

Subjective well-being and generic preference-based measures of health: an empirical contribution

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November 30, 2012

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Abstract

Background: A growing body of literature proposes alternatives to the current use of generic preference-based measures of health in decisions of resource distribution in health care. One prominent suggestion is the use of subjective well-being. While arguments have developed both for and against this concept there has been limited empirical research carried out into the implications of its use. This study investigates some of the ways in which generic preference based measures and subjective well-being might differ in their sensitivity and responsiveness to differences and changes in health. **Methods:** Analyses are carried out using ‘satisfaction with life’ and SF-36 values from multiple waves of the British Household Panel Survey. Using ordered probit and tobit regression models this study compares how different factors have an impact upon an individual’s valuation of their current state in terms of life satisfaction, and upon the responses that inform their SF-6D state. Using difference-in-difference analysis, the study investigates the extent to which satisfaction with life and SF-6D values are responsive to objective changes in health. In addition we investigate ‘satisfaction with health’ as a possible measure of health outcome. **Results:** Results indicate that subjective well-being is not sensitive or responsive to differences and changes in health to the same extent as SF-6D values. Differences in the determinants of each measure fit well with existing theory, and some

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reservations about the use of subjective well-being appear justified. 'Satisfaction with health' is sensitive and responsive to a similar extent to the SF-6D. **Conclusions:** Our evidence suggests that, in the case of satisfaction with life and SF-6D, subjective well-being measures may not represent a practical alternative to generic preference-based measures of health. Our results are consistent with existing theory about the differences between such measures and the implications of their use. Satisfaction with health may represent a useful outcome measure, and more research into this topic is needed.

1 Introduction

The dominant method of economic evaluation in health care is ‘cost-per-QALY’ analysis. The calculation of a quality adjusted life-year (QALY) involves applying a utility weighting to a period of time in a given health state. Current practice defines health states using generic preference-based measures (PBMs), such as the EQ-5D and SF-6D. Utility values are estimated using standard gamble and time trade-off techniques, capturing public preferences, and are then applied to health states to estimate the associated health-related quality of life (HRQoL). There is a growing body of literature supporting the idea that measures of subjective well-being (SWB) could, or should, be used in place of, or in addition to, generic PBMs.

It has been suggested that there is no reason why the concept of the QALY must be limited only to health [3]. ‘Quality adjusted’ implies the inclusion of aspects beyond health, and it may be more appropriate to use a more holistic measure of quality of life (QoL) rather than being limited to HRQoL. It could be argued that the measurement of the benefits of a health care intervention should not be limited to health benefits alone. For reasons such as these there is a substantial literature developing on the normative arguments in favour of using SWB measures over generic PBMs in QALY calculations. However, researchers have focused largely on theoretical arguments for and against the use of SWB. Only a limited amount of research has provided any positive assertions on the subject, and few studies have presented empirical evidence demonstrating the ways in which the use of SWB in economic evaluation or resource allocation might lead to different decisions. As such we know very little about how, for a given population, responses to SWB questions and generic PBMs might differ based on health state; or in fact if they will differ at all. It has been argued that SWB represents a more accurate and more direct way in which to assess the impact of health states upon the lives of those affected[10]. However, there is no existing evidence that presents SWB as either better or worse than decision utility measures [17]. As such there is a need to identify, using empirical evidence, any ways in which SWB might lead to different outcomes.

The primary aim of this study is to investigate whether subjective well-being and a generic preference-based measure of health are sensitive and responsive to differences and changes in health. And, if they are, to which health problems each measure is responsive and or sensitive. We discuss some of the ways in which we might expect SWB to indicate different optimal strategies to generic PBMs, and some of the ways in which the two types of measure might converge. We seek to answer 3 questions;

1. to what extent does SWB share the same determinants as a generic PBM
2. to what extent is an individual’s health problem reflected in their SWB and generic PBM response
3. to what extent is SWB and a generic PBM responsive to a change in an individual’s health state

This study is structured as follows. Section 2 discusses the background literature and theory of the use of SWB as a health outcome measure, presenting some of the key reasons why the use of SWB might lead to different decisions. Section 3 presents the methodology of our study including a description of the data and econometric methods. Section 4 sets out our results and section 5 presents a discussion of our results including some conclusions and limitations of our study.

2 Theory and measurement of subjective well-being

Generally, subjective well-being (SWB) has been found to be a valid measure of quality of life (QoL), insofar as it correlates well with a variety of relevant measures [22]. The terms well-being, happiness, quality of life, satisfaction with life and subjective well-being are often used interchangeably. This study takes SWB to represent an overall judgement, by an individual, of how they feel about their life. Our analyses assume SWB to be a latent value presented as ordinal data. SWB is not based on an individual's preferences but upon their experiences and feelings. In this sense SWB represents a judgement of experienced utility. Any weightings of different aspects of life that underlie this overall value are applied by the individual. There is a huge literature on SWB including psychological, medical, sociological and philosophical theory, as well as economic theory. Much of the literature on the theory and application of SWB measures concerns the investigation of its determinants. Dolan et al [11] provide a review of this literature. A number of common relationships are found with SWB such as income, age, sex, race, education, employment status and others. One can imagine how characteristics such as these may bear similar (or different) relationship with an individual's HRQoL. SWB has been presented as one of the best measures of QoL [7], with grounding in utilitarian philosophy. However, some have argued against its use on grounds of reliability [22] and validity [14]. Schwarz and Strack [16], for example, demonstrate that life satisfaction is influenced by the current weather, though when asked the weather is not reported to influence life satisfaction.

Dolan[9] identifies three necessary questions to address the 'quality adjusted' part of the QALY: *what* is to be valued; *how* is it to be valued; and *who* is to value it? SWB and generic PBMs may differ in how they address each of these three questions.

Firstly, the methods differ in terms of *what* is actually being valued. In theory at least, SWB measures QoL while generic PBMs measure HRQoL. As such, SWB measures might account for many non-health related considerations such as freedom, strength of relationships or the fulfilment of aspirations. One argument against the use of generic PBMs is that they fail to consider positive states, tending to include questions about pain, suffering, discomfort or limitations. These measures might therefore only allow for, at the limit, an absence of ill-health. This does not adhere to The World Health Organization's definition

of health as “...not merely the absence of disease or infirmity” [23]. Furthermore, it is conceivable that health problems may not increase suffering but might simply reduce an individual’s satisfaction with life [13], and vice versa. Proponents of SWB often argue that QoL is a more appropriate outcome measure if public services seek to increase QoL and there is a necessary trade-off between sectors [13, 15]. However, there is evidence that SWB does not measure an appropriate outcome and is more closely related to individual personality and character traits. For example, Smith et al [17] find that SWB, while highly variant amongst individuals, tends to be very stable over time; suggesting that SWB may not be responsive to changes in circumstances. It has also been argued that there is substantial overlap in what SWB and generic PBMs are measuring. While it has been shown that there is a relationship between SWB and health [1], it is not clear in which direction causality might travel. Furthermore, it has been argued that QoL and HRQoL are indivisible [13], and that generic PBMs might not be limited only to capturing HRQoL [3].

Secondly, SWB differs from generic PBMs in *how* it is valued. The estimation of an individual’s SWB does not require a distinct valuation process, as any valuation is implicit in an individual’s response. Generic PBMs require a valuation by methods such as time trade-off (TTO) or standard gamble (SG). When asked to give a SWB rating an individual is not asked to focus on any specific aspect of their life but simply their life overall. Conversely, when individuals are asked to value health states in a TTO or SG exercise they are specifically asked to consider states relating to ill health. This gives rise to focussing effects [9]. While SWB questions might not suffer from this problem, they may be subject to memory and focusing bias [17], and may be dependent on the way questions are introduced [18]. Furthermore, TTO and SG methods value preferences over hypothetical situations, while SWB is based on experiences.

Finally, The methods differ in terms of *who* values different states. As stated above, SWB is not ‘valued’ in the same sense as generic PBMs. However, insofar as SWB represents a valuation of a given state, this valuation can only be made by the individual experiencing that state. Generic PBMs, on the other hand, are routinely valued based on public preferences. People are often affected by impairments of functionality much less than preferences would suggest. Therefore, individual’s valuations of their own health states may differ from the public’s valuation of this state. A common finding is that the public overestimate the impact of physical health problems and underestimate the impact of mental health problems. Further discrepancy may be caused by focusing effects in the questionnaires or there may be adaptation. Adaptation might be reflected in SWB values due to defense and coping mechanisms [20, 8]. However, generic PBMs might also detect adaptation due to rescaling effects [21] or by asking about normal or usual activities. It has also been argued that personality and individual traits are important determinants of SWB [19, 6], where publicly valued generic PBMs should not detect this. However, it is also possible that generic PBMs will also depend on personality differences; the calculation of the SF-6D, for example, includes individual responses to questions concerning emotions, nerves and social limitations.

3 Methods

This study uses data from the British Household Panel Survey (BHPS). The BHPS is a UK-based survey run by the Institute for Social and Economic Research at the University of Essex. The survey has been carried out every year since 1991 using a nationally representative panel of individuals. The most recent waves of the BHPS include data on over 15000 individuals. Waves 6 to 10 and 12 to 18 of the BHPS all include the question “*How dissatisfied or satisfied are you with your life overall?*”.

The individual answers this question on a scale from 1-7; 1 being ‘not satisfied at all’ and 7 being ‘completely satisfied’. Life satisfaction is considered to be one aspect of SWB; pleasant affect and unpleasant affect being the other two [8]. However, satisfaction with life (SWL) questions such as this have been found to be a good proxy for SWB. For example, Kahneman and Krueger[15] show that questions of life satisfaction have been found to correlate well with various measures that could be deemed relevant to SWB, such as happiness, smiling and psychometric indicators. This study therefore uses it as such. In addition the questionnaire asks about an individual’s satisfaction with various aspects of their life, including health. The satisfaction with health question is answered in the same way as the SWL question.

The most commonly used generic PBM of health is the EQ-5D. Unfortunately the EQ-5D questionnaire is not included in any waves of the BHPS. However, waves 9 and 14 of the BHPS include the SF-36 questionnaire. We can use these data to generate a generic PBM; the SF-6D. Additionally we present an analysis of ‘satisfaction with health’ (SWH). To our knowledge, SWH is not a commonly used measure of health outcome in any field of health research. However, if one accepts that satisfaction with life is a good proxy for quality of life valuation, then satisfaction with health could potentially represent a valuation of health-related quality of life.

3.1 Sensitivity to differences in health

For this part of the analysis we use cross-sectional data from wave 14 of the BHPS. Our primary interest is the extent to which SWL, SWH and SF-6D are sensitive to differences in health state. The BHPS includes information on a number of health problems and ailments. The BHPS questionnaire simply asks “*Do you have any of the health problems or disabilities listed?*”. Individuals are asked to exclude any temporary conditions. The health problems included are (verbatim):

- Problems or disability connected with: arms, legs, hands, feet, back, or neck (including arthritis and rheumatism)
- Difficulty in seeing (other than needing glasses to read normal size print)
- Difficulty in hearing
- Skin conditions/allergies

- Chest/breathing problems, asthma, bronchitis
- Heart/blood pressure or blood circulation problems
- Stomach/liver/kidneys or digestive problems
- Diabetes
- Anxiety, depression or bad nerves
- Alcohol or drug related problems
- Epilepsy
- Migraine or frequent headaches
- Cancer
- Stroke
- Other health problems

and also “*Do you consider yourself to be a disabled person?*”. Individuals respond yes or no to each of these. All of these health problems are included in the analysis of the determinants of SWL, SWH and SF-6D.

In addition we include regressors for the demographic determinants of SWB, as summarised in a review by Dolan et al[11]. The models include dummy variables for if the individual; is female; is black; is of another non-white ethnicity; is married; has a degree; is unemployed, and also variables for the individual’s; age; number of children; income; number of hours worked each week; and amount of religious activity. Health is also an important determinant of SWB and is being included insofar as it is defined by the health problems detailed above.

Satisfaction with life and satisfaction with health responses have a natural ordering; ‘completely satisfied’ is logically better than ‘somewhat satisfied’, which is better than ‘not satisfied at all’. This means that the dependent variable is discrete in that it can only take certain values, with ordered multinomial outcomes. Ordered probit is an econometric model used to deal with a dependent variable of this sort. The model works by assuming that the dependent variable is based on a latent value on an ordinal scale, as shown by:

$$y^* = x'\beta + \varepsilon \tag{1}$$

where y^* is the unobserved latent variable, $x'\beta$ represents the independent variables and corresponding coefficients and ε is a stochastic error term. This model estimates the true underlying value of SWL or SWH; the higher this latent value, the more likely the individual is to give a higher category response. In this case the range of possible values can fall into 7 categories, so we divide the latent variable into 7 intervals. The model estimates threshold values that represent the point at which an individual moves between categories. We use an

ordered probit model to estimate the marginal effects of given health problems and socio-demographic factors on an individual’s observed SWL and SWH.

While responses to satisfaction with life and health have a discrete value, SF-6D values are treated as being continuous. It is also important to choose a model that can deal with the fact that SF-6D values have an upper and lower bound. Tobins probit, the tobit model, is an extension of the probit. The model assumes that there is a latent dependent variable, in this case SF-6D value, and a normally distributed error term. In this way the tobit is similar to the ordered probit. The tobit model is designed to deal with limited dependent variables. SF-6D data have an upper-limit of 1 and a lower-limit of 0.301. Research has shown that, while the EQ-5D has a ceiling effect, the SF-6D suffers primarily from a floor effect[5, 2]. Therefore, the distribution of these data is a mixture of discrete and continuous distributions. It is likely that there is an upper threshold for individuals’ SF-6D responses, above which their health state would be valued as ‘full health’. Similarly there is likely to be a lower limit, below which their health state would be valued at 0.301. The tobit model combines methods in order to deal with this. For the tobit model our maximum likelihood function is a combination of the likelihood for a discrete and a continuous distribution. We use a tobit model to estimate the marginal effects of given health problems and socio-demographic factors on an individual’s observed SF-6D response. SF-6D values are estimated from an individual’s SF-36 response, using standard UK values[4]

3.2 Responsiveness to changes in health

Using difference-in-difference (DiD) analysis we estimate the extent to which SWL, SWH and SF-6D responses change with ‘diagnosis’ of a health problem, and compare this with the change for individuals not diagnosed with the health problem. The time frame used is five years, as necessitated by the availability of SF-36 data in the BHPS. All questions about health problems are included in waves 9 and 14 of the BHPS, except stroke and cancer which only began being collected from wave 11. As such we assume an individual’s response to these two questions is the same in wave 11 as it would have been in wave 9. For the analysis the ‘treatment’ group is individuals who report not to have a given health problem in wave 9, but do report it in wave 14. The ‘control’ group consists of individuals who do not report having the health problem in either wave 9 or wave 14.

We implement 3 regression models to obtain estimators of the difference in differences. Model I estimates the DiD effect for each health problem separately:

$$y_{it} = \beta_0 + \beta_1 X_i T_t + \beta_2 X_i + \beta_3 T_1 + \varepsilon_{it} \quad (2)$$

where X is the health problem and β_1 is the DiD estimator. Model II estimates the DiD effect for each health problem while controlling for all other health problems:

$$y_{it} = \beta_0 + [\beta_1 X_i^a T_t + \beta_2 X_i^b T_t \dots] + [\beta_3 X_i^a + \beta_4 X_i^b \dots] + \beta_5 T_1 + \varepsilon_{it} \quad (3)$$

where $[X^a, X^b \dots]$ are the health problems and $[\beta_1, \beta_2 \dots]$ are the DiD estimators. Model III estimates the DiD effects for all health problems simultaneously, additionally controlling for the determinants of SWB, as set out above:

$$y_{it} = \beta_0 + [\beta_1 X_i^a T_t + \beta_2 X_i^b T_t \dots] + [\beta_3 X_i^a + \beta_4 X_i^b \dots] + [\beta_5 \text{age} + \beta_6 \text{sex} + \beta_7 \text{education} \dots] + \beta_8 T_1 + \varepsilon_{it} \quad (4)$$

where $[X^a, X^b \dots]$ are the health problems and $[\beta_1, \beta_2 \dots]$ are the DiD estimators.

Due to SWL and SWH being measured on a different scale to SF-6D it is not possible to compare the magnitude of either changes or differences in values; we can only compare whether effects are positive or negative and whether regressors have a statistically significant effect.

4 Results

Table 1 shows SF-6D values summarised by SWL and SWH responses. 14.2% of individuals responded as “*completely satisfied*” for SWL. For those who responded as “*completely satisfied*” with life, the average SF-6D score was 0.84; some way from full health. 2.4% of individuals had SF-6D scores of 1 and 76% of these individuals responded either “*completely satisfied*” or “*somewhat satisfied*” with life.

Table 2 shows the regression coefficients and marginal effects for the determinants of SWL, SWH and SF-6D. Socio-demographic variables behave largely as expected. All outcome measures have a U-shaped relationship with age. Being female has a positive effect on SWL and SWH, but a negative effect on SF-6D. Being unemployed has a negative effect on SWL, but no significant effect on SWH or SF-6D. Having a degree also has a negative effect on SWL and no significant effect on SWH, but has a positive effect on SF-6D. Number of children and income have no statistically significant effect on SWL, SWH or SF-6D. Being black or of other non-white ethnicity has a negative impact on SWL and SWH that are significant at the 5% level. More engagement in religious activity is associated with a greater likelihood of reporting complete satisfaction with life and health, but has no statistically significant effect on SF-6D.

4.1 Sensitivity

As Table 2 shows, individuals are likely to have a lower SWL if they suffer from almost any of the health problems included. However, for sight, hearing, skin problems, diabetes, epilepsy and cancer there is shown to be no significant effect at the 5% level. Similarly, the SF-6D scores of individuals with hearing problems, epilepsy or stroke are not statistically different from those without. However, SF-6D shows a significant negative impact of cancer and, somewhat surprisingly, of sight problems also. Espallargues et al[12], for example, show that EQ-5D and SF-6D fail to respond sufficiently to visual impairment. SWH responses are sensitive to the same health problems as SF-6D values.

For all health problems, across all measures, relationships of significance are negative. However it is clear that, for each measure, different health problems

have different effect sizes. The presence of anxiety has, compared with other health problems, the largest negative impact on an individual's SWL. While anxiety also has the largest effect upon SF-6D and SWH, the effect size, proportional to that of other health problems, is not as large. The effect of anxiety upon SF-6D is only slightly greater than being disabled, or having health problems with arms, legs or hands.

4.2 Responsiveness

Our results suggest that, as shown in Table 3 and Figure 1, SWL is not responsive to a majority of health problems. Model III finds that only anxiety and problems with arms, legs or hands have a significant impact on an individual's SWL. For SWL, anxiety has the largest significant effect size in all three models. SF-6D values, on the other hand, are responsive to a majority of health problems, as shown in Table 5 and Figure 3. Both anxiety and disability have similarly large negative impacts on an individual's SF-6D values. As shown in Table 4 and Figure 2, SWH is also responsive to a majority of health problems, though appears to be particularly responsive to different health problems, with cancer having by far the largest negative impact in Model III.

5 Discussion

Section 2 presented three reasons why SWB responses might differ from SF-6D values. The first possibility was that *what* SWB and SF-6D measure differs, and outcomes would diverge as a result of this. Our results provide some evidence of this. Being unemployed or engaging in religious activity, for example, corresponds to differences in SWL but not SF-6D. However, there is some evidence that SF-6D may be sensitive to differences in non-health-related aspects of an individual's QoL, such as sex, ethnicity, marital status and education. The second reason for SF-6D and SWB leading to different outcomes is that *how* they value states is different. This would primarily lead to differences in the effect size of different health problems. Unfortunately we are not able to compare effect sizes between SF-6D and SWB responses. The third reason why SF-6D and SWB values may diverge is that they differ in terms of *who* values them. SWB is implicitly valued by the individual, while SF-6D is explicitly valued using public preferences. Due to the public's inability to accurately predict the impact of health problems, or factors such as adaptation or coping mechanisms, it is possible that SWB and SF-6D values may have assigned differing weights to different health problems. This appears to play out to some extent, with SWL, SWH and SF-6D responding in varying magnitudes to different health problems.

Arguments against the use of SWB as an outcome measure in health research suggest that, as a result of these differences, SWB might not be sufficiently sensitive and responsive to differences and changes in health. Our results provide some evidence of this claim. Of the 16 health problems listed, SF-6D is sensitive

to 13, while SWL is sensitive to 10. Our basic DiD model finds that SF-6D is responsive to changes in 11 of the 14 health problems, while the full model finds 8 of the 14 lead to a significant difference in differences. For SWL the numbers are just 5 and 3, respectfully. While we cannot compare the magnitude of effects caused by differences and changes in health across measures, we can compare the relative effect sizes of different health problems for each measure separately. While SWB is primarily responsive only to changes in anxiety, SF-6D provides a similar weight to anxiety, disability and cancer.

5.1 Limitations

There are a number of limitations to our study. The health problems listed in the BHPS, and used in our analyses, are by no means comprehensive. There are many other health problems to which an appropriate measure must be sensitive and responsive. Furthermore, because the health problems used in our model are not comprehensive, it is possible that they do not sufficiently capture the effects of an individual’s health state upon their SWB. As tables 3, 4 and 5 show, individuals who are in the ‘treatment’ group (those who later report having a given health problem) have consistently lower SWL, SWH and SF-6D scores at baseline. For this reason, model I is likely to be a poor predictor of the true effect of the reported health problem. It is not clear whether model II or model III sufficiently control for differences in the populations to capture this effect.

Our study was also limited by the availability of data in different waves of the BHPS; SF-36 was only collected in waves 9 and 14. This means that, by wave 14, individuals could have been reporting their health problem for between 1 and 4 years, and this may affect an individual’s reported SWL, SWH and estimated SF-6D values. Furthermore, our results for cancer and stroke may be distorted due to our use of responses to this question from wave 11.

5.2 Conclusion

Our results indicate that reservations about the use of subjective well-being in the evaluation of health care interventions may, to some extent, be justified. Our models showed that SWL responses were sensitive and responsive to fewer health problems than the SF-6D. The implication of this is that it may not sufficiently capture the beneficial effects of health care interventions or the burden of illness. If SWL were used as an outcome measure we would expect it to assign a greater weight to mental health problems than physical health problems.

To our knowledge, satisfaction with health has not previously been considered as a potential health outcome measure. Our results indicate that SWH is sensitive and responsive to more health problems than SWL. Subject to the limitations discussed above, our analyses show that SWH is as sensitive and responsive as SF-6D values to differences and changes in health. We hope that further empirical research will be done into the use of the measure as a health outcome, along with a discussion of the theoretical justifications for its use.

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| | freq | SF-6D | | |
|--------------------------|--------|-------|-------|-------|
| | | mean | min | max |
| Satisfaction with life | | | | |
| Not at all satisfied | 1.29% | 0.574 | 0.301 | 1.000 |
| 1 | 2.32% | 0.648 | 0.319 | 1.000 |
| 2 | 6.22% | 0.695 | 0.301 | 1.000 |
| 3 | 13.42% | 0.750 | 0.301 | 1.000 |
| 4 | 29.28% | 0.808 | 0.319 | 1.000 |
| 5 | 33.27% | 0.843 | 0.334 | 1.000 |
| Completely satisfied | 14.20% | 0.838 | 0.340 | 1.000 |
| Satisfaction with health | | | | |
| Not at all satisfied | 4.21% | 0.563 | 0.301 | 1.000 |
| 1 | 4.62% | 0.641 | 0.301 | 0.929 |
| 2 | 10.04% | 0.718 | 0.301 | 1.000 |
| 3 | 15.10% | 0.763 | 0.316 | 1.000 |
| 4 | 23.13% | 0.821 | 0.301 | 1.000 |
| 5 | 28.04% | 0.860 | 0.334 | 1.000 |
| Completely satisfied | 14.86% | 0.878 | 0.395 | 1.000 |

Table 1: Summary table

| Variable | Coefficients | | | Marginal effects | | |
|-------------------------|----------------------------|----------------------------|---------------------------|----------------------------|----------------------------|----------------------------|
| | SWL | SWH | SF-6D | SWL(=6) | SWH(=6) | SF-6D |
| Age | -0.111*** | -0.054*** | -0.007*** | -0.022*** | -0.010*** | -0.007*** |
| Age-squared | 0.002*** | 0.001*** | 1.57×10^{-4} *** | 4.39×10^{-4} *** | 1.97×10^{-4} *** | 1.54×10^{-4} *** |
| Age-cubed | -1.19×10^{-5} *** | -5.45×10^{-6} *** | -1.06×10^{-6} | -2.39×10^{-6} *** | -1.01×10^{-6} *** | -1.04×10^{-6} *** |
| Female | 0.050** | 0.052** | -0.019*** | 0.010** | 0.010** | -0.019*** |
| Black | -0.272** | -0.344*** | -0.018 | -0.046** | -0.051*** | -0.018 |
| Other non-white | -0.351*** | -0.381*** | -0.026*** | -0.057*** | -0.056*** | -0.026*** |
| Married | 0.233*** | 0.016 | 0.005** | 0.046*** | 0.003 | 0.005** |
| Number of children | -0.024* | 0.016 | -0.002 | -0.013*** | 0.003 | -0.002 |
| Degree | -0.050** | 0.003 | 0.005*** | -0.010** | 0.001 | 0.005*** |
| Log of income | -0.002 | -0.003 | 0.001 | -3.88×10^{-4} | -4.76×10^{-4} | 0.001 |
| Unemployed | -0.248*** | -0.042 | -0.008 | -0.043*** | -0.008 | -0.008 |
| Number of working hours | -0.001 | 0.002*** | 0.001*** | -1.19×10^{-4} | 4.04×10^{-4} *** | 0.001*** |
| Religious activity | 0.082*** | 0.058*** | 0.001* | 0.017*** | 0.011*** | 0.001* |
| Disabled | -0.374*** | -0.557*** | -0.099*** | -0.063*** | -0.079*** | -0.098*** |
| Arms / legs / hands | -0.194*** | -0.523*** | -0.080*** | -0.037*** | -0.086*** | -0.079*** |
| Sight | -0.006 | -0.109** | -0.012*** | -0.001 | -0.019*** | -0.012*** |
| Hearing | -0.047 | -0.058 | -0.004 | -0.009 | -0.011* | -0.004 |
| Skin | -0.053* | -0.113*** | -0.006** | -0.010* | -0.020*** | -0.006** |
| Chest | -0.115*** | -0.342*** | -0.039*** | -0.022*** | -0.054*** | -0.038*** |
| Heart | -0.149*** | -0.347*** | -0.025*** | -0.028*** | -0.057*** | -0.024*** |
| Stomach | -0.232*** | -0.497*** | -0.043*** | -0.042*** | -0.071*** | -0.042*** |
| Diabetes | 0.003 | -0.250*** | -0.009** | 0.001 | -0.040*** | -0.009** |
| Anxiety | -0.782*** | -0.661*** | -0.103*** | -0.105*** | -0.086*** | -0.102*** |
| Drugs | -0.428*** | -0.391*** | -0.040*** | -0.066*** | -0.057*** | -0.040*** |
| Epilepsy | -0.031 | -0.304*** | -0.006 | -0.006 | -0.047*** | -0.006 |
| Migraine | -0.136*** | -0.243*** | -0.033*** | -0.026*** | -0.040*** | -0.032*** |
| Cancer | -0.054 | -0.490*** | -0.028*** | -0.011 | -0.067*** | -0.028*** |
| Stroke | -0.192** | -0.067 | -0.012 | -0.034** | -0.012 | -0.011 |
| Other | -0.239*** | -0.540*** | -0.040*** | -0.042*** | -0.073*** | -0.039*** |
| /cut1 | -4.143 | -3.187 | | | | |
| /cut2 | -3.627 | -2.696 | | | | |
| /cut3 | -3.040 | -2.097 | | | | |
| /cut4 | -2.401 | -1.520 | | | | |
| /cut5 | -1.533 | -0.820 | | | | |
| /cut6 | -0.453 | 0.137 | | | | |

Table 2: Regression estimates

| Health problem | Without | | With | | Difference in differences | | |
|---------------------|---------|-------|--------|-------|---------------------------|-----------|-----------|
| | Before | After | Before | After | Model I | Model II | Model III |
| Disabled | 4.344 | 4.302 | 3.946 | 3.611 | -0.294*** | -0.359** | -0.256 |
| Arms / legs / hands | 4.366 | 4.314 | 4.272 | 4.108 | -0.112** | -0.159** | -0.220*** |
| Sight | 4.291 | 4.233 | 4.148 | 4.012 | -0.078 | 0.021 | 0.055 |
| Hearing | 4.279 | 4.224 | 4.281 | 4.233 | 0.008 | 0.226 | 0.213 |
| Skin | 4.312 | 4.258 | 4.169 | 4.016 | -0.099 | -0.103 | -0.093 |
| Chest | 4.339 | 4.276 | 4.054 | 3.918 | -0.074 | -0.066 | -0.166 |
| Heart | 4.284 | 4.238 | 4.294 | 4.143 | -0.106* | -0.088 | -0.109 |
| Stomach | 4.330 | 4.272 | 4.016 | 3.795 | -0.162** | -0.103 | -0.153 |
| Diabetes | 4.277 | 4.223 | 4.220 | 4.197 | 0.030 | 0.030 | 0.032 |
| Anxiety | 4.384 | 4.338 | 3.834 | 3.161 | -0.627*** | -0.602*** | -0.603*** |
| Drugs | 4.284 | 4.225 | 3.333 | 2.800 | -0.474 | -0.997* | -1.271** |
| Epilepsy | 4.280 | 4.222 | 3.952 | 4.250 | 0.356 | 1.140* | 0.948 |
| Migraine | 4.323 | 4.263 | 3.977 | 3.796 | -0.121 | -0.082 | -0.006 |
| Cancer | 4.283 | 4.236 | 4.165 | 4.129 | 0.011 | 0.240 | 0.032 |
| Stroke | 4.292 | 4.254 | 4.042 | 3.707 | -0.297* | -0.007 | -0.009 |
| Other | 4.302 | 4.247 | 4.138 | 3.846 | -0.236*** | -0.156 | -0.233 |

Table 3: Satisfaction with life

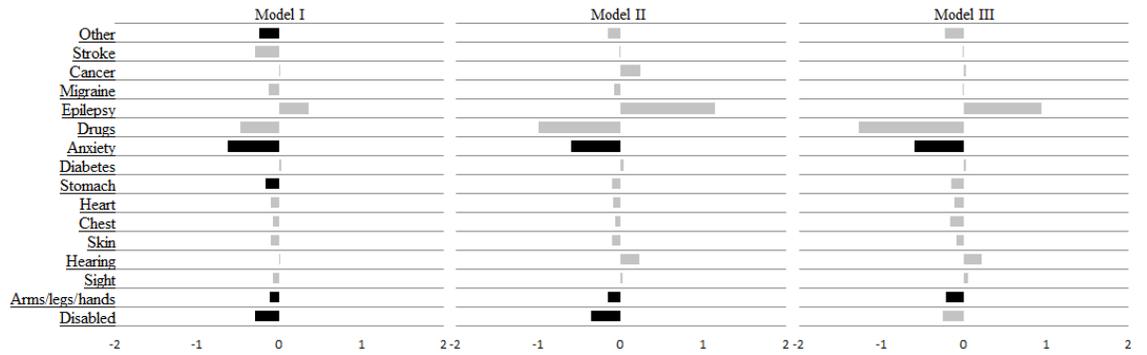


Figure 1: Satisfaction with life: DiD effects

| Health problem | Without | | With | | Difference in differences | | |
|---------------------|---------|-------|--------|-------|---------------------------|-----------|-----------|
| | Before | After | Before | After | Model I | Model II | Model III |
| Disabled | 4.25 | 4.070 | 2.96 | 2.46 | -0.315*** | -0.364* | -0.421** |
| Arms / legs / hands | 4.456 | 4.264 | 3.939 | 3.404 | -0.343*** | -0.392*** | -0.465*** |
| Sight | 4.124 | 3.949 | 3.358 | 2.988 | -0.196* | -0.284 | -0.238 |
| Hearing | 4.118 | 3.937 | 3.580 | 3.457 | 0.059 | 0.048 | 0.052 |
| Skin | 4.134 | 3.945 | 3.668 | 3.425 | -0.053 | 0.086 | 0.083 |
| Chest | 4.217 | 4.029 | 3.462 | 2.944 | -0.331*** | -0.417*** | -0.361** |
| Heart | 4.234 | 4.071 | 3.834 | 3.249 | -0.421*** | -0.349*** | -0.390*** |
| Stomach | 4.187 | 4.013 | 3.392 | 2.672 | -0.545*** | -0.780*** | -0.842*** |
| Diabetes | 4.088 | 3.917 | 3.490 | 3.080 | -0.239* | -0.450* | -0.493* |
| Anxiety | 4.209 | 4.027 | 3.371 | 2.512 | -0.677*** | -0.695*** | -0.641*** |
| Drugs | 4.060 | 3.881 | 2.636 | 2.133 | -0.324 | 0.546 | -0.088 |
| Epilepsy | 4.059 | 3.882 | 3.952 | 3.050 | -0.726 | -0.201 | -0.765 |
| Migraine | 4.132 | 3.952 | 3.497 | 3.186 | -0.131 | -0.119 | -0.051 |
| Cancer | 4.076 | 3.914 | 3.212 | 2.699 | -0.351** | -1.25*** | -1.612*** |
| Stroke | 4.092 | 3.933 | 2.934 | 2.629 | -0.146 | -0.427 | -0.427 |
| Other | 4.125 | 3.954 | 3.721 | 2.950 | -0.599*** | -0.687*** | -0.833*** |

Table 4: Satisfaction with health

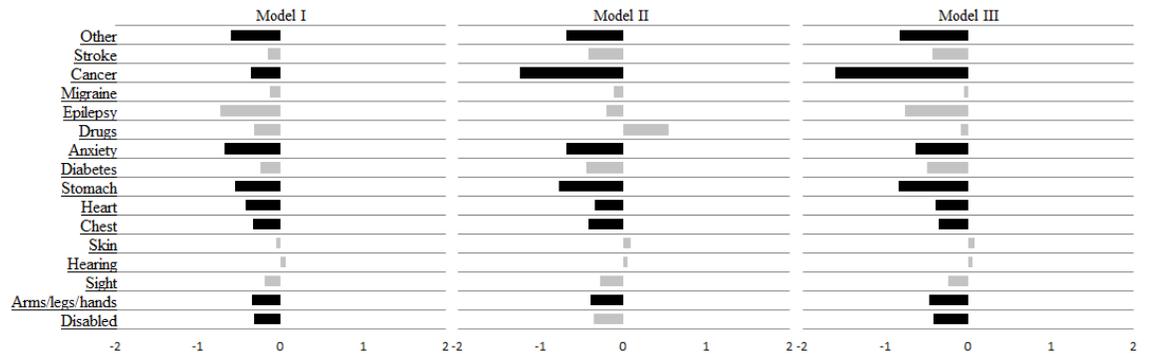


Figure 2: Satisfaction with health: DiD effects

| Health problem | Without | | With | | Difference in differences | | |
|---------------------|---------|-------|--------|-------|---------------------------|-----------|-----------|
| | Before | After | Before | After | Model I | Model II | Model III |
| Disabled | 0.829 | 0.821 | 0.705 | 0.637 | -0.060*** | -0.063*** | -0.076*** |
| Arms / legs / hands | 0.849 | 0.845 | 0.802 | 0.741 | -0.057*** | -0.047*** | -0.050*** |
| Sight | 0.817 | 0.807 | 0.729 | 0.697 | -0.022*** | -0.022* | -0.019 |
| Hearing | 0.816 | 0.807 | 0.759 | 0.736 | -0.013 | -0.002 | -0.003 |
| Skin | 0.815 | 0.803 | 0.778 | 0.756 | -0.011 | 0.007 | 0.005 |
| Chest | 0.822 | 0.813 | 0.747 | 0.699 | -0.038*** | -0.037*** | -0.033*** |
| Heart | 0.827 | 0.820 | 0.783 | 0.744 | -0.033*** | -0.023*** | -0.020*** |
| Stomach | 0.820 | 0.810 | 0.755 | 0.697 | -0.048*** | -0.052*** | -0.055*** |
| Diabetes | 0.812 | 0.802 | 0.746 | 0.719 | -0.016 | -0.019 | -0.026 |
| Anxiety | 0.824 | 0.814 | 0.748 | 0.659 | -0.079*** | -0.075*** | -0.076*** |
| Drugs | 0.810 | 0.798 | 0.706 | 0.632 | -0.063** | -0.038 | -0.077* |
| Epilepsy | 0.810 | 0.798 | 0.781 | 0.748 | -0.021 | 0.016 | 0.024 |
| Migraine | 0.817 | 0.805 | 0.765 | 0.731 | -0.022** | -0.025** | -0.022* |
| Cancer | 0.811 | 0.800 | 0.749 | 0.692 | -0.046*** | -0.056** | -0.067** |
| Stroke | 0.813 | 0.802 | 0.687 | 0.645 | -0.030* | -0.078* | -0.075 |
| Other | 0.815 | 0.804 | 0.771 | 0.727 | -0.032*** | -0.038*** | -0.042*** |

Table 5: SF-6D

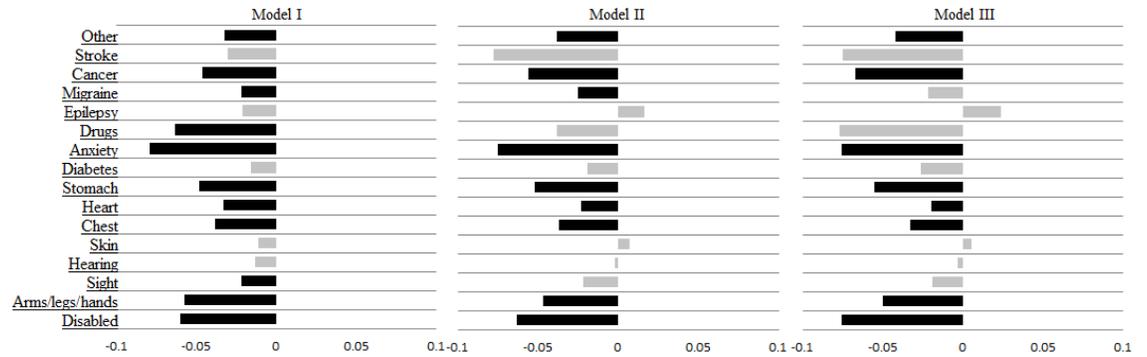


Figure 3: SF-6D: DiD effects