Ill-Health as a Household Norm:

Evidence from Other People's Health Problems

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Abstract

This paper proposes that an individual's self-assessed health (SAH) does not only suffer from systematic reporting bias and adaptation bias but is also biased owing to confounding health norm effects. Using 13 waves of the British Household Panel Survey, I am able to show that, while there is a negative and statistically significant correlation between SAH and individuals' own health problem index, this negative effect reduces with the average number of health problems per (other) family member. The relative health bias is small, however, which implies that measures of SAH may not suffer seriously from systematic health norm bias.

Keywords: Self-assessed health; subjective health; relative; norm; comparison effects; chronic illness; BHPS

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1. Introduction

Perhaps one of the most widely used measures of personal health in empirical research, self-assessed health (SAH) is often shown to be correlated with actual health (e.g. Cutler & Richardson, 1997; Kaplan & Baron-Epel, 2003; Groot et al, 2004). It is also shown to be a powerful predictor of mortality (Idler & Benyamini et al, 1999; van Doorslaer & Gerdtham, 2003), subsequent disability (Kaplan et al, 1993; Idler & Kasl, 1995), morbidity (e.g., Ferraro et al, 1997) and subsequent use of medical care (e.g., van Door et al, 2004). Yet because it is subjective in nature, its validity continues to be questioned in the literature. Do people say what they mean when prompted to answer a subjective health question such as "Please think back over the last 12 months – how would you say your health has on the whole been?" More specifically, if SAH is a valid measure of true health, why do we continue to observe a differential reporting of health across individuals or groups of individuals with the same objective health status?

A popular explanation for this observation is that SAH suffers from systematic reporting bias. Individuals from different population sub-groups (e.g. categorized by, among other things, age, gender, education, language and income) are thought to interpret the SAH question within their own specific context and therefore use different reference points when asked to respond to the same question (see, e.g., Lindeboom & van Doorslaer, 2004; Hernandez-Quevedo et al, 2005). In short, SAH does not have a natural reference point; rather, it is determined by individual specific situations and characteristics. Another potential explanation for this observation could be that individuals have some notable abilities to adapt to ill health (see, e.g., Groot, 2000; Oswald & Powdthavee, 2008). In this case, people who have been ill for a long period of time may report levels of health that are much higher than those of individuals struck down with the same illness for the first time, thus leading to the differential reporting of SAH among those with an objective health status.

This paper extends from the previous literature by proposing that measures of SAH do not only suffer from systematic reporting bias and adaptation bias but may also be biased owing to confounding health norm effects. This means that individuals with the same level of objective health may not only differ in their interpretation of their health, but their interpretation may also be a function of their social environment. To test this idea, this paper uses thirteen waves of the British Household Panel Survey to investigate what happens to the reported SAH levels as the indices of health problem of other household members increase. Does the gap in SAH between individuals with and without health problems reduces as the average number of health problems per (other) household members and the share of people with physical limitations go up? What is the extent of household norm bias in health, and how much should we worry about controlling for it when making statistical inferences on the SAH data?

Section 2 briefly discusses previous literature on SAH. Section 3 considers the role of relative health on SAH. Section 4 implements the test and discusses the results. Section 5 concludes.

2. Literature review

Previous research on SAH suggests that the respondent's rating of his or her health status expresses subjective as well as objective aspects: information and knowledge that the respondent has, together with body sensations and such subjective elements as perceptions, evaluations and judgemental attitudes (Liang, 1986; Kaplan & Baron-Epel, 2003). With respect to the subjective dimension of SAH, Krause and Jay (1994) found that people of different age groups tend to think about different aspects of their health when making evaluations. Using data on 158 in-depth interviews, they showed that older respondents were more likely to use specific health problems (e.g., hypertension) as a reference point for their health, while the younger cohorts were more likely to focus on their own physical functioning such as mobility and acute conditions. This means that people with the same 'true health' may end up reporting different levels of SAH depending on their age. The differential reporting of SAH among people with the same objective health is not limited to only those of different age groups. For example, Baron-Epel and Kaplan (2001) showed that people with more years of education tend to assess their health in an optimistic way, even when they share other characteristics such as language, culture, nationality and religion. Using Swedish micro-data, Gerdtham and Johannesson (2001) found SAH to be higher among women, those with a high income, the highly educated, the employed and the married. The differential mapping of true health when reporting SAH by respondent characteristics has been termed 'state-dependent reporting bias' (Kerkhofs & Lindeboom, 1995), 'scale of reference bias' (Groot, 2000) and 'response category cut-point shift' (Lindeboom & van Doorslaer, 2004; Hernandez-Quevedo et al, 2005). For a comprehensive review on the evidence of non-random measurement error in SAH, see Currie and Madrian (1999).

Another issue related to the evaluation of SAH concerns the individual's comparison process when making health assessments. Reference group theory suggests that, when asked to evaluate their perceived health, people may compare themselves against their own previous health conditions (e.g. Groot, 2000; Oswald & Powdthavee, 2008) or others of the same age (e.g., Cockerham et al, 1983; Fienberg et al, 1985). For example, Singer (1974, 1977) found that people with Parkinson's disease tend to select others of their own age rather than those with the same illness as their reference group. When confronted by illness, old people tend to make themselves feel better about their health by adjusting their perception to match that of their age peers (e.g., Levkoff et al, 1987) or the health of stereotypical others of the same age (e.g., Fienberg et al, 1985). The comparison sets used by respondents may also vary by the level of subjective health they report. Using the subjective health information of 383 Israeli residents, Kaplan and Baron-Epel (2003) found that young people who report sub-optimal health (e.g. less than satisfied with health) tend not to compare themselves to people their own age, whereas a high percentage of old people do. With respect to the comparison with one's own previous health, Oswald and Powdthavee (2008) found that individuals are able to recover around 30% of their loss of well-being after three years of serious disability. More generally, these results seem to suggest that people tend to find ways to evaluate their health in a more positive light.

While the above findings appear to suggest that we are inclined to compare our health with that of stereotypical others with the same characteristics, much less attention has been paid to whether the health of those in close proximity to us has any influence on our health perceptions. Recent studies have shown that the actions of our relevant others (e.g., friends, family, neighbours) can influence not only our objective behaviours but also our subjective well-being (see, e.g., Luttmer, 2005; Vera-Toscano & Ateca-Amestoy, 2008). Kulik et al (1996) found that patients fare better in terms of mental well-being and future recovery time while awaiting a coronary bypass operation when they share a room with another cardiac patient than with a non-cardiac patient or do not share a room at all. One reason for this may be that it is psychologically beneficial for patients to live with someone who also shares the same burden. More recent evidence for this is shown by Clark and Etilé (2008), who found that obesity (a BMI of over 30) has a strong negative effect on psychological well-being.

However, this effect is smaller if the individual lives in a household where there is at least one other obese person.

3. Conceptual issues

The SAH function estimated by studies cited in Section 2 is of the form:

$$H(.) = H(P,...) \qquad (1)$$

where H is a subjective health index and P is an index of the individual's own health problems. Assume, as conventional, that subjective health is decreasing in P. This paper argues that others' health problems, denoted by $\overline{P}$, can also be added into equation (1). Here, subjective health, H, is given by:

$$H(.) = H(P, \overline{P},...) \qquad (2)$$

One question of interest is how the health problems of our relevant others, $\overline{P}$, enter our subjective health function, H. There is relatively little social-science theory upon which to draw. However, mention should be made of Akerlof's (1980) theory of social custom, which proposes that:

- In any given peer-group, there will be a set of standards that individuals are required to follow.
- Deviance from such standards can be costly.
- The cost of deviance will be smaller in peer-groups where the norm to follow such standards is weaker.

To see how we may be able to apply the above model to the case of others' health problems, assume that, in every peer-group, there is a certain health standard for everyone to follow. The level of health standard is highest in peer-groups every one of its members is healthy, e.g. has no health problems. The drop in subjective health from being healthy to being unhealthy is thought to be largest in peer-groups where everyone of its (other) members is healthy, simply because the norm to be healthy is strongest in these groups. What this framework also suggests is that the weaker the norm to be healthy (as represented by an increase in the share of unhealthy people in the peer-group), the smaller the gap in subjective health between the healthy and the unhealthy.

The literature is coy, however, about who constitutes the peer-group in question. Given that we tend to compare our health with that of stereotypical others of the same characteristics as us, an average health of all within the same age band or of the same gender as the respondent may be a good guess. However, it may also be that the relevant group for the health norm is much more narrowly defined than this. Individuals may also (subconsciously) compare themselves with those living in close proximity to them, such as other family members in their household (see Clark & Etilé, 2008), and it is this group that I will be focusing in this paper.

4. Implementing a test

4.1 Data

The data set comes from the British Household Panel Survey (BHPS). The BHPS is nationally representative of British households, contains over 10,000 adult individuals and has been conducted between September and Christmas of each year since 1991. The study interviews separately all adult members of the household with respect to their income, employment status, marital status, health and attitudes. The question on SAH, which is available in every wave of the BHPS, asks individuals:

> "Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say your health has on the whole been excellent, good, fair, poor, very poor?"

For simplicity, the data is recoded such that responses regarding SAH increase in value, running from very poor health to excellent health. By definition, the SAH version of the BHPS is thought to capture the respondent's health perception relative to the individual's concept for the norm of their age group (or as age-related SAH as described in Baron-Epel & Kaplan, 2001).

This paper draws on two survey questions on health problems in the BHPS. The first asks each individual in every wave of the BHPS to state which (but not limited to one) of the following 13 illnesses or disabilities he or she has, excluding temporary conditions:

1. Arms, legs, hands, feet or neck (including arthritis and rheumatism)
2. Difficulty in seeing (other than needing glasses to read normal-size print)
3. Difficulty in hearing
4. Skin conditions/allergies
5. Chest/breathing problems, asthma, bronchitis
6. Heart/blood pressure or blood circulation problems

7. Stomach/liver/kidneys or digestion problems

8. Diabetes

9. Anxiety, depression or bad nerves

10. Alcohol or drug-related problems

11. Epilepsy

12. Migraine or frequent headaches

13. Other health problems not on the list

This checklist of illnesses has been shown to correlate well with GP reports (Kriegsman et al, 1996) and the use of health and welfare services (Sacker et al, 2003), with people more likely to under-report their true health conditions in the absence of a list. There is also evidence that the inclusion of a checklist of conditions in the survey encourages reporting of illnesses by the genuinely ill and not by those who are less severely affected by their disease (Knight et al, 2001). For an application of the checklist in the health literature, see Groot et al (2004).

The second question asks individuals about their physical functioning: "Does your health in any way limit your daily activities compared to most people your age?" The daily activities in question include housework, climbing stairs, dressing oneself and walking for at least 10 minutes. This variable appears in every wave of the BHPS, except for Waves 9 and 14.

This paper analyses Waves 1–15 of the BHPS, leaving out Waves 9 and 14. I restrict the sample to contain only those observations with information on both health perception and objective health problems. I also restrict the sample to contain only those individuals who do not live alone. This yields a sample of an unbalanced panel of 127,699 observations (or 21,941 individuals). Around 30% of individuals reported to have one of the listed health problems, and approximately 27% reported to have two or more. Roughly 17% of the sample said that health has limited them from doing day-to-day activities. Approximately 37% of the sample stayed in all 15 waves of the BHPS. Descriptive statistics of the variables are reported in Table 1.

4.2 Empirical strategy

The latent variable specification for the models considered in this study is given by:

$$H_{iht}^{*} = P_{iht}^{'}\beta_1 + (1 - P_{iht}^{'})\frac{1}{N_{hm}}\sum_{j}^{N_{hm}} HM_j\beta_2 + (P_{iht}^{'} \times \frac{1}{N_{hm}}\sum_{j}^{N_{hm}} HM_j)\beta_3 + X_{iht}^{'}\gamma + u_i + \varepsilon_{iht}, \quad (3)$$

where H_{iht}^{*} represents the subjective level of health for an individual *i* in a household *h* at a time *t*. As subjective health is not observable we rely on the use of SAH as an appropriate dependent variable. The variable $P_{iht}^{'}$ is a vector of the respondent's health problems. N_{hm} is the number of other household members and HM_j denotes the health problems of other household members. The variable X_{iht} represents a vector of personal and household characteristics that are assumed to be important in influencing SAH and are typically included in the estimation of SAH (see, e.g., Ferrer-i-Carbonell & van Praag, 2002). This includes dummy variables for gender, marital status, education, employment status, region and year, as well as age, age-squared, log of real household income per capita, number of people in the household and number of children aged under 16. u_i is an individual-specific and time-invariant random component. ε_{iht} is a time and individual-specific error term which is assumed to be normally distributed and uncorrelated across individuals and waves and uncorrelated with u_i.

There are two variables that represent own and others' health problems in equation (3): the checklist of illnesses and the 'health limits daily activities' variables. For simplicity, an illness index is created by summing the individual illnesses for the 13 types of health conditions. This results in a single illness index, which ranges from 0 (no health problem) to 13 (suffer from all listed health problems). The dummy variable representing the individual's ability to perform daily activities is kept the same. Only the same types of health problems between the individual and other household members are interacted, i.e. the individual's own illness index is interacted with the average illness index of other household members, while the individual's own ability to function is interacted with the average ability to function of other household members. The prevalence of other members with health problems is reported against the individual's own health status for each of the SAH categories in the Appendix.

Equation (3) allows us to test the hypotheses that, *ceteris paribus*, people with health problems will report a lower SAH than average (or $\beta_1 < 0$) and that other members' health problems will lower the SAH for those people without a health problem (or $\beta_2 < 0$). However, the negative correlation between having health problems and the corresponding SAH will be smaller in households where the average health problems of other household members are high (or $\beta_3 > 0$).

Random effects ordered probit specifications (e.g., Contoyannis et al, 2004) are used to estimate equation (3). Whilst the latent variable outcome H^*_{iht} is not observed, we can observe an indicator of the category in which the latent indicator falls (H_{iht}). The observed mechanism can be expressed as:

$$H_{iht} = j \quad \text{if} \quad \mu_{j-1} < H^{*}_{iht} \leq \mu_j , \quad j = 1,...,m \tag{4}$$

where $\mu_0 = -\infty, \mu_j \leq \mu_{j+1}, \mu_m = \infty$. Given the assumption that the error term is normally distributed, the probability of observing subjective health H_{iht}, conditional on the regressors and the individual effect, is:

$$P(H_{iht} = j) = \Phi(\mu_j - x^{'}_{iht}\beta) - \Phi(\mu_{j-1} - x^{'}_{iht}\beta_i) \tag{5}$$

where $\Phi(.)$ is the standard normal distribution function, and $x^{'}_{iht}$ denotes, for simplicity, all the covariates specified in equation (3). To implement the random effects estimator the individual effect can be integrated out, assuming that the density of u_i is $N(0,\sigma^2_u)$ and orthogonal to the observed explanatory variables. This gives the following sample log-likelihood function:

$$\ln L = \sum_{i=1}^{n} \left\{ \ln \int_{-\infty}^{+\infty} \prod_{t=1}^{T} (P_{ihtj})[(1/\sqrt{2\pi\sigma^2_u})\exp(-u^2 / 2\sigma^2_u)]\partial u \right\} \tag{6}$$

Equation (6) contains a univariate integral which can be approximated by Gauss-Hermite quadrature. The latent random effects model is estimated using the random effects ordered probit estimator which is available in STATA.

4.3 Results

Is the SAH gap between the healthy and the unhealthy smaller in unhealthy households? To test this hypothesis, I first calculated the average SAH score between individuals with no illness and those who listed one illness out of the 13 listed conditions. Figure 1 summarises the difference between the two for households where the average of illnesses per (other) member is zero, one, and two, respectively. Consistent with Akerlof's model, Figure 1 reveals a noticeably smaller SAH gaps between the healthy and the unhealthy in unhealthier households: health problems hurt less in households where the average illness index per (other) members is high. Figure 2 repeats the analysis for the variable 'health limits daily activities'. Similarly, we can see that the SAH gap is slightly smaller in households where the proportion of other household members whose health limits daily activities is 1 (SAH gap = 1.314) than in households where the proportion is 0 (SAH gap = 1.362). Hence, there is some evidence consistent with a health norm effect. Nevertheless, there is much inherent variation in SAH scores and the points in Figures 1 & 2 have large standard errors attached.

Table 2 moves to econometric evidence. Estimates from the unbalanced panel regression are reported in the first column of Table 2. The coefficients on an individual's own illness index and his/her 'health limits daily activities' variable, in the first column of Table 2, are −0.439 and −1.134, respectively. This implies that subjective health is, ceteris paribus, associated negatively with an individual's own illnesses and restricted ability to carry out daily activities. The standard errors on the coefficients are 0.005 for the illness index and 0.015 for 'health limits daily activities', so that the null of zero can be rejected at the 1% level.

The remainder of the health problem variables in the first column of Table 2 includes the average illness index and the proportion of limited abilities to undertake daily activities through health of other members in the household. This is to capture the extent of household norm in health, if any.

The average illness index of others has a coefficient of −0.070, while the proportion of others with restricted abilities to perform daily tasks has a coefficient of −0.065. Both are statistically significant at the 1% level, suggesting that others' health problems lower the SAH for those who do not have health problems on average. There is, however, an offsetting factor for those with health problems. As could be seen from the table, an interaction term for *own illness index* × *average illness index of other household members* has a coefficient of 0.032, with a standard error of 0.003. In addition to this, an interaction term for *own health limits daily activities* × *proportion of other household members with restricted abilities* is also positive and significant: the estimation coefficient is 0.073, with a well-determined standard error of 0.027. These variables and their coefficients suggest that the SAH gap between individuals with no health problems and those with health problems is statistically significantly smaller in households where health problems are more prevalent among other household members, which is consistent with Akerlof's theory. It is also consistent with the findings on relative obesity by Clark and Etilé (2008) and reminiscent of Clark (2003) and Powdthavee (2007), who found that it is psychologically preferable to be unemployed in an area where there are many jobless people.

4.3 Robustness checks

A number of robustness checks can be made.

First, according to Contoyannis et al (2004), the attrition rates in the BHPS are inversely related to SAH, and in particular, attrition is highest among those who start the survey in very poor health. To be sure that the results are not being driven by individuals who are in the panel only briefly, I redid the estimation, in the second column of Table 2, on a smaller balanced panel (i.e. recorded over 15 years in the BHPS). Despite some notable increases in the standard errors, there is little change in the size and the significance of the estimated coefficients on own and others' illness index. However, the same cannot be said for the 'health limits ability' variable: the estimate on interaction with others' health limitations falls by over half and becomes insignificant.

Second, to what extent are the results being driven by systematic reporting bias? The random effects ordered probit models of Table 2 assumed implicitly that the explanatory variables have the same impact on the odds of all the ordered scores and that there is a single index that describes 'true health'. However, as described earlier in the literature review, there is evidence that people of different sub-groups in a population tend to interpret the SAH question within their own specific context and therefore use different reference points when they are answering the same question, despite having the same level of true health. To be sure that the results are not driven by the restrictive assumptions of the random effects ordered probit model, the first panel of Table 3 reports estimates from a random effects generalized ordered probit specification (see, e.g., van Doorslaer & Jones, 2003; Cunha et al, 2007) in which the β values are allowed to vary across the reported category of SAH (β_j, j=1…5) using the balanced panel. This very flexible model can be obtained by making the cut points, μ, linear functions of the observed variables as follows:

$$\mu_j = \tilde{\mu}_j + x'_{iht}\delta_j, \quad j = 1,...,J, \tag{7}$$

Substituting (7) into (5) gives the probability of observing subjective health H_{iht}, conditional on the regressors and the individual effect:

$$P(H_{iht} = j) = \Phi(\tilde{\mu}_j + x'_{iht}\delta_j - x'_{iht}\beta) - \Phi(\tilde{\mu}_{j-1} + x'_{iht}\delta_{j-1} - x'_{iht}\beta), \tag{8}$$

where $\beta_j = \beta - \delta_j$ and it is understood that $\tilde{\mu}_0 = -\infty, \tilde{\mu}_j \le \tilde{\mu}_{j+1}, \tilde{\mu}_m = \infty$ as before. The model now contains $J-1$ parameter vectors $\beta_2,...,\beta_j$, plus $J-1$ constants $\tilde{\mu}_2,...,\tilde{\mu}_j$ that can be estimated jointly by maximum likelihood. By making cut points linear functions of the observed covariates, we have relaxed the assumption of constant relative effects and allowed the effects of covariates on the odds to be category specific. However, mention should be made that, in the model of generalized threshold, it is necessary that the multiple indices satisfy the ordered restrictions for all observations *i*, i.e. the larger values of SAH must correspond to "higher" subjective health for all individuals in the sample.

With the exception of the 'health limits daily activities' variable, the coefficients on the interaction terms between own and others' health problems continue to be positive and statistically significant at conventional confidence levels in all categories of SAH. The estimated parameters are also similar in size. For example, the interaction term for *own illness index* × *average illness index of other household members* has a coefficient of 0.017 in the equation that determines the choice between the category *very poor* and the combined categories *poor*, *fair*, *good* and *very good* (i.e. equation *j*=1). The same variable has a coefficient of 0.021 in the equation that determines the choice between the combined categories *very poor*, *poor*, *fair* and *good* and the category *very good* (i.e. equation j=4). It can therefore be concluded that the effect of health norm on SAH, at least for the average illness index, is robust to systematic reporting bias.

Third, the random effects specifications assume that the individual effect u_i is uncorrelated with the explanatory variables. However, it is well-known in the psychology literature that some people are born with persistent personality traits that make them rate their subjective well-being in a more optimistic way than others. These predispositions, noted by Headey (2006), are also likely to determine the type of life events the person will experience in his/her lifetime. For example, subjective well-being scores, including SAH, tend to be higher among extroverts. However, extroverts are also more likely to engage in risky behaviours and, as a result, are more prone to chronic health problems and disabilities than less extrovert individuals. This positive correlation between SAH and the incidence of disabilities violates the assumption of zero correlation between u_i and the health problems variables and can therefore result in an overestimation of the true impact of health problems on SAH.

One way of dealing with heterogeneity bias is to allow for correlations between unobserved time-invariant factors and the observed variables of interest. The solution, originally proposed by Mundlak (1978), involves a process that decomposes the individual effect in equation (3) into a time-variable and time-constant component. This can be done by decomposing the explanatory variables of interest – the objective health variables – into their mean over the observation period and the deviation from that mean as follows:

$$h_{iht} = \overline{h}_{ih} + (h_{iht} - \overline{h}_{ih}), \qquad (9)$$

where the objective health variables, denoted by *h*, are both own and others' illness index and health limits activities variables. The inclusion of these average variables (the so-called Mundlak transformation) is interpreted as picking up the correlation between the individual effect and objective health variables. In effect, the coefficients on the current level of own and others' health problems can now be interpreted as the *shock* effects that are independent from their mean (or permanent) effects on SAH, which are also in the process free from adaptation bias generated by the respondent's prior experiences of health problems (see Ferrer-i-Carbonell & van Praag, 2002).

The generalized ordered probit estimates that incorporate the Mundlak transformation are reported in the second panel of Table 3. Despite the decrease in the size of estimated parameters for some of the health problem variables, nearly all of the interaction terms for *own illness index* × *average illness index of other household members* in the second panel of Table 3 continue to be positive and statistically significant at conventional confidence levels. The results thus suggest that the effect of health norm on SAH is also robust to controls for unobserved time-invariant factors.

Finally, an alternative explanation of the positive externality of others' health problems on SAH may not be psychological at all but in fact reflect a real phenomenon. For example, if I suddenly find it difficult to walk in a household with similarly disabled people, it is likely that the accommodation will be equipped with rails, stair lifts and so on. Similarly, individual with diabetes or a heart condition might benefit from being in household with others with similar conditions because they would benefit from effective dietary control as part of the management of their condition. To test whether the results are being driven by certain types of physical illness that could potentially benefit from others' disabilities of the same type such as problems with walking or difficulty in hearing, Table 4 unpacks the own illness indexes and interacts them separately with the average illness index of other household members in a random effects generalized ordered probit specification with the Mundlak transformation. While the coefficient on the interaction between own and others' illness indexes is positive and statistically significant in all categories of SAH for physical illnesses, such as *arms, legs, hands, feet or neck*, there is evidence that people who suffer from depression and anxiety also benefit in terms of their SAH from an increase in the average illness index of other household members, which is consistent with the psychological explanation of health norm on health perception. Here, 8 out of the 13 health problems 'work' in the expected directions, i.e. the coefficient on own health problem is negative, but the coefficient on own health problem interacted with others' health problem is positive.

4.4 Marginal effects

To illustrate the size of the estimated health norm effect, Figure 3 plots, for a representative individual, the estimated effects of having one of the listed 13 illnesses on the probability of reporting a SAH score of 5 (excellent health category) against the average illness index per other members. The results are based on the random effects generalized ordered probit with Mundlak transformation estimates taken from the second panel of Table 3.

Although statistically important, the estimated health norm effect appears to be very small. The gap in the probability of reporting a SAH of 5 between the healthy (own illness index = 0) and the unhealthy (own illness index = 1) is approximately 9.4% in households where the average illness index per other members is zero. An increase in the average illness index per other household members from 0 to 1 reduces this gap from 9.4% to 8.7%, while a further unit increase reduces this gap by the same amount from 8.7% to 8.0%. This 8.0% gap in the probability of reporting a SAH score of 5 is only relevant to a very small fraction of the population sampled (less than 10% of total *N* live in households where the average illness index ≥ 3).

5. Conclusion

The objective of this paper was to present evidence that self-assessed health does not only suffer from systematic reporting bias and adaptation bias (see, e.g., Groot, 2000; van Doorslaer & Jones, 2003) but is also biased owing to the confounding health norm effects. Using 13 waves of the BHPS, I find some evidence consistent with Akerlof's (1980) theory of social custom: the gap in SAH between people with health problems and those without health problems is statistically significantly smaller in households where the average number of health problems per other family member is high. The economic significance of this effect is negligibly small, however: an increase in the average number of other household members' health problems of one point reduces the gap in reporting an "excellent" SAH between individuals with and without health problems by less than 1%. In short, although there is a statistically important health norm effect at the household level, the bias on SAH is unlikely to be very large. This is very good news for researchers working with SAH data as it implies that we may not have to worry too much about controlling for confounding influences from the health of other household members when estimating SAH regression equations.

As in any study, there are limitations and potential weaknesses to these results. Firstly, there is a measurement issue with respect to the constructed illness index. By adding up the 13 listed health problems, I can obtain what could only be described as a crude measure of illness index. This is because each illness is not interchangeable and is unlikely to have the same impact on SAH. Secondly, I am unable to consider other comparison groups such as colleagues, friends, and people in the same region, clearly an important subject for future research. Furthermore, there may be a Manski-type reflection issue if the health problems of other household members influence the respondent's health behaviours (and problems) directly rather than being exogenously given as I have portrayed them throughout this article (Manski, 1993). This implies that the estimated health norm effect cannot be treated as causal and has to be interpreted with care. It seems desirable that future work aim to establish a casual link between relative health and SAH.

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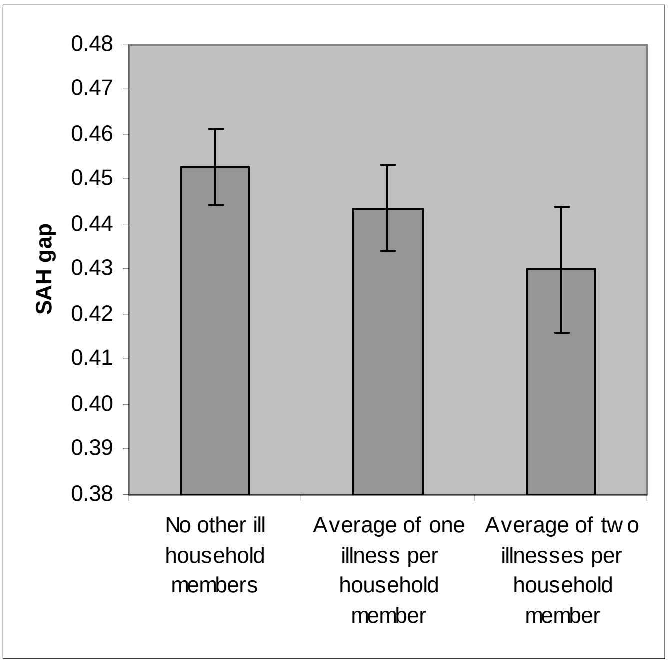
Table 1: Descriptive statistics (BHPS, Waves 1-8, 10-13, & 15)

Variables	M	SD
i) Health related variables		
Self-assessed health (SAH)	3.858	0.930
Own illness index	1.108	1.237
Own health limits ability to do daily activities	0.147	0.354
Others' illness index	1.108	1.147
Others' health limits ability to do daily activities	0.147	0.326
ii) Personal and household characteristics		
Male	0.495	0.499
Age	42.632	17.330
Age-squared/100	21.178	16.286
Log of real household income per capita	8.254	2.471
Cohabiting	0.116	0.321
Widowed	0.019	0.137
Divorced	0.020	0.141
Separated	0.006	0.078
Single	0.184	0.388
Unemployed	0.040	0.198
Self-employed	0.075	0.264
Retired	0.148	0.355
Disabled	0.036	0.188
Not active in the labour market	0.160	0.366
Completed first degree	0.084	0.278
Completed higher degree	0.020	0.140
Household size	3.216	1.256
Number of dependent children (age < 16)	0.575	0.976
N = 127699		

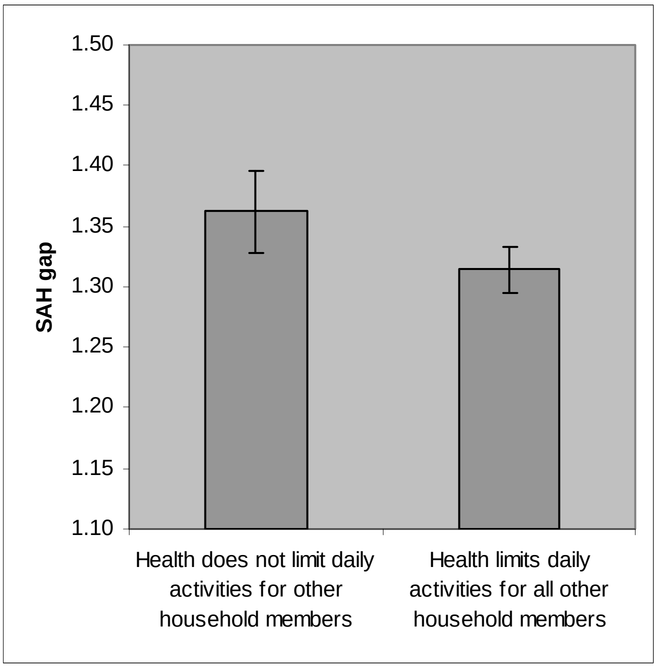
Note: SAH is on a 1-5 scale; the illness index is on a 0-13 scale; and the health limits daily activities is on a 0-1 scale.

Figure 1: The SAH gap between individuals with no illness and those with one illness ($SAH_{P=0}$-$SAH_{P=1}$) and other household members' health problems



Note: Average $SAH_{P=0}$ = 4.278 with no other ill household members (N=27,552), average $SAH_{P=1}$ = 3.825 with no other ill household members (N=12,979), average $SAH_{P=0}$ = 4.248 with the average of one illness per member (N=16,350); average $SAH_{P=1}$ = 3.801 with the average of one illness per member (N=12,201); average $SAH_{P=0}$ = 4.215 with the average of two illnesses per member (N=6,247); average $SAH_{P=1}$ = 3.785 with the average of two illnesses per member (N=5,838). A higher number in the Y-axis means a larger difference in the reported SAH between the healthy and the unhealthy. 2-standard-error-bands (90% C.I.) are reported.

Figure 2: The SAH gap between 'those whose health does not limit daily activities' and 'those whose health limits daily activities' ($SAH_{P=0}$-$SAH_{P=1}$) and other household members' ability to physically function



Note: Average $SAH_{P=0}$ = 4.082 with no other 'not able to do daily activities' household members (N=91,256), average $SAH_{P=1}$ = 2.719 with no other 'not able to do daily activities' household members (N=10,289), average $SAH_{P=0}$ = 3.915 with health limits daily activities for all other household members (N=10,214); average $SAH_{P=1}$ = 2.601 with health limits daily activities for all other household members (N=4,141). A higher number in the Y-axis means a larger difference in the reported SAH between the healthy and the unhealthy. 2-standard-error-bands (90% C.I.) are reported.

Table 2: Random effects ordered probit SAH regressions with health problems as independent variables

Dependent variable: SAH - 5 point-scale	Unbalanced panel	Balanced panel
Own illness index	-0.439	-0.420
	[0.005]**	[0.008]**
Average illness index of other household members	-0.070	-0.063
	[0.006]**	[0.009]**
Own illness index × Average illness index of other members	0.032	0.029
	[0.002]**	[0.004]**
Own health limits ability to do daily activities	-1.134	-1.044
	[0.015]**	[0.022]**
Proportion of members whose health limits the ability to do daily activities	-0.065	-0.029
	[0.016]**	[0.023]
Own health limits ability × Proportion of members whose health limits ability	0.073	0.035
	[0.027]**	[0.045]
Male	0.081	0.129
	[0.014]**	[0.024]**
Age	0.004	0.004
	[0.002]*	[0.004]
Age-squared/100	-0.007	-0.002
	[0.002]**	[0.004]
Log of real household income per capita	0.013	0.028
	[0.004]**	[0.008]**
Cohabiting	-0.059	-0.070
	[0.017]**	[0.027]*
Widowed	-0.053	-0.015
	[0.040]	[0.073]
Divorced	-0.053	0.005
	[0.034]	[0.052]
Separated	-0.149	-0.152
	[0.052]**	[0.084]+
Single	0.049	0.028
	[0.021]*	[0.034]
Unemployed	-0.185	-0.128
	[0.020]**	[0.032]**
Self-employed	0.069	0.067
	[0.019]**	[0.027]*
Retired	-0.069	-0.023
	[0.019]**	[0.028]
Disabled	-0.697	-0.559
	[0.025]**	[0.041]**
Not active in the labour market	-0.100	-0.030
	[0.013]**	[0.020]
Completed first degree	0.209	0.178
	[0.021]**	[0.034]**
Completed higher degree	0.275	0.245
	[0.042]**	[0.068]**
Household size	-0.008	-0.010
	[0.005]	[0.008]
Number of dependent children (age < 16)	-0.006	0.008

	[0.007]	[0.011]
Cut_1	-4.347	-1.530
	[0.056]**	[0.087]**
Cut_2	-3.001	-2.962
	[0.055]**	[0.088]**
Cut_3	-1.565	-4.274
	[0.054]**	[0.087]**
Cut_4	0.406	0.393
	[0.054]**	[0.091]**
Rho	0.410	0.500
	[0.004]**	[0.006]**
Regional dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	127699	58132
Log likelihood	-126604.22	-55090.92

Note: + 10%, * 5%, ** 1%. Standard errors are in parentheses. Self-assessed health (SAH) is measured using a 5-point scale, ranging from 1.very poor health to 5.excellent health. Reference groups are: female, marital status: married, employment status: in full-time employment, education: no formal education. All equations are robust to clustering by personal identification.

Table 3: Random effects generalized ordered probit SAH regressions (balanced panel)

Dependent variable: SAH - 5 point-scale	Random effects generalized ordered probit				Random effects generalized ordered probit with Mundlak transformation			
	j=1	j=2	j=3	j=4	j=1	j=2	j=3	j=4
Own illness index	-0.260	-0.368	-0.472	-0.439	-0.223	-0.426	-0.377	-0.333
	[0.021]**	[0.014]**	[0.011]**	[0.014]**	[0.025]**	[0.016]**	[0.012]**	[0.016]**
Average illness index of other household members	-0.078	-0.067	-0.075	-0.036	-0.058	-0.032	-0.062	-0.070
	[0.033]*	[0.018]**	[0.012]**	[0.011]**	[0.020]**	[0.038]	[0.012]**	[0.013]**
Own illness index × Average illness index of other members	0.017	0.022	0.031	0.021	0.033	0.015	0.022	0.022
	[0.010]+	[0.006]**	[0.006]**	[0.008]**	[0.006]**	[0.008]**	[0.006]**	[0.010]*
Own health limits ability to do daily activities	-0.929	-1.159	-1.064	-0.736	-0.223	-0.726	-1.066	-0.973
	[0.055]**	[0.031]**	[0.028]**	[0.051]**	[0.025]**	[0.030]**	[0.062]**	[0.054]**
Proportion of members whose health limits the ability to do daily activities	0.157	-0.026	-0.056	-0.014	-0.058	0.016	0.161	-0.055
	[0.126]	[0.051]	[0.030]+	[0.031]	[0.020]**	[0.057]	[0.034]	[0.035]
Own health limits ability × Proportion of members whose health limits ability	-0.104	0.079	-0.030	-0.206	0.033	-0.072	0.098	-0.017
	[0.137]	[0.067]	[0.062]	[0.142]	[0.006]**	[0.141]	[0.067]	[0.137]
Mean over the observation period								
Illness index					-0.158	-0.134	-0.141	-0.200
					[0.034]**	[0.024]**	[0.021]**	[0.023]**
Average illness index of other household members					0.002	0.021	0.007	0.013
					[0.045]	[0.028]	[0.022]	[0.022]
Health limits ability to do daily activities					-0.479	-0.916	-1.232	-0.641
					[0.114]**	[0.081]**	[0.074]**	[0.091]**
Proportion of members whose health limits the ability to do daily activities					-0.129	-0.033	-0.244	-0.133
					[0.156]	[0.101]	[0.080]**	[0.082]
Rho	0.394 [0.006]**				-0.227 [0.107]**			
Observation	58132				58132			
Log likelihood	-54681.368				-54331.970			

Note: + 10%, * 5%, ** 1%. SAH categories: j=1 (very poor), j=2 (poor), j=3 (fair), j=4 (good). Standard errors are in parentheses. Other controls are as in Table 2.

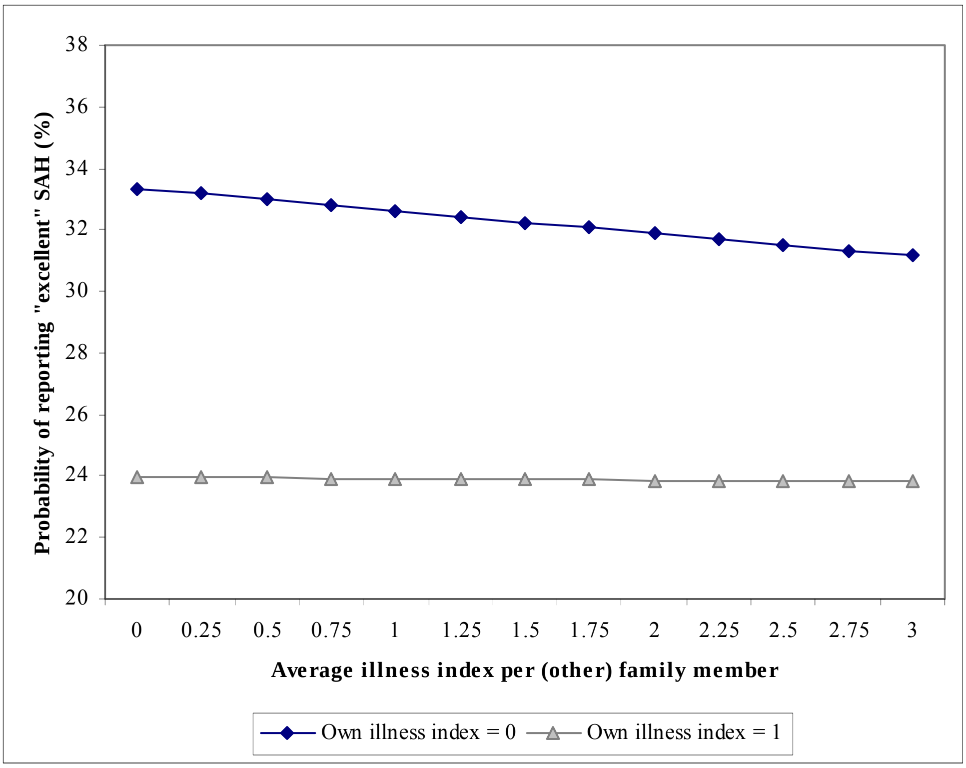
Table 4: Random effects generalized ordered probit SAH regression with unpacked illness index and Mundlak transformation (balanced panel)

Dependent variable: SAH - 5 point-scale	j=1	j=2	j=3	j=4
Arms, legs, hands, feet, or neck	-0.056	-0.335	-0.418	-0.459
	[0.078]	[0.042]**	[0.029]**	[0.033]**
Average illness index of other household members	-0.065	-0.078	-0.062	-0.035
	[0.040]	[0.021]**	[0.013]**	[0.012]**
Arms, legs, hands, etc. × Average illness index	0.060	0.060	0.019	0.038
	[0.034]+	[0.019]**	[0.015]	[0.018]*
Difficulty in seeing	-0.107	-0.114	-0.203	-0.004
	[0.116]	[0.074]	[0.060]**	[0.073]
Difficulty in seeing × Average illness index	-0.013	0.005	0.071	-0.051
	[0.047]	[0.031]	[0.029]*	[0.039]
Difficulty in hearing	0.258	0.144	-0.068	-0.172
	[0.143]+	[0.080]+	[0.054]	[0.060]**
Difficulty in hearing × Average illness index	-0.024	-0.036	-0.005	0.034
	[0.050]	[0.031]	[0.024]	[0.029]
Skin conditions/allergies	0.037	0.024	-0.137	-0.114
	[0.101]	[0.056]	[0.039]**	[0.042]**
Skin conditions/allergies × Average illness index	0.003	-0.010	0.003	0.008
	[0.044]	[0.026]	[0.020]	[0.025]
Chest/breathing problems, asthma, bronchitis	-0.132	-0.312	-0.487	-0.403
	[0.087]	[0.053]**	[0.042]**	[0.055]**
Chest/breathing problems × Average illness index	-0.038	-0.034	0.017	-0.030
	[0.035]	[0.023]	[0.019]	[0.029]
Heart/blood pressure or blood circulation problems	-0.225	-0.447	-0.551	-0.591
	[0.088]*	[0.052]**	[0.039]**	[0.051]**
Heart/blood pressure × Average illness index	-0.046	0.023	0.050	0.057
	[0.034]	[0.022]	[0.018]**	[0.025]*
Stomach/liver/kidneys or digestion problems	-0.671	-0.636	-0.716	-0.681
	[0.084]**	[0.054]**	[0.046]**	[0.074]**
Stomach or digestion problems × Average illness index	0.141	0.091	0.075	0.018
	[0.037]**	[0.025]**	[0.023]**	[0.043]
Diabetes	-0.014	-0.348	-0.725	-0.598
	[0.173]	[0.114]**	[0.101]**	[0.155]**
Diabetes × Average illness index	-0.028	0.031	0.060	0.068
	[0.060]	[0.044]	[0.041]	[0.064]
Anxiety, depression or bad nerves	-0.446	-0.711	-0.747	-0.659
	[0.083]**	[0.054]**	[0.048]**	[0.080]**
Anxiety, depression or bad nerves × Average illness index	0.000	0.060	0.084	0.094
	[0.037]	[0.025]*	[0.025]**	[0.047]*
Alcohol or drugs related problems	0.088	-0.549	-0.046	-0.071
	[0.420]	[0.254]*	[0.229]	[0.396]
Alcohol or drugs related problems × Average illness index	-0.144	0.167	-0.299	-0.177
	[0.154]	[0.143]	[0.145]*	[0.343]
Epilepsy	-0.552	-0.052	-0.763	-0.339
	[0.275]*	[0.226]	[0.198]**	[0.240]
Epilepsy × Average illness index	0.124	0.063	0.129	0.016
	[0.117]	[0.084]	[0.072]+	[0.096]
Migraine or frequent headaches	-0.061	-0.141	-0.285	-0.307
	[0.098]	[0.057]*	[0.043]**	[0.050]**
Migraine or frequent headaches × Average illness index	0.025	0.007	0.020	0.030
	[0.043]	[0.027]	[0.023]	[0.030]

Other health problems	-0.642	-0.604	-0.738	-0.526
	[0.087]**	[0.058]**	[0.050]**	[0.073]**
Other health problems × Average illness index	0.041	0.012	0.070	0.006
	[0.042]	[0.029]	[0.029]*	[0.048]
Health limits ability to do daily activities	-0.964	-1.044	-0.840	-0.694
	[0.064]**	[0.035]**	[0.030]**	[0.055]**
Proportion of members whose health limits the ability to do daily activities	0.171	-0.060	0.013	0.007
	[0.137]	[0.057]	[0.035]	[0.035]
Health limits ability × Proportion of members whose health limits ability	-0.037	0.116	-0.011	-0.200
	[0.141]	[0.068]+	[0.063]	[0.143]
Rho	0.361 [0.006]**			
Observation	58132			
Log likelihood	-53761.647			

Note: + 10%, * 5%, ** 1%. Standard errors are in parentheses. Other controls are as in Table 2.

Figure 3: Predicted probabilities of an average individual reporting a SAH score of 5 (excellent health)



Note: The predicted probabilities are based on the estimates taken from the random effects generalized ordered probit with Mundlak transformation specification in the second panel of Table 3.

Appendix: The prevalence of others' health problems for each category of SAH

Own status: no health problems	Others' illness index	Others' health limits daily activities
Very poor	1.008 (1.209)	0.198 (0.374)
Poor	0.832 (0.956)	0.178 (0.355)
Fair	0.883 (1.025)	0.162 (0.340)
Good	0.786 (0.959)	0.124 (0.302)
Excellent	0.741 (0.922)	0.104 (0.277)
Mean	**0.778 (0.952)**	**0.126 (0.304)**
Own status: with at least one illness/health limits daily activities		
Very poor	1.223 (1.307)	0.299 (0.428)
Poor	1.124 (1.222)	0.282 (0.419)
Fair	1.065 (1.176)	0.267 (0.413)
Good	1.014 (1.101)	0.226 (0.390)
Excellent	0.943 (1.068)	0.253 (0.402)
Mean	**1.020 (1.122)**	**0.268 (0.413)**