A Study of the Relationship between Health and Subjective Well-Being in Parkinson’s Disease Patients

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ABSTRACT

Objectives: Governments are turning their attention to evidence on subjective measures of well-being to inform policy decisions. In the context of health, there is, therefore, growing interest in understanding how measures of health-related quality of life relate to subjective well-being and whether subjective well-being could provide a basis for resource allocation decisions in the future. This study investigates the relationship between health-related quality of life, as measured by the EuroQol five-dimensional (EQ-5D) questionnaire, and subjective well-being in Parkinson’s disease. Methods: A paper questionnaire including the EQ-5D questionnaire, four key subjective well-being questions taken from the Integrated Household Survey in England, and other demographic details was distributed to people with Parkinson’s disease in the United Kingdom. Responses were used to estimate multiple regression models explaining subjective well-being using the EQ-5D questionnaire index (UK weights), EQ-5D questionnaire dimensions and the visual analogue scale, and patients’ sociodemographic characteristics. Results: A total of 199 responses were received. Combining visual analogue scale and EQ-5D questionnaire dimensions, especially anxiety/depression and, to a lesser extent, mobility, yielded the best-fitting models (adjusted R² range 0.36–0.53). Patients with Parkinson’s disease living in care homes report lower levels of subjective well-being than do those living alone. These effects are not captured by the health-related quality-of-life measures in the analysis. Conclusions: Usual health-related quality-of-life measures can partially explain different well-being dimensions, yet they fail to capture part of the broader impact of disease on subjective well-being. Further empirical research into the relationship between subjective well-being and the EQ-5D Parkinson’s disease longitudinally, and in different disease areas, is required, and further standardization of subjective well-being measures is recommended.

Keywords: EQ-5D, happiness, Parkinson’s disease, subjective well-being.

Introduction

Governments across the world, including the UK government [1], and bodies such as the Organisation for Economic Co-Operation and Development (OECD) [2], are increasingly using evidence on subjective measures of happiness as a way of informing decisions about a wide range of public policies.

In the context of the health care sector, this has generated considerable interest in understanding how measures of health-related quality of life (HRQOL), which are widely used to inform decisions about pricing and reimbursement of health care technologies, relate to these measures of happiness or subjective well-being (SWB), and whether the latter might provide a basis for resource allocation decisions about health care in the future. This raises fundamental questions about what the purpose of health care is—to improve health or to improve happiness—and how these outcomes are best measured. For example, does the EuroQol five-dimensional (EQ-5D) questionnaire [3]—a generic measure of HRQOL that is recommended by the National Institute for Health and Care Excellence for use in evidence submitted to its health technology assessment process [4] and widely used internationally—capture some aspects of SWB? Which specific dimensions of the EQ-5D questionnaire relate to which measures of SWB? What aspects of SWB are missed by the EQ-5D questionnaire?

Some evidence on these questions is available. For example, a number of articles have attempted the use of SWB in valuing HRQOL states described in terms of the EQ-5D questionnaire and the SF-6D (as an alternative to current approaches used to value HRQOL states, such as the time trade-off [TTO]) [5–8]. Studies have also explored the extent to which various conditions contribute most to unhappiness [9]. To date, however, there has been little detailed examination of the relationship between dimensions and levels of the EQ-5D questionnaire (the EQ-5D questionnaire profile) and SWB by disease area; how patients’ overall assessment of their own health on the visual analogue scale (VAS) relates to their self-reported SWB; and how these relationships differ across different aspects of SWB that might be measured.

Answering these questions is complicated somewhat by the lack of standardization in the use of the term SWB, the “new science” of SWB, as Layard describes it [10], having emerged relatively recently.
For instance, the terms “happiness” and “subjective well-being” are often used interchangeably [11], although they are not identical according to most definitions. For example, happiness has been described as equivalent to life satisfaction, quality of people’s lives [11], or experienced utility [12]. However, SWB is frequently used as an umbrella term for how we feel (“affective happiness”) and think (“evaluative happiness” or “rewardingness”) about life [11]. Recent recommendations from the OECD [13] distinguish three different components of SWB: evaluative (reflective assessment of life “as a whole” or an aspect of it), affective (experience or feelings), and eudaimonic (functioning and realization of the person’s potential). Many different instruments have been developed to measure the various nuanced definitions of SWB. A comprehensive collection of the available instruments can be found in Helliwell et al. [11], and different guidelines providing advice on the collection and use of such instruments can be found in the OECD [13]. In this article, we viewed SWB as a broad concept that encompasses the three components.

In the United Kingdom, subsequent to a public consultation and advice from academics, the following SWB questions on an ordinal scale of 0 to 10 were defined for inclusion in the ongoing Integrated Household Survey beginning in April 2011 [14]:

1. Overall, how satisfied are you with your life nowadays?
2. Overall, to what extent do you feel that the things you do in your life are worthwhile?
3. Overall, how happy did you feel yesterday?
4. On a scale on which 0 is “not at all anxious” and 10 is “completely anxious,” overall, how anxious did you feel yesterday?

Question 1 is intended to capture the evaluative component. Question 2 represents the eudaimonic dimension. Questions 3 and 4 may be the basis for the second dimension (“affective”) in terms of positive and negative affect [11].

SWB determinants suggested by Helliwell et al. [11] embrace a wide variety of factors, for example, income, quality of governance, day-to-day joys, trust in one’s community, and having someone to count on in times of difficulty. Among all the factors influencing SWB, health obviously plays an important role, and HRQOL is frequently considered as a key dimension of SWB. Because SWB is a broader concept, and captures the individual’s own experience of his or her well-being, advocates of SWB would argue that using SWB to value health improvements could in theory address many of the limitations of measures of HRQOL. For example, SWB has the potential to be used more broadly as a measure of benefit across different sectors (e.g., across health and social care services) because arguably increasing well-being should be the ultimate goal of most, if not all, government policies whether in health or in any other sector. Thus, concerns about whether widely used measures of HRQOL—such as the EQ-5D questionnaire—are missing dimensions of health that are relevant to patients also is addressed because individuals would implicitly include these in their own assessment of SWB. How SWB relates to HRQOL, and particularly to the EQ-5D questionnaire, however, has not been widely studied.

The primary aim of this exploratory study was therefore to investigate the relationship between HRQOL (as measured by both the EQ-5D questionnaire profile and patients’ overall rating of their health on the VAS or EQ-VAS) and SWB scores (on the four key Office for National Statistics (ONS) questions described above) in a given health condition. The population chosen for this analysis is patients with Parkinson’s disease (PD). PD is a progressive neurodegenerative disorder affecting approximately 120,000, or 1 in 500, people in the United Kingdom. The condition is characterized by disabling motor symptoms, including tremor, rigidity, and slowness of movement, often accompanied by nonmotor symptoms, including pain, depression and anxiety, constipation, and fatigue.

This patient cohort is interesting for a number of reasons. First, although the EQ-5D questionnaire appears to work reasonably well as a measure of HRQOL in PD [15], no previous research explored how the UK SWB measures perform in this group of respondents. Second, PD is a good example of a disease area for which the usual measures of HRQOL may fail to capture part of the wider effects of the disease on SWB. For instance, SWB determinants suggested by Helliwell et al. [11] as “having someone to count on in times of difficulty” or “trust in one’s community” may not be captured by usual measures of health or utility. We analyzed the degree of correlation of proxies for these determinants and SWB for patients with PD, with and without controlling for health-related factors. If significant differences were found, this would be an indicator that the extent to which a disability affects subsequent well-being depends not just on the severity of the disability but also on other factors, and the extent to which patients are enabled in maintaining their social connections. If so, the article would provide some insights into the appropriateness of using SWB measures as a complement for health resource allocation in the near term.

Methods

The Questionnaire and Data Collection

A paper questionnaire was developed for self-completion by individuals with a diagnosis of PD in the United Kingdom. The questionnaire included the following items:

1. Demographic characteristics questions (age range, sex, years since diagnosis, marital status, employment status, household situation, and education). Income data were not collected because of concerns that this might adversely affect the response rate [16]. A tick-box format was used for ease of completion.

2. The three-level EQ-5D questionnaire instrument [3], including both the patients’ EQ-5D questionnaire health profile and the patients’ overall assessment of their health on a VAS (the EQ-VAS, from 0 to 100, representing worst-possible and best-possible health, respectively). The EQ-5D questionnaire health profiles can also be summarized by a single number representing the relative value of that health state on a scale anchored at 1 (full health) and 0 (dead). The value set used for this purpose in this study is the UK value set reported by Dolan et al. [17].

3. The four SWB questions taken from the Integrated Household Survey, as shown in the Introduction, and adapted from the verbal interviewer script into a written format to enable self-completion.

Two versions of the questionnaire were developed, in which the order of the EQ-5D questionnaire and SWB questions was alternated (50:50 split) to control for ordering effects.

Two strategies were used to contact potential participants:

1. Attendance at seven local Parkinson’s UK support group meetings and three larger regional Parkinson’s UK forum meetings in the southeast of England where objectives of the research were presented and questions answered. Questionnaires were then distributed to interested members.

2. An e-mail sent to the Parkinson’s UK’s online research network inviting interested members to request a questionnaire by post. Stamped, addressed envelopes were provided for returns. Participants were assured that their responses would...
be anonymous and participation voluntary. The questionnaire took approximately 10 minutes to complete.

**Analysis**

Participants’ responses were analyzed using Stata12. Initially, descriptive statistics were performed on each of the independent SWB variables and the dependent variables individually.

**Regression models**

The SWB data collected are ordinal, that is, ranked data, rather than cardinal in nature. Because ordinal measures of health are one of the most commonly used indicators, a wide variety of techniques have been developed to make the responses suitable for different regression analyses. The present study uses two different approaches. (A thorough discussion of the measurement scale of health variables can be found in Erreygers and van Oort [18].)

1. Direct assumption of the existence of a cardinal scale at the response level: The SWB will be interpreted as a continuous value from 0 to 10 with ratio properties (e.g., a difference between categories 2 and 3 in an SWB measure equals the difference between categories 4 and 5). This assumption is consistent with the large number of categories in the SWB answers, and it supports the use of common parametric methods as ordinary least squares regression.

2. Projection of continuous, cardinal scales on ordinal measures: We assume the existence of a latent, unobservable well-being variable that is distributed in a particular way across the different categories (e.g., changes in the degree of well-being between two categories are explained in terms of changes in the values of the latent variable). A typical example of this approach is the ordered probit/logit regression models, as can be found, for instance, in Van Doorslaer and Jones [19].

Health measures of a general population sample usually have a skewed distribution, with the great majority of respondents reporting their health toward the high end of the scale. A similar outcome could be expected for well-being measures because (our hypothesis is that) health is a key factor at explaining SWB. This study collects data from patients with PD rather than the general population, but skewness in the distribution of most of the SWB variables still is apparent (see Fig. 1). This suggests that SWB may better fit the assumption of a skewed distribution. To ensure that the SWB variable (y) is skewed in the appropriate direction (for life satisfaction, life worthwhile, and happiness dimensions; this change does not apply to anxiety), we need to invert the 0 to 10 scale and derive a mirror-image “subjective unwell-being” variable (h, where h = 10−y) that will more closely follow a standard lognormal distribution. A similar method has been applied to health (“ill health”), for example, in Cubí-Mollá and Herrero [20].

Three types of regressions have been developed to model the distribution of each of the SWB questions. For this purpose, the retransformation methods for the analysis of the expected values feature from our perspective. Therefore, other issues such as retransformation methods for the analysis of the expected values conditional on the covariates:

\[ y^* = x\beta + \epsilon, \quad \epsilon \sim N(0, \sigma^2) \]

\[ y = k \in \{0, 1, \ldots, 10\} \text{ if } a_k < y^* \leq a_{k+1}, \text{with } a_0 = -\infty, a_{11} = +\infty \]

**Explanatory variables**

Four different specifications of HRQOL were used for each model: 1) EQ-5D questionnaire TTO index [17]; 2) dummy variables for the EQ-5D questionnaire levels in every dimension; 3) EQ-VAS; and 4) dummy variables as well as the EQ-VAS.

Each model also controlled for different factors that may affect the self-valuation of the well-being. We were interested in particular in analyzing one of the SWB determinants suggested by Helliwell et al. [11], “having someone to count on in times of difficulty.” To capture this, we used household composition as a proxy. Our hypothesis was that patients living alone would report lower SWB levels than would those living with partners or relatives, or in care homes, and that this effect would not be captured by the HRQOL measures. The models also controlled for the number of years since diagnosed, the age, sex, and education of the respondent.

The results of the approaches were summarized and compared. The coefficients were to be used to investigate the relationship between HRQOL and SWB in patients with PD.

**Results**

**Participants**

A total of 276 questionnaires were distributed and 199 participants responded (response rate 72%). Of the respondents, 118 (60%) participants were men and 78 (40%) women, although the incidence of PD is similar in men and women. About 80% of the participants were older than 61 years, consistent with the mean age of onset of around 65 years. Approximately 81% of the participants lived with a spouse or partner, representing relatively high levels of social support from informal careers. About 47% of the participants had a recent diagnosis in the past 5 years and a further 27% in the last 6 to 10 years. A summary description of the relevant variables is provided in Table 1.

**Descriptive Statistics of Health and Well-Being**

As anticipated, a large proportion of patients (58%) reported that they suffered from at least moderate anxiety and depression. The majority of participants also reported moderate problems with mobility, usual activities, and pain/discomfort (see Table 2).

Table 3 and Figure 1 show summary descriptive statistics and histograms of the distribution of the main variables of the study. Table 3 also includes the descriptive statistics in the first release of the SWB data collected by the ONS opinions survey, which was made available in December 2011 [21]. Patients with PD reported on average poorer SWB scores than did the general population (though we do not control for, e.g., age or sex). We can also observe that for patients with PD, “life satisfaction,” “life worthwhile,” and “happiness” scores performed similarly in skewed distributions, with mean values around 6.5 and SDs around 2 points. At face value, they also appeared to behave similarly in
the EQ-VAS. The EQ-5D questionnaire index had a different shape, displaying a bimodal distribution that is characteristic in patient populations and had a higher SD [22].

“Anxious yesterday” scores behaved differently from all other measures and had a quite different distribution. On closer inspection of the raw data, it was found that many of those reporting high levels of SWB in terms of life satisfaction, life worthwhile, and happiness were also reporting high levels of anxiety. To find people scoring differently in each measure may be highlighting the importance of incorporating the fourth question (anxiety) into the valuation of SWB. We should take this interpretation, however, with caution. That is because an alternative explanation may be that the scale used for anxiety is the inverse of that of other SWB questions (i.e., 0 = not at all anxious,
Ferrer-i-Carbonell and Frijters [23], who found evidence that the health. This result is consistent with the result of the study by...[23] in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002. This outcome is not observable in the “anxiety” dimension, as it will be explained later.

Overall, the model results for “life satisfaction” (Appendix Table A1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002) are as follows. Regardless of which model we used (OLS or OPM), the EQ-5D questionnaire TTO index appeared to be the least useful of the HRQOL variables in explaining the variance in “life satisfaction.” Only the dimensions of pain/discomfort (level 3) and anxiety/depression (levels 2 and 3) were statistically significant across models, in addition to the dimension of usual activities (level 3) in the OPM.

All the OLS Normal models for “life satisfaction” rejected the assumption of normality, and only two of the OLS Lognormal models did not reject it. This suggests that the distribution of “life satisfaction” was certainly skewed. Therefore, the OLS Normal models may not be capturing the distribution properly, despite having a better goodness of fit.

Several socioeconomic factors that usually correlate with HRQOL indicators—such as education, sex, or employment status—were not statistically significant in the regressions. The household composition, however, seemed to be an important explanatory factor for life satisfaction. In particular, patients with PD living with a partner or with other family members report greater life satisfaction than do those living alone. This could support the hypothesis suggested by Helliwell et al. [11] that “having someone to count on in times of difficulty” is a key determinant of SWB. It is also notable that patients living in health care homes reported lower life satisfaction levels than did those living alone. This result was not expected to be affected by the severity of the illness or by the number of years with PD, because these variables were not statistically significant in the models.

The model results for the SWB variable “life worthwhile,” shown in Appendix Table A2 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002, were as follows.

The feeling was that “life is worthwhile” is apparently more difficult to model and explain than feelings of life satisfaction, with (pseudo) R² values that are somewhat lower. The hypothesis of normal distribution of the residuals was not rejected, and so the OLS Normal distribution appeared to fit the data better. Again, combining the EQ-VAS and dimensions of the EQ-5D questionnaire yield the best-fitting models. Only anxiety/depression (levels 2 and 3) and mobility (level 3) were significant in

The best possible state, whereas for the other SWB questions, 0 = not at all satisfied, worthwhile, or happy, respectively, the worst possible state), which was counterintuitive and suggested misinterpretation of the scale. This second interpretation is in some way supported by an analysis of SWB anxious scores by EQ-5D questionnaire anxiety/depression dimension level, whereby it was observed that some nonanxious/depressed individuals had high SWB anxious scores and some moderately anxious/depressed individuals reported low SWB anxious scores. Therefore, the analysis of the SWB anxiety dimension was included in the article, but the potential interpretations of the results should be done with caution. No relationship between the ordering of the questions (EQ-5D and SWB) and the counter-intuitive answers to them was found.

### Multiple Regression Analysis

Results for each of the models estimated for the four SWB variables are reported in Appendix Tables A1 – A4 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002.

On comparing results for every SWB question, we can observe that all the models displayed some similarities in terms of the significance of coefficients and direction of the effect (note that OLS Lognormal regression for “life satisfaction,” “happiness,” and “life worthwhile” results is expressed in terms of effect on ill health). This result is consistent with the result of the study by Ferrer-i-Carbonell and Frijters [23], who found evidence that the assumptions on cardinality/ordinality of the variable “happiness” make little difference to the statistical significance and qualitative interpretation of the coefficients.

For “life satisfaction,” “happiness,” and “life worthwhile,” the adjusted R² values and pseudo R² values suggest that the EQ-VAS performed better than the EQ-5D questionnaire in explaining SWB in terms of both the index values and its individual dimensions. The models with the best explanatory power, however, were achieved by combining the EQ-VAS and significant dimensions of the EQ-5D questionnaire (see columns “EQ-5D and EQ-VAS” in Appendix Tables A1–A3 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002). This outcome is not observable in the “anxiety” dimension, as it will be explained later.

### Table 1 – Summary descriptive statistics for control variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years since diagnosed</td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>198 (47.5)</td>
</tr>
<tr>
<td>6–10</td>
<td>198 (27.3)</td>
</tr>
<tr>
<td>11–15</td>
<td>198 (15.7)</td>
</tr>
<tr>
<td>16–20</td>
<td>198 (6.1)</td>
</tr>
<tr>
<td>&gt;20</td>
<td>198 (3.5)</td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
</tr>
<tr>
<td>41–50</td>
<td>198 (4.0)</td>
</tr>
<tr>
<td>51–60</td>
<td>198 (15.2)</td>
</tr>
<tr>
<td>61–70</td>
<td>198 (34.3)</td>
</tr>
<tr>
<td>71 or older</td>
<td>198 (46.5)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>196 (60.2)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Beyond leaving school</td>
<td>195 (67.7)</td>
</tr>
<tr>
<td>Household (with whom do you live?)</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>197 (17.8)</td>
</tr>
<tr>
<td>With partner/spouse</td>
<td>197 (76.2)</td>
</tr>
<tr>
<td>With other family members</td>
<td>197 (3.6)</td>
</tr>
<tr>
<td>In care home</td>
<td>197 (1.5)</td>
</tr>
</tbody>
</table>

* Indicates the reference category.

**Table 2 – Distribution of EQ-5D questionnaire responses by dimension and level.**

<table>
<thead>
<tr>
<th>EQ-5D questionnaire profile</th>
<th>No problems (1)</th>
<th>Some problems (2)</th>
<th>Extreme problems (3)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td>45 (23)</td>
<td>150 (76)</td>
<td>1 (1)</td>
<td>196 (100)</td>
</tr>
<tr>
<td>Self-care</td>
<td>100 (51)</td>
<td>92 (46)</td>
<td>5 (3)</td>
<td>197 (100)</td>
</tr>
<tr>
<td>Usual activities</td>
<td>35 (18)</td>
<td>150 (76)</td>
<td>12 (6)</td>
<td>197 (100)</td>
</tr>
<tr>
<td>Pain/Discomfort</td>
<td>53 (27)</td>
<td>126 (64)</td>
<td>18 (9)</td>
<td>197 (100)</td>
</tr>
<tr>
<td>Anxiety/Depression</td>
<td>82 (42)</td>
<td>105 (53)</td>
<td>9 (5)</td>
<td>196 (100)</td>
</tr>
</tbody>
</table>

EQ-5D, EuroQol five-dimensional.

* Values are n (%).
explaining the sense of life being worthwhile. Household situations were again a consistently significant socioeconomic variable, with the same direction of effects as that for “life satisfaction.” The model assuming an OLS Lognormal distribution showed that age above 50 years seems to be directly correlated with life satisfaction, which may suggest that the relationship between life satisfaction and age could be U-shaped—with the minimum occurring around the age of 50 years, as others have also suggested [24]. The same association was shown by the OLS Normal regression but not by the OPM one.

With respect to the models for “happiness” (Appendix Table A3 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002), again the OLS Normal model combining EQ-VAS and EQ-SD questionnaire dimensions explained happiness the best. Similarly to the life-worthwhile models, mobility (level 3) and anxiety/depression (levels 2 and 3) seemed to be the only EQ-SD questionnaire dimensions that could explain part of the happiness. Interestingly, and in contrast to the “life satisfaction” and “life worthwhile” models, living with a spouse or family was no longer significant, perhaps illustrating the multidimensional nature of SWB, and suggesting that having family may be worthwhile, but may not necessarily contribute to happiness. Living in a care home was, however, associated with significantly lower levels of happiness in some of the models, as was true in the other SWB dimensions. Age of the patient was also significant here in some of the models, suggesting again that older patients are more likely than younger ones to report a higher category of happiness, regardless of the number of years since diagnosis.

In the regressions for “anxiety” (Appendix Table A4 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.002), the EQ-SD questionnaire dimension for anxiety/depression was found to be significant, as expected. For instance, under the OLS Normal assumptions, a patient reporting “I am extremely anxious or depressed” will be expected to choose a level of SWB “anxiety” four points higher than a patient reporting “I am not anxious or depressed.” In the same way, having problems with performing the usual activities is associated with higher levels of SWB “anxiety.” Mobility and pain/discomfort were not significant anymore, contrary to what was observed in the previous SWB dimensions. The EQ-VAS, when used as the only health-related control variable, was found to be significant (same as the EQ-SD questionnaire TTO tariff). It was not, however, when used in combination with the EQ-SD questionnaire dummies. Contrary to “life satisfaction,” “life worthwhile,” and “happiness,” EQ-SD questionnaire dimensions performed better than the EQ-VAS in explaining SWB “anxiety.” Living in a care home was associated with significantly higher levels of anxiety in most of the models, in line with the results for other SWB dimensions. To a lesser extent, patients diagnosed more than 20 years ago were associated with lower categories of anxiety.

The regressions for “anxiety” also yielded unexpected results. Being unable to wash or dress themselves was associated with a lower level of anxiety, compared with those with “no problems in self-care today.” This result was observable across the different regression models. Because such anomaly can be read as a potential misinterpretation of the SWB anxious scale by the respondents, these results should be taken with caution.

**Discussion**

The purpose of this study was to examine the strength of the relationship between the EQ-SD questionnaire and SWB as defined and measured by the ONS Integrated Household Survey [14]. The analysis has focused on people with PD, a disease for which the usual measures of HRQOL may fail to capture some of the broader impact of a chronic condition on SWB.

Regression analysis determined that the EQ-SD questionnaire, both its index and dimensions, have a moderate explanatory power for SWB in PD in terms of life satisfaction, life being worthwhile, happiness, and anxiety; adjusted R² values in the OLS models ranged from 0.13 to 0.40 (OLS Normal) and 0.12 to 0.36 (OLS Lognormal). It appeared that some dimensions, in particular self-care and ability to perform usual activities, were fairly redundant in explaining SWB (with the exception of the “anxiety” dimension). In contrast, symptoms such as anxiety/depression and, to a lesser extent, pain/discomfort and mobility were more important. The statistically significant coefficient was typically associated with level 3 and, in some cases, also with level 2. Thus, more severe health states seemed to have a higher impact on the SWB measures, compared with lesser deviations from “full health.” Interestingly, the EQ-VAS performed generally better than the EQ-SD questionnaire index, with adjusted R² values in the range 0.36 to 0.45 (OLS Normal) and 0.32 to 0.49 (OLS Lognormal) for “life satisfaction,” “life worthwhile,” and “happiness.” Combining the EQ-VAS and EQ-SD questionnaire dimensions into one model yielded the best results, with R² values in the range 0.40 to 0.49 (OLS Normal) and 0.36 to 0.53 (OLS Lognormal).

It is interesting to reflect on why the EQ-VAS should have performed better than the EQ-SD questionnaire in predicting SWB. First, if there are any aspects of HRQOL important to people but not reflected in the EQ-SD questionnaire dimensions, then this will act to influence the EQ-VAS, and probably SWB also. Second, as the EQ-VAS is the overall assessment of the individual’s own (experienced) health state rather than the valuation of that individual’s EQ-SD profile by members of the general public, intuitively it will be closer to SWB, which is also self-rated, and may take account of phenomena such as adaptation, which the EQ-SD questionnaire does not reflect.

### Table 3 – Summary descriptive statistics for SWB, the EQ-SD questionnaire index, and the EQ-VAS in PD survey respondents and the general UK population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>PD survey respondents</th>
<th>ONS IHS respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observations</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Life satisfaction</td>
<td>195</td>
<td>6.22 ± 1.96</td>
</tr>
<tr>
<td>Life worthwhile</td>
<td>194</td>
<td>6.58 ± 2.08</td>
</tr>
<tr>
<td>Happy yesterday</td>
<td>195</td>
<td>6.55 ± 2.16</td>
</tr>
<tr>
<td>Anxious yesterday</td>
<td>195</td>
<td>3.98 ± 2.51</td>
</tr>
<tr>
<td>EQ-VAS</td>
<td>190</td>
<td>62.92 ± 18.89</td>
</tr>
<tr>
<td>EQ-SD questionnaire index</td>
<td>193</td>
<td>0.57 ± 0.28</td>
</tr>
</tbody>
</table>

EQ-SD, EuroQol five-dimensional; ONS, Office for National Statistics; IHS, Integrated Household Survey; PD, Parkinson’s disease; SWB, subjective well-being; VAS, visual analogue scale.
Another important finding of the research is that OPM and OLS regressions of SWB look similar in terms of the significance of coefficients and direction of the effect, suggesting that the SWB data, although strictly speaking ordinal, behaves similar to cardinal data on an interval scale, that is, in a linear fashion. This result is consistent with that of other authors such as Ferrer-i-Carbonell and Frijters [23]. As such, it would be tempting to treat SWB as interval data in future research. Dolan [6] supports this view, suggesting that the area under a happiness curve over time could be summed, in the same way that quality-adjusted life-years are derived, although it would not represent the same value as a quality-adjusted life-year. SWB questions, however, are not anchored in the same way as, for example, the EQ-5D questionnaire, that is, by “dead” and “perfect health,” leading to potential problems of interpersonal comparability. Although it is difficult to conceive of anchoring SWB to death, other means of calibrating the scale, for example, the use of SWB vignettes, might be considered in future to address this concern.

The results also suggest that usual measures of HRQOL fail to capture part of the broader impact of disease on SWB. We observe that household composition is an important explanatory factor for all the SWB dimensions. In particular, patients with PD living with partners or relatives are more likely than those living alone to report higher levels of SWB. This result is systematically observed across the models. Thus, the SWB determinant suggested by the OECD as “having someone to count on in times of difficulty” does not seem to be captured by the EQ-5D questionnaire-related measures. It is notable that patients living in care homes systematically report lower levels of SWB than do patients living alone, after controlling for age and years since diagnosis. This finding suggests concerns that should be explored in more detail.

In terms of the SWB “anxious” measure, respondents appeared to have some difficulty interpreting the question, probably given the change in direction of the scale compared with the preceding three SWB questions. Interestingly, in the first release of the SWB data collected by the ONS opinion survey that was made available in December 2011, the SWB anxious scores had a similarly large SD compared with our results, which was also larger than for the other SWB questions (see Table 3). This suggested that respondents to the verbally administered British Household Panel Survey had interpretation difficulties similar to the participants in our study; the format of the question therefore merits some reassessment.

These research findings have several implications. Although the relationship between EQ-VAS, the EQ-5D questionnaire, and SWB in PD was not especially strong, a mapping exercise of EQ-VAS and appropriate EQ-5D questionnaire dimensions onto SWB is not inconceivable if we take the step discussed above and treat SWB as interval-scale data. Brazier et al. [25] noted in a recent literature review of models mapping HRQOL instruments, both disease-specific and generic, that the explanatory power of models, mostly OLS, ranged from a poor 0.17 to 0.71. The OLS models generated in this research fit easily within this range. Such an exercise could potentially yield a wealth of information about the SWB benefits of health care interventions in the past, where EQ-5D questionnaire and EQ-VAS data were originally collected, to inform future SWB-based research and policy.

We should be mindful that the study had several limitations, including the focus on only one disease area, potential selection bias, cross-sectional design due to time constraints, lack of income data collected, the potential focusing effect of the way the happiness topic was presented to participants, and possible problems with participants misinterpreting the SWB anxious scale. Future research should aim to address these limitations, and potentially examine the relationship between the EQ-5D questionnaire and SWB in a more controlled setting and through time—for example, in clinical trials—and in a wider variety of disease areas. Consideration also should be given to mapping the EQ-VAS and the EQ-5D questionnaire index to SWB, as noted earlier. In the longer term, if SWB is to gain further support, then attempts should be made to further standardize its definition, similar to the generic HRQOL measures such as the EQ-5D questionnaire, and its collection should become more routine and widespread. Thought also should be given to anchoring SWB states, as previously mentioned.

Conclusions
The results of this pilot study indicate that the EQ-VAS, in combination with certain dimensions of the EQ-5D questionnaire, particularly anxiety/depression and pain/discomfort, taken together with some demographic variables, can partially explain different SWB dimensions (life satisfaction, life worthwhile, and happiness) both in PD and potentially in other diseases. Nevertheless, and as expected, given the different conceptual basis for the approaches, EQ-5D questionnaire-related measures do not capture all the relevant factors affecting SWB. Evidence is strong that SWB determinants such as “having someone to count on in times of difficulty” or “trust in one’s community” may not be captured by the measures of health or utility typically used in health care decision making. These findings suggest that there may be a role for using SWB, as a complement to conventional generic measures of HRQOL, as a basis for evaluations, where 1) interventions may affect both health and social care outcomes, beyond those captured by measures such as the EQ-5D questionnaire, and 2) where it is important to be able to compare outcomes and resource allocation across different areas of the public sector.

As the interest in SWB as a policy tool gathers momentum, proxies for it may be developed using existing data from generic HRQOL measures such as the EQ-5D questionnaire profile and the EQ-VAS. These conclusions, however, require further substantiation through a larger body of empirical research into SWB and EQ-5D questionnaire/EQ-VAS in other diseases and through time. SWB definitions and measures may require further standardization and refinement to ensure that they provide a valid and appropriate basis for social policies.

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