from respiratory infections about once every year. He is short of breath 3 or 4 times a week and had to be admitted to hospital twice in the past month with a bad cough that required treatment with antibiotics.
15. Peter has been a heavy smoker for 30 years and wakes up with a cough every morning. He gets short of breath even while resting and does not leave the house anymore. He often needs to be put on oxygen.

**Depression vignettes:**

16. Ann feels depressed most of the time. She weeps frequently and feels hopeless about the future. She feels that she has become a burden on others and that she would be better dead.
17. Patricia feels nervous and anxious. She worries and thinks negatively about the future, but feels better in the company of people or when doing something that really interests her. When she is alone she tends to feel useless and empty.
18. Jean enjoys her work and social activities and is generally satisfied with her life. She gets depressed every three weeks for a day or two and loses interest in what she usually enjoys but is able to carry on with her day-to-day activities.