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Self-rated health and changes in self-rated health as predictors of mortality

– first evidence from German panel data

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Abstract

Background. Studies from several countries have shown that self-rated health is an independent predictor of mortality. However, no empirical evidence exists for Germany so far. We investigate the effectiveness of (i) self-ratings of health by individuals and (ii) changes in self-rated health, as predictors of mortality for Germany.

Methods. A sub-sample of 3,096 respondents, aged 50 years and over, is drawn from the annual collections of data of the German Socio-Economic Panel Study (GSOEP), between 1994 and 1996. Several probit models are estimated in order to analyse the impact of self-rated health and of changes in self-rated health on predictions of mortality.

Results. We find that, while currently self-rated health is shown to be a valid predictor of mortality in Germany, adding previously self-rated health has no effect on explaining the probability of death. Furthermore, one-year changes in self-rated health do not have an additional impact on predicting mortality.

Conclusion. Our results for Germany confirm international evidence. In addition, the assumption that self-rated health reflects trajectories and not only the current level of health can be neglected. This leads us to the conclusion that self-rated health reflects a static rather than a dynamic perspective of health. Therefore, when evaluating a population's state of health, it may be sufficient to rely on self-assessments of health at one point of time instead of using panel data.

Introduction

Compared with medical check-ups carried out by physicians, self-ratings of health are not only extraordinarily cost-effective, but also quick, and able to be distributed efficiently for completion by large population groups. This procedure could, therefore, serve as a simple instrument to help in allocating resources, to justify interventions by health policy, and to predict retirement as well as utilisation of medical care. Rising methodological efforts have been undertaken to enhance cross-population comparability of survey results¹, and self-rated health has become a central indicator for several summary measures of population health used by the WHO for country ratings in its World Health Report. Following the first analysis of self-rated health and mortality², studies from several countries with quite diverse cultural and institutional backgrounds have shown that self-rated health is an independent predictor of mortality.^{3,4} Studies have been carried out in the USA, Canada, Great Britain, Sweden, Finland, Netherlands, Poland, Hong Kong, Japan, Australia, Lithuania, France and China, but not in Germany.

Thus, one objective of our study is to investigate the effectiveness of self-ratings of health by individuals as predictors of mortality in Germany. However, our objective is not only to replicate what has already been done elsewhere, and for which similarly significant results are expected for German data. We also intend to contribute some pieces to the unsolved puzzle of how to interpret the independent impact on predictions of mortality of self-rated health, in the presence of other health variables that have to be taken into account.

Idler and Benyamini give a comprehensive overview of possible interpretations.³ They also discuss the question of whether self-rated health reflects a static or a dynamic perspective of

health. Empirical evidence on this topic is scarce because such studies require at least two measures of self-rated health for the same respondent. So far, only few studies can be found where a measure of change in self-rated health is included.^{3,5,6} Although the effect of self-rated health is found to be weaker than in cross-sectional studies, it is still significant.

A particular interpretation of self-rated health is the “trajectory” hypothesis, which suggests “that poor self-rated health represents respondents’ assessments of their impending decline or doom.” (7, p. S336). To test this hypothesis, Wolinsky and Tierney use a survey in which respondents were asked whether they expected their health to get worse in future.⁷ They find that “the relationship between poor self-rated health and adverse outcomes is not a simple reflection of unmeasured self-assessments of impending decline or doom. Rather, the effects of poor self-rated health and declining health trajectory appear to be independent and complementary” (7, p. S336).

The data that we use come from the German Socio-Economic Panel Study (GSOEP), a representative longitudinal database on German households. The GSOEP provides information on death as well as on self-ratings of health. Our data enable us to construct a measure of changes in self-rated health from self-rated health assessments provided by survey respondents in two consecutive years. Of course, this is different from the trajectory hypothesis as formulated by Wolinsky and Tierney. However, we analyse the effects of changes in self-rated health on predictions of mortality, including questions such as whether currently self-rated health is a sufficient predictor of mortality on its own, or whether *additional* information comes from changes in self-rated health.

Methods

Data source

The GSOEP is a representative longitudinal micro-database that provides a wide range of socio-economic information on private households in Germany. The first collection of data was gathered from about 12,200 randomly selected adult respondents (in 6,000 families) in the former West Germany in 1984. After the German reunification in 1989, the GSOEP was extended by about 4,500 persons (in 2,200 families) from the former East Germany. Annual re-interviews were completed with original panel respondents. Where there were new respondents entering the panel, this was due either to persons moving into a surveyed household or to children who became respondents in their own right at age 16. Respondents who left the panel exited due to death or panel attrition. The panel attrition rate, however, was moderate and over the period of 16 collections of data, it amounted to between three and four % of the respondents from one collection to the next.⁸

The GSOEP also provides information on death, our first central variable, and indicates whether a survey respondent died in a certain year or whether he or she is still alive. This information is collected by interviewers. Information on death in the GSOEP is representative when compared with official statistics.⁹ Since 1984, about 1,000 instances of death have been recorded by the researchers. Our second central variable is self-rated health, which was first included in the GSOEP in 1994. Self-rated health is measured in the GSOEP by the internationally accepted five-point scale question: 'How would you evaluate your present health? Is it (1) very good, (2) good, (3) fair, (4) poor, or (5) very poor?' The GSOEP data are available as a "scientific use" file.^{10,11} Additional information on these data are available from

the German Institute for Economic Research (DIW), in Berlin (at website address <http://www.diw.de/soep>).

We select the data for our analysis from the GSOEP as follows. Firstly, we exclude the GSOEP data from pre-1994 collections, since the question that is central for our study— on self-rated health—was not part of the questionnaires before that year. Secondly, although the question on self-rated health is available for 1997, we cannot use it in our study because we do not have the information on deaths for 1998. Overall, therefore, the information that we need is only available for the collections of GSOEP data gathered for the years between 1994 and 1996, inclusive, and consequently our sub-sample consists of respondents who were interviewed between 1994 and 1996. In addition, we know which of those respondents died in 1997.

We exclude respondents younger than 50 years of age, which is in line with most other studies of self-rated health. We also exclude from the sample foreigners who are living in Germany, because many of them return to their country of origin when they are elderly persons. This means that, in most cases, there is no reliable information on death for such foreigners. In total, our sub-sample consists of 3,096 respondents.

To construct a variable that measures changes in self-rated health, the respondents have to be interviewed in at least two consecutive years. As we are able to study all cases of death in 1996 or 1997, for all respondents who died in 1996 ($n=51$) we use the questionnaires from 1994 and 1995, and for all respondents who died in 1997 ($n=76$) we use the questionnaires from 1995 and 1996. For those respondents who were still alive in 1997 ($n=2,969$) we also use the questionnaires from 1995 and 1996.

The construction of our baseline data is in line with most studies that analyse the impact of self-rated health on predictions of mortality: they use baseline data that are collected from surveys in one year, supplemented by information on whether a survey respondent has died or is still alive in the following year. A recent French study, for example, uses baseline data for a population aged 65 years and over, collected between 1988 and 1990.¹² Data on health status during five years were collected from families, physicians and civil state records. In contrast to this, our data provide information on subjective health for a baseline year and for a second consecutive year. Thus, we can study the impact of changes in self-rated health as predictors of mortality.

Model

Since we have information on self-rated health for two consecutive years, we are able to express currently self-rated health in two different ways. The current self-rated health status that is usually used in studies on mortality can be represented not only as a single measure on its own, but also as the previously self-rated health together with the change in self-rated health between the previous and the current year. Formally, both versions are identical. However, if the latter shows more statistical power in explaining mortality, then it can be argued that changes in self-rated health have an *additional* impact. If, on the other hand, it shows less statistical power, then it would be sufficient to have information on the current self-rated health status only, since no additional predictive power would be obtained from the information on changes in self-rated health.

Our model can be formally represented as follows: Let Y_t^* be the unobserved probability that a respondent will die in year t , with the possible influence of socio-demographic variables X_t and currently self-rated health SR_t :

$$(1) \quad Y_t^* = a + bX_t + cSR_t + \varepsilon$$

where a , b , and c are parameters to be estimated, and ε is the unobservable effects. As stated above, Y^* cannot be observed directly. Instead, we can observe whether a respondent is dead at point of time t ($Y_t=1$); specifically, we note whether he or she died after the last, but before the next questioning, or whether he or she is still alive ($Y_t=0$). Assuming that ε has a standard normal distribution with a mean of zero, all parameters can be estimated by using a simple probit model.¹³ Model (1) is the same as the standard model used by most international studies on this topic³. It is formally identical with the following version, where currently self-rated health SR_t is represented by previously self-rated health SR_{t-1} and changes in self-rated health between the current and the previous year ($SR_t - SR_{t-1}$):

$$(2) \quad Y_t^* = a + bX_t + m(SR_t - SR_{t-1}) + nSR_{t-1} + \varepsilon$$

In Model (2), parameter n measures the impact of the previously self-rated *health status*, and m the impact of *changes* in self-rated health between the past and the current year on predictions of mortality. If the estimated parameter m equals the estimated parameter n , it can easily be seen that only currently self-rated health (SR_t) can help to explain mortality: no *additional* information comes from previously self-rated health. However, we cannot test this in a direct way, because of scaling problems that we will discuss below. Therefore, we rewrite Model (2) as:

$$(3) \quad Y_t^* = a + bX_t + cSR_t + dSR_{t-1} + \varepsilon$$

where c measures the impact of currently self-rated health on mortality, and d equals $(n-m)$ from Model (2). If the estimated parameter d is not significantly different from zero, only the

currently self-rated health status explains the probability of death. In other words, changes in self-rated health would not have an impact on explaining mortality, and current information on self-rated health would be a valid indicator on its own. Model (3) would then be equivalent to Model (1).

For estimation purposes, the five-point rating scale (SR) is broken down into three dummy variables (see Table 1), where the ratings of ‘very good’ and ‘good’ serve as reference categories. This is in line with most of the international studies on this topic.³ We can estimate our Model (2) in two different ways. On the one hand, we can estimate it as formulated in Model (3) because this is just a reformulation of Model (2). Therefore, we can include both currently self-rated health, SR_t , and previously self-rated health, SR_{t-1} . In this case, it should be noted that the parameter estimated for SR_{t-1} , d , should be interpreted as the difference between the parameters n and m from Model (2).

On the other hand, we can estimate Model (2) in a direct way, by including previously self-rated health, SR_{t-1} , as well as the difference between currently self-rated health and previously self-rated health ($SR_t - SR_{t-1}$). However, if we attempt to estimate Model (2) by subtracting one scale from the other, we face the problem of the bounded scale of self-rated health. Moreover, the fact that the scale is bounded from above makes a direct estimation of the impact of declining health trajectories especially difficult. In particular, respondents who rate their health as ‘very poor’ do not have the possibility of rating their health as poorer in the following year. To deal with this problem, we create another five dummy-variables to measure changes in self-rating health:

1. self-rated health decreased by two or more points on the scale;

2. self-rated health decreased by one point;
3. self-rated health increased;
4. a rating of 'very poor' in both years, serving as a control for the scaling problem;
5. no (other) changes in self-rated health, serving as the reference category.

Control variables

To control for some well-known relationships between socio-demographic variables and mortality we also include the following variables (X_i) in all models: gender, age in years, a regional dummy for East Germany, the type of household, information on whether the partner died last year, a subjective measure for loneliness, per capita disposable household income, education and occupational skills. We also include information on functional disability that was provided by the respondents as what can be classified as relatively *objective* health information. In addition, we have information on utilisation of the medical care system, also provided by the respondents. This includes visits to a physician in the last quarter before the survey took place, the number of visits, and information on hospitalisation in the previous year. Studies that make use of utilisation indicators in order to control for objective morbidity are rare.¹⁴ Means, standard deviations and ranges for all variables used in the estimations are shown in Table 1.

[Table 1 about here]

Results

Impact of control variables

Before examining self-rated health variables, it is useful to briefly consider the impact of socio-demographic variables and health measures on predictions of mortality. In our first estimation, all variables except self-rated health variables are included (see Table 1). The estimated relationships between socio-demographic variables such as age, sex, and household composition and the probability of death have the expected signs, and these results show no changes later on, when the self-rated health variables are included. Education and occupational skills are not significant. Most of their effects may, however, have been encompassed by the income variable, which is found to be significantly negative: The higher the disposable per capita income of the household, the lower is the probability of death. The finding that residents from the former German Democratic Republic have a higher probability of death, a probability that even shows an increase after reunification, is a well-known fact.¹⁵ The death of a partner in the previous year does not have an impact on the probability of mortality; neither does reported loneliness of respondents .

As can be seen in Table 1, nearly all of the objective health variables are significant determinants for the probability of death. There are more deaths of respondents who reported disability than of those who did not. Our other health variables measure utilisation of the health care system. Persons who visited a physician in the last quarter before the survey have a lower probability of death. The visit to a physician in the last quarter before the survey took place may be able to be interpreted as an indicator for regular visits, possibly as an example of the utilisation of preventive care. Regular visits to a physician lower the risk of mortality. In contrast to regularity, the frequency of physician contacts is primarily an indicator of

morbidity. Therefore, the more frequent the visits to a physician, the higher the probability of death, and this is also linked with a higher morbidity. Being in a hospital during the previous year does not have a significant influence on mortality, but the number of nights in a hospital leads to a significant increase in the likelihood of death.

Self-rated health and mortality

We start by analysing the effects of currently self-rated health on the respondents' mortality. The results from Model (1) confirm international evidence^{3,4} (see Table 2). The probability of death within the year after having been surveyed is significantly higher for those respondents who reported their health as 'poor' or 'very poor'. The category 'fair' is not significant. The reference category is respondents with self-ratings as 'good' or 'very good'. Moreover, self-rated health seems to be an independent indicator for explaining the probability of death because we include objective information on health (as indicated by functional disability and utilisation of the medical care system). There are only a few changes in sign and significance of these objective health variables, as well as of socio-demographic variables, regardless of whether or not self-rated health indicators are included in the regressions. The LR-test statistic shows that this model is preferable to the model without this information (see Table 2). In other words, the self-rated health variable significantly increases the prediction of mortality.

With regards to the association of previously self-rated health with mortality, it is shown in Table 2 (column 5: "for comparison") that the effect of previously self-rated health is also statistically significant, although not as strong as that of current health assessments. To estimate Model (3) we include self-rated health from both the current and the previous year. The LR-test statistic shows that this model is again preferable to the model without information on self-rated health (see Table 2). It can, however, also be shown that none of the

previously self-rated health variables are statistically significant. The corresponding parameter for previously self-rated health in Model (3) is d , which then is zero. Again, d equals $(n-m)$ from Model (2). Thus, our results suggest that previously self-rated health has no obvious *additional* impact on explaining mortality. Although we have information on self-rated health from the previous year, it may, nonetheless, be sufficient to estimate a model where only currently self-rated health is included. Indeed, the LR-test supports the result that Model (3) contains no additional information for explaining mortality (see Table 2).

[Table 2 about here]

Changes in self-rated health

We now come to the examination of the effect of changes in self-rated health between two successive years, as formulated by Model (2). As noted earlier, this model is theoretically equivalent to Model (3) and, therefore, similar results to those described earlier are to be expected. In the estimates shown by Table 2, changes in self-rated health are explicitly included as explanatory variables for mortality. It can be seen that some of the change variables are significantly different from zero. Given the self-rated health information from the previous year, a decrease in self-rated health by one or two points on the scale is found to increase the probability of death. Again, however, the question is whether this model can give a better explanation, in the sense that changes in self-rated health contribute *additionally* to the version described in Model (1) to the probability of death. In that case, Model (2) would have to be statistically more powerful than Model (1). To determine whether this is the case, we test Model (2) against Model (1) by using an LR-test (see Table 2). Again, we have to reject the hypothesis that changes in self-rated health provide additional explanatory power. Therefore, from all models discussed here, Model (1) is the one preferred.

Discussion

Using data from the German Socio-Economic Panel Study (GSOEP) we confirm that the international evidence for self-rated health as a valid predictor of mortality also applies to Germany. Currently self-rated health seems to be an independent indicator for health status because there are only few changes in significance of objective health variables also included in the regressions. In addition, our data enable us to test the impact of changes in self-rated health as a predictor. We find that, although changes in self-rated health are a valid predictor of mortality, a model where the current self-rated health status alone is included is sufficient. No *additional* information comes from taking into account one-year changes in self-rated health. It is sufficient to know the current self-assessments of health, without needing to know the changes that led to the current status.

This result points out the advantages of self-assessments of health more clearly. By relying on self-assessments of health at one point of time instead of using panel data, a population's state of health can be evaluated even more cost-effective, quick and efficient. Therefore, self-ratings of health is a suitable instrument to evaluate social policy interventions. The fact that currently self-rated health alone is a reliable predictor of mortality enables cross-sectional comparisons at different points of time with a high claim of reliability and validity especially within a country, but also in cross-country comparisons. One-time surveys, which are conducted for purposes other than health aspects and which include no health measure but self-rated health, can now be interpreted also under health specific considerations. This might be the case for surveys with a general focus on the social security system of a country.

Since we have no objective information about declining health status nor do we have information like expectations of being hospitalised or being placed in a nursing home in later years, we cannot prove the trajectory hypothesis.⁷ However, our results support the interpretation that self-rated health reflects a rather static than a dynamic perspective of health.³ Thus, the reason for the independent effect of self-ratings of health on mortality is not that they reflect a dynamic perspective of health. Obviously, self-rated health captures a wider array of the current health status as measured by the objective health variables.

In their comprehensive review of 27 community studies Idler and Benyamini³ discuss several possibilities of how to interpret the consistent results. Our data do not allow for valid interpretations whether self-rated health captures the full array of a person's diseases and possibly even symptoms of yet undiagnosed illness. Nor can we give evidence that self-ratings of health represent complex human judgements about the severity of current illness or that they reflect family history³. Our conclusion, that self-rated health reflects a stationary perception should therefore be verified in further research by using longer time periods of the GSOEP in order to better control for unobserved heterogeneity of the respondents and to increase the number of deaths for higher accuracy of the estimates. Since no additional information comes from taking into account one-year changes in self-rated health, one might think that looking at changes over a longer period of time also has no effect on the prediction of mortality. Using survey information of more than two consecutive years would enable us to verify that our outcome, which is so far restricted to one-year changes, can be generalized to larger periods of time. However, since for most indicators used in our study panel information is not available due to changing survey questions during the considered years, we have to rely on future collections of the GSOEP. In addition, other panel studies, e.g. the British Household Panel Study (BHPS), should be used to further verify our results. Furthermore,

with the increasing importance of this indicator in health economics^{16,17}, future research should also examine whether self-rated health can be used more generally in health economics, e.g. to predict the use of physicians' services or to predict retirement.

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Table 1: Description of variables used in the probit models and probit estimates on mortality

Variable Name	Mean (SD)			Probit estimates on mortality
	Total N=3,096	Men N=1,384	Women N=1,712	Parameter (Std. Error)
Died (1996 or 1997) (dependent variable)	0.04	0.05	0.04	
Socio-demographic variables				
Female (D)	0.55	-	-	-0.3076** (0.1125)
East (former GDR) (D)	0.36	0.36	0.36	0.3292** (0.1027)
Age in years	65.63 (8.9)	64.32 (8.2)	66.69 (9.3)	0.0532** (0.0056)
Married couple (D)	0.54	0.65	0.46	-0.1932 (0.1302)
Couple with children (D)	0.18	0.22	0.15	0.0084 (0.1759)
More generation household (D)	0.05	0.04	0.06	0.1204 (0.1848)
Living alone (D) (reference category)	0.23	0.09	0.33	-
Partner died last year (D)	0.01	0.01	0.01	-0.3431 (0.5870)
Feeling very lonely (D)	0.09	0.07	0.11	0.2305 (0.1404)
Per capita income in DM	1589 (797)	1598 (893)	1581 (711)	-0.0002* (0.0001)
High school degree (D)	0.10	0.15	0.06	0.2001 (0.1701)
No occupational skills (D)	0.25	0.09	0.38	0.1501 (0.1150)
Health variables				
Functionally disabled (D)	0.26	0.32	0.21	0.4803** (0.1025)
Visiting physician last quarter (D)	0.84	0.81	0.86	-0.2631 (0.1441)
Number of physician visits	4.24 (5.8)	4.18 (6.3)	4.28 (5.4)	0.0209** (0.0062)
Hospitalised previous year (D)	0.16	0.16	0.16	0.1563 (0.1456)
Number of hospital nights	3.73 (13.8)	4.01 (14.9)	3.51 (12.8)	0.0116** (0.0027)
Self-rated health (D)				
Current year very good	0.02	0.02	0.02	-
Currently good	0.22	0.24	0.20	-

Currently fair	0.46	0.46	0.45	-
Currently poor	0.24	0.21	0.25	-
Currently very poor	0.07	0.07	0.08	-
Previous year very good	0.02	0.03	0.02	-
Previously good	0.25	0.27	0.23	-
Previously fair	0.44	0.45	0.43	-
Previously poor	0.23	0.20	0.25	-
Previously very poor	0.06	0.05	0.07	-
Decrease 2 ^{a)}	0.03	0.03	0.03	-
Decrease 1 ^{b)}	0.22	0.23	0.22	-
Increase ^{c)}	0.21	0.20	0.21	-
Both very poor ^{d)}	0.03	0.03	0.04	-
No changes in self rated health	0.51	0.51	0.50	-
Log-Likelihood	-	-	-	-412.52

Source: German Socio-Economic Panel Study (GSOEP), collections 1994–1997

The sub-sample includes respondents with interviews in at least two consecutive years between 1994 and 1996, respondents younger than 50 years of age and foreigners excluded.

Note: D is a Dummy variable coded 0,1.

^{a)} Self-rated health decreased from previous year to current year by two or more points on the scale.

^{b)} Self-rated health decreased from previous year to current year by one point on the scale.

^{c)} Self-rated health increased from previous year to current year on the scale.

^{d)} Self-rated health was very poor in the previous year as well as in the current year.

* Statistically significant at the 5% level, ** at the 1% level .

Table 2: Probit estimates on mortality including information on self-rated health (SRH)

(Total: N=3,096)

	Model (1)	Model (2)	Model (3)	For comparison:
	Only currently SRH	Change in SRH and previously SRH	Currently and previously SRH	Only previously SRH
Variable	Parameter (Std. Error)	Parameter (Std. Error)	Parameter (Std. Error)	Parameter (Std. Error)
Previously fair	-	0.4651** (0.1609)	0.2116 (0.1570)	0.2769* (0.1493)
Previously poor	-	0.5939** (0.1886)	0.0870 (0.1838)	0.3135* (0.1664)
Previously very poor	-	0.9124** (0.3100)	0.3728 (0.2175)	0.7533** (0.1900)
Decrease 2	-	0.5874* (0.2586)	-	-
Decrease 1	-	0.4135** (0.1277)	-	-
Increase	-	-0.0725 (0.1599)	-	-
Both very poor	-	0.4010 (0.3005)	-	-
Currently fair	0.1482 (0.1647)	-	0.0988 (0.1716)	-
Currently poor	0.4705** (0.1732)	-	0.4140* (0.1882)	-
Currently very poor	0.8503** (0.1985)	-	0.7188** (0.2252)	-
Log-Likelihood	-399.40	-395.69	-396.91	-404.19

χ^2 (df)- LR-Tests:	Model without information on self-rated health versus Model (1): 26.24(3)**
	Model without information on self-rated health versus Model (3): 31.22(6)**
	Model (3) versus Model (1): 4.98(3)
	Model (2) versus Model (1): 7.24(4)

Source: German Socio-Economic Panel Study (GSOEP), collections 1994–1997.

The sub-sample includes respondents with interviews in at least two consecutive years between 1994 and 1996, respondents younger than 50 years of age and foreigners excluded.

The models have been adjusted for the following control variables: Female, East, Age, Married couple, Couple with children, More generation household, Living alone, Partner died last year, Feeling very lonely, Per capita income, High school degree, No occupational skills, Functionally Disabled, Visiting physician last quarter, Number of physician visits, Hospitalised previous year, Number of hospital nights.

* Statistically significant at the 5% level, ** at the 1% level .