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Summary

Background: Researchers can rely on either on retrospectively reported or on prospectively measured health changes to identify and quantify recent changes in respondents' health status. The two methods typically do not provide the same answers. This paper compares the criterion validity of prospective versus retrospective measures of health changes by investigating their predictive power for subsequent mortality.

Methods: Data are drawn from the GLOBE study, a prospective cohort study conducted in the Netherlands. We compare the ability of changes in self assessed health (SAH) - reported retrospectively and measured prospectively for 1991, 1993 and 1995 - to predict mortality until 2004. Proportional hazard models with frailty are used to model the relationships between health changes and mortality, before and after controlling for a set of pre-existing chronic conditions and the onset of new chronic diseases.

Results: For a high proportion of reports (39.8 %), prospectively measured health changes in SAH do not concur with retrospectively reported health changes. Controlling for a set of chronic conditions, the onset of new chronic conditions and unobserved characteristics, prospectively reported health changes still predict longevity over and above health levels, whereas retrospective changes do not.

Conclusions: We find that prospectively registered changes in SAH are better predictors of mortality than retrospectively reported health changes. These results suggest that longitudinal collection of health change information has advantages over the - easier and cheaper – option of retrospective data collection.

Keywords: Mortality, self-assessed health, predictive validity, prospective change, retrospective change.

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1 Introduction

It is well known that self-assessed health (SAH) at one point in time has substantial predictive power for behavior including medical care utilization, labor force participation, as well as for subsequent health outcomes, like survival prognosis, even after controlling for other, more objective, health indicators.[1-4] Much less is known about the predictive value of health *dynamics*, i.e. changes in SAH. In many instances, researchers are interested in such changes, especially the negative ones – often referred to as ‘health shocks’ – because these may be equally (or even more) important precursors of later outcomes as (than) health levels. They are also indicators of the degree of volatility or persistence of health status. The two questions that we seek to answer are: (a) do changes in health levels have predictive ability over and above the information contained in health level itself?; and, if so, (b) how can such changes best be elicited?

A priori, the answer to the first question ought to be affirmative, and this can easily be seen from the graph in Figure 1, which depicts health trajectories for two hypothetical individuals A and B. Clearly, the information about a difference in the level of health at time t+1 has predictive power for the likelihood of each person’s health falling below a critical level. If all else is equal, including the health level at t, then person A, with the lower health at t+1, is likely to reach the minimal critical health level sooner and exhibit shorter expected survival. In the particular case depicted, knowing that both persons started off at the same health in t will lead to very different predictions of future health paths than knowing that they were already in different health states at t and moved along parallel trajectories between t and t+1 (such as A’ and B). It seems therefore obvious that information on the latest health changes will add to the information on health levels.

[Insert Figure 1 here]

Regarding the second question, there are basically two main approaches to eliciting health changes from self-reports. The first and easiest option is to simply ask *retrospective* questions about health changes: respondents then rate their health compared to a reference point in the past. This health transition question asks respondents to rate their general health compared with a previous period, with three response categories: “better”, “same”, and “worse”. It represents a simple and straightforward way of obtaining health change information from cross-sectional surveys when there is no opportunity to follow respondents over time. However, it only provides a proper alternative to the prospective, longitudinal collection of health change data, if the information obtained is similar, if not identical. However, it has been shown that retrospectively reported health changes between point 1 and 2, assessed at point 2, do not always concur with prospectively assessed changes between point 1 and 2 in time.[5] The question then becomes: which of the two contains more meaningful information?

The literature on this subject is surprisingly thin. In spite of an abundance of studies reporting the predictive ability of SAH for mortality, there are very few that have done this for health changes. Some studies have investigated the effect of changes on expectations about survival[5] or other adverse outcomes[6] rather than actual mortality. We could only find one (unpublished) study examining the effect of changes in SAH in addition to levels. Using data from the German Socio-Economic Panel, Schwarze et al. found that mortality was not only affected by the level of SAH but also by changes compared to a previous year.[7] On the other hand, the only study we could find which analyzed simultaneously the effect of SAH and retrospectively reported health declines, found only the latter to be significant.[8] Comparisons of the predictive ability of self-reported retrospective versus prospective changes are even more rare. Benitez-Silva and Ni have done such a comparison using data from the US Health and Retirement Survey (HRS) but again for longevity expectations as outcome measure, rather than actual mortality.[5] Their results have favored the use of retrospectively reported health changes instead of prospectively computed changes in SAH. However, their outcome variable has been shown elsewhere to be noisy and subjective itself.[9]

In this study, we exploit the simultaneous availability of four waves (1991-92-93-95) of longitudinal health data from the GLOBE study[10] and a mortality follow-up until 2004 to examine and compare the criterion validity of alternative measures of health levels and changes for predicting mortality. These health measures include the level of SAH, computed changes in SAH, retrospective assessments of health changes, a set of self-reported chronic conditions and changes in self-reported chronic conditions. They enable us to answer the two main questions of this study. First, is there any value added of including retrospective/prospective health changes for mortality prediction, over and above health levels? Second, are prospectively and retrospectively reported health changes equally predictive of subsequent mortality?

2 Methods

2.1 Study population

Our data were taken from the longitudinal GLOBE study that was conducted since 1991 in a region in the Southeast of the Netherlands. The study is based on a cohort of non-institutionalized Dutch nationals, aged 15-74 years, living in the city of Eindhoven and surroundings. More information on the design and objectives of the GLOBE study can be found elsewhere.[10] A baseline random sample of approximately 27.000 individuals (stratified by age and postal code) was drawn from the population registries of the participating municipalities. These individuals received a postal questionnaire in the Spring of 1991, which had a response rate of 70.1% (n = 18973).

Two sub-samples drawn from the baseline sample were re-interviewed in the autumn of 1991 and in subsequent years. The first subsample, hereafter called the “healthy sample”, was randomly drawn from the baseline sample (n = 2800). These individuals were re-interviewed in 1993, 1995 and 1997. In the second subsample, which we call the “frail sample”, individuals who reported to have at least one of four chronic conditions (asthma, severe low back pain complaints, diabetes mellitus and heart disease) were overrepresented (n =2867). The frail sample was re-interviewed annually in 1992-1995 and 1997. In our analysis, we only use data from years in which both samples were interviewed (so, we exclude 1992 and 1994) and for which the main variables of interest were available. This means that we further exclude data from 1997 as none of the samples was asked to report retrospective health changes in this year. For the same reason, we use the 1991 wave only to compute prospective changes in SAH between 1991and 1993. In the analyses presented in this paper, we pool the healthy and the frail samples in order to increase the sample size. Dropping cases with missing values for at least one of the variables used in the analyses leaves us with a total of 6148 observations (3242, in 1993, and 2906, in 1995), of which 3238 belong to the healthy sample (1705, in 1993; 1533, in 1995) and 2910 to the frail sample (1537, in 1993; 1373, in 1995).

The GLOBE dataset was augmented through linkage to the national register of cause-of-death, until the end of 2004. During the follow-up period of 11 years, 8.6 % (282/6148) of the respondents in our sample died.

2.2 Measures

We use several measures of health levels and of health changes in our analysis. The main measure of health level is derived from the standard question: "How is your health in general?" with response categories very good, good, fair, sometimes good/sometimes poor and poor. Further measures of health levels are whether individuals suffer from a range of chronic physical and mental conditions, described in detail below.

The *retrospective health change* variable is the directly reported change in respondent's health compared to a previous year (cf below). Response categories are "health remained the same", "health has improved" and "health has worsened". In 1995, respondents in the frail sample were asked to compare their health to that one year before, while for the healthy sample the reference period was two years. In 1993, the reference period was two years for both samples. Since we use the pooled sample in our analysis, we tested whether our results are sensitive to consideration of a different reference period for 1995 for the frail sample. This was done by including in the model interaction terms between an indicator of these observations and the indicators of reported changes. These interaction terms were jointly not significant (p-value=0.395), supporting our use of the pooled sample. We compute *prospective health changes* (better, same or worse) as the difference between currently and previously reported SAH. Better or worse computed changes reflect jumps of one or more health categories between waves. The reference periods considered for the computation of prospective health changes are consistent with those described above for reported health changes. A set of interaction terms between an indicator of observations from the frail sample in 1995 and indicators of computed changes was also jointly not significant (p-value=0.334).

Several recent papers have favored the use of prevalence[11] or the onset of new chronic conditions[12-14] as arguably more objective indicators of health and health changes than those derived from self-assessed health and self-reported (prospective or retrospective) health changes. The GLOBE data also provide information on the presence of self-reported chronic physical and mental conditions, and whether they were diagnosed during the 12 months prior to the survey. We are therefore able to assess whether the association between self-assessed health - and retrospective/prospective health changes - and mortality can be explained by prevalence and onset of these conditions. We use information on fourteen conditions: high blood pressure, back pain / problems, diabetes, heart diseases, stroke, cancer, anchylosis, rheuma, lung diseases, stomach diseases, nervous diseases, intestine diseases, skin diseases. Additional emotional and mental health information is taken from Nottingham Health Profile questions (we consider an indicator of presence of at least 1 emotional or mental problem). We use both prevalence and onset of new chronic conditions between waves.

Since we are interested in the effects of health changes (i.e., self-reported retrospective/prospective and onset of chronic conditions) controlling for health levels, we need to define these in a consistent manner. Note that the effects of a health change can be obtained in two different ways, as the effects of: *i)* current health, H_2, controlling for previous health, H_1; or *ii)* a health change, H_2 - H_1, controlling for previous health, H_1 (it can be easily shown that $a.H_2 + b.H_1 = a.(H_2 - H_1) + (a+b).H_1$, i.e., that the effect of (H_2 - H_1) in *ii)* equals the effect of H_2 in *i)*). Since retrospective changes are a direct measure of changes, H_2 - H_1, and for comparative purposes, we opted for option *ii),* rather than *i)*, to evaluate effects of all health changes. We have therefore considered previous health levels (self-assessed health and prevalence of chronic conditions) observed at the reference point in time for health changes (that is, two years ago for both the sub-samples in 1993 and for the healthy sub-sample in 1995; and one year ago for the frail sample in 1995), rather than current levels. If, on the other hand, the model included (H_2 - H_1) and H_2, then the effect of the former could not be interpreted as that of a health change because $a.(H_2 - H_1) + (a+b).H_1 = -b.(H_2 - H_1) + (a+b).H_2$, ie, the latter effect of (H_2 - H_1) does not equal that of the other two options and will, in fact, be of the opposite sign if effects of current and previous health levels are of the same sign in *i),* which is a reasonable expectation.

We also included two indices based on activities of daily living (ADL). The first is an ADL index and is simply a sum score of problems with the following activities: move at the same floor, get in/out of bed, eat and drink, getting (un)dressed, washing face/hands, washing completely. The second is an index of mobility problems, which adds up indicators of difficulties with each of the following activities: walking down/up stairs, moving outdoors, leaving/entering house, sitting down/getting up from chair.

We also control for the following demographic and socioeconomic characteristics, gender, marital status (unmarried, married, divorced, widowed), education (at most primary, low vocational, middle education, high education), working status (employed, unemployed, disabled, retired, housework, student, living from investments) and income (low, middle, high). GLOBE respondents reported their total monthly household income in 13 categories ranging from '0-1000 guilders' to 'above > 5800 guilders' (the guilder – 1 guilder = 0.45€ - was the currency in The Netherlands during the period under analysis). We consider values under 1900 guilders as low income (first four categories), 1900-3500 as middle income (5^{th} to 9^{th} categories) and more than 3500 as high income. All demographic and socioeconomic characteristics are measured both in 1993 and 1995, except for education (measured only at the baseline). Descriptive statistics for all variables used in the analyses are shown in Table 1.

[Insert Table 1 here]

2.3 Statistical Analysis

To estimate the relationship between prospective and retrospective health changes and age at death (in full years), we use the Gompertz proportional hazards model. The Gompertz model is the most commonly used in the biological and medical literature modeling mortality (see Balia and Jones[15] for a comparison favoring this over alternative models for mortality). Since we observe the same individuals over two waves, our data exhibits within-individual variation in the mortality determinants – health levels/changes and socioeconomic characteristics. This makes it possible to use two observations per individual, which is appealing in two respects. First, we almost double our sample size. We should note the necessary transformation in the dependent variable. This equals, for the first period, age at death as observed in that period, i.e.: actual age at death, if it occurred until the end of the period, and age by then, otherwise.[16] Similarly, in the second period, in which only survivors are observed, the dependent variable equals the age at death, if that occurred until the end of follow-up period, and age by then, otherwise.[16] Secondly, we are able to account for the effects of unobserved time-constant factors (e.g. childhood conditions, genetic factors, family history or *frailty*), which may influence the intrinsic propensity to die at any moment in time, over and above the effects of observed time-varying factors. This acts as multiplicative effect on the Gompertz hazard, assumed to follow a Gamma distribution.[16]

The association between retrospective/prospective health changes and mortality is first examined controlling for SAH level and socioeconomic characteristics only. We estimate two separate models, each including either retrospective or prospective health changes, and compare the magnitude and significance of their hazard ratios, as well as the overall fit of the models. Secondly, we control for a set of other - arguably more objective - indicators of health levels and changes: the prevalence and onset of new chronic conditions, and ADL and mobility problems indices. This makes it possible to assess whether the association between retrospective/prospective health changes can be explained by these additional indicators or, on the contrary, those measures of health changes carry extra information relevant for mortality.

3 Results

Table 2 presents a comparison between prospectively computed and retrospectively reported health changes. The proportion of cases reporting no health change is about 60% for the prospective measure, while the remaining cases report better or worse health in equal shares. A more sizeable share (80%) reports the same health retrospectively (about 11% report and improvement and 9% a deterioration). Observations located on the diagonal represent consistent reports across measures (only 60.2% of cases). Inconsistent reports (39.8%) could reflect noise in one (or both) of the measures. The most serious violation of consistency occurs when according to one of the measures health has improved whereas according to the other health has deteriorated (2.72%). On the other hand, in 8.97% of cases the prospective health measure identifies no change, while the retrospective measure does. Table 2 also shows the proportions of people who died during the follow-up period by prospective and retrospective health changes. These descriptive statistics do not however, show a smaller risk for those whose health improved than for those whose health remained the same. Our hazard regression analysis will assess whether these relationships hold when controlling for a number of other mortality determinants, and considering full survival, rather than just a binary indicator.

[Insert Table 2 here]

Hazard regression results for SAH levels and health changes are shown in Table 3 for the two alternative models considering prospectively computed or retrospectively reported changes. The first row shows results of the model controlling only for health changes, SAH levels and demographic and socioeconomic characteristics. A hazard ratio of one indicates that a variable has no effect on mortality. A hazard ratio of more/less than one indicates that a variable is associated with higher/lower mortality. As widely observed in the literature[1-4], we obtain a strong effect of SAH on longevity: being in the fair to bad categories compared to the very good health category significantly increases the hazard of dying. Over and above the SAH level, a prospective SAH change also affects mortality. Respondents with a *prospective* decline in their health are about twice as likely to die as those prospectively reporting an improvement (hazard ratio=2.13). For individuals who *retrospectively report* a health decline, the hazard of dying is 1.83 higher than for those reporting a health improvement. The mortality hazard for those remaining in the same SAH level (compared to the previous period) is significantly higher than for those moving into better SAH, while those who retrospectively report the same health are not more likely to die than those who report an improvement.

The second row of Table 3 presents results for the full model which controls, in addition, for prevalence and onset of chronic conditions and ADL indices. As expected, the effects of SAH levels as well as of both measures of health changes on mortality are lower in the full model. However, only the effect of a retrospectively reported health deterioration becomes insignificant, while the hazard ratio for a prospectively computed health deterioration remains significant (CI: 1.15- 2.42). These results suggest that the measure of prospectively reported changes in SAH between waves has superior predictive ability for longevity than retrospective reports. Goodness of fit of both models improves with the inclusion of prevalence and onset of chronic conditions: the Akaike Information Criterion (AIC) improves from 417.71 (422.84) to 355.60 (355.70) for reported (computed) changes. The full model with retrospective reported changes provides a very close fit to the one with prospective changes in SAH. Table 4 shows further results of the full models, namely, the association between prevalence/onset of chronic conditions and mortality. Having heart disease and cancer, suffering the onset of high blood pressure, cancer and lung diseases, and having more mobility problems increases the risk of dying.

Insert Tables 3& 4 here]

4 Discussion

In this paper we have examined (a) whether, over and above the level of health itself, reported changes in health still contribute significantly to better prediction of survival outcomes, and (b) how this predictive ability compares between retrospectively reported and prospectively measured changes in SAH over time. We answer these questions using data from a unique Dutch survey which couples longitudinal measurement of health reporting over several waves of a panel with mortality follow up over a period of 11 years. Our findings confirm our expectation that information regarding recent health changes carries additional information to that contained in the reported health level. This is even true after controlling for both the prevalence and the onset of a large set of chronic conditions.

Our study adds to the relevant literature in a number of important respects. First, the simultaneous availability of several waves of longitudinal subjective and objective health data, of retrospectively reported health changes and of a fairly long (11 years) mortality follow-up allowed a proper comparative assessment of survival prediction. Secondly, by using appropriate survival modeling strategies for panel data, we were able to account not only for observed determinants of mortality but also for unobserved time-invariant factors (such as frailty, influence of childhood conditions, genetic factors or family history) which may influence the intrinsic mortality risk. Thirdly, we focus on the dynamic effects of health changes, while most previous studies have focused on baseline static characteristics only. Finally, we were also able to control for a battery of self-reported more objective measures of health levels and changes, often alleged to carry more valuable information about mortality risk.

We observe that for a large proportion of individuals, prospective health changes are not consistent with retrospective health changes. Reporting no retrospective health change at the same time as a prospective health change could be, for example, due to recall bias in the retrospective measure, or to the same true level of health being considered as better/worse when evaluated at a later period. But some inconsistencies could be merely a reflection of the different nature of the measures. For example, cases with no prospective health changes and with some retrospective health change could mean that health changes captured by the latter measure are not large enough to cause a category jump in SAH, suggesting that retrospective changes may be more informative than prospective changes. In particular, prospective changes may suffer from floor and ceiling effects: for individuals in the lowest/highest category, this measure captures no change if their health deteriorates/improves further. To minimize this problem, we add indicators of whether individuals reported the top or bottom category in both periods in our models. These indicators were not significant in our models and so we report results of models that do not include them.

The main findings can be summarized as follows. First, our findings confirm our prior expectation that ratings of self-reported health do not entirely capture the information contained in changes (and *vice versa*): recent health changes do have predictive power for subsequent survival over and above the effects of current self-reported (subjective) health indicators, as well as over presence and onset of chronic conditions. This suggests that health variability itself, over and above the level of health around which this variability occurs, is a risk factor. Our results are consistent with those of a previous study showing that SAH and corresponding health trajectories have an independent effect on mortality.[7]

Secondly, we find that prospectively reported changes in SAH over time have higher predictive power for mortality risk than retrospectively reported health changes. It therefore rejects the hypothesis that the collection of retrospective health information is a cheaper and simpler alternative to the more expensive and cumbersome prospective collection of longitudinal health data. Moving from longitudinally measured prospective changes to cross-sectional retrospective changes leads to some loss of information about mortality risk.

A recent study favored the use of retrospective self-reported health changes, after showing that this measure predicts subjective longevity expectations better than prospective SAH changes.[5] Our results are strikingly different. This could partly be due to the use of a different outcome variable. In particular, there is some evidence to suggest that subjective longevity expectations are subject to bias.[9] In addition, unlike in our study, that analysis has not controlled for the level of health in a manner consistent with the prospectively computed measure, and therefore the resulting effect cannot be interpreted as one of a health change (as shown above in section 2.2).

While our study offers a number of important advances over earlier research, it does, nonetheless, still suffer from some limitations. One obvious limitation is the use of all-cause mortality as our main outcome measure. Clearly, not all ill health is fatal and leads to higher mortality, while other causes of mortality (like accidents) are not health-related. We were unable to exclude mortality from causes clearly unrelated to prior health evolution. However, while such exclusion might further improve the predictive ability of SAH levels and changes, it is unlikely to affect the comparison between retro- or prospectively measured changes. The formation of perceptions of health may involve a number of cognitive processes, such as recall of relevant experience and evaluation of relevant information, which may be dependent on cognitive ability. Unfortunately, our data does not include measures of cognitive ability, and so we were unable to assess its role in the predictive ability of health change measures for mortality.

We believe our results have important implications for future research on the relationship between levels of (and changes in) SAH and adverse health outcomes Understanding the underlying mechanisms driving the strong relationship between levels and changes of SAH with mortality remains an important question. We leave this research subject for future agenda.

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Conflict of Interest: None declared.

KEY MESSAGES:

- Prospective changes in SAH are a strong predictor of mortality over and above SAH levels.
- Prospective changes in SAH predict subsequent mortality after controlling for a battery of indicators of prevalence of and onset of chronic conditions, whereas retrospective changes do not.

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Figure 1: Health trajectories of hypothetical individuals a, a' and b.

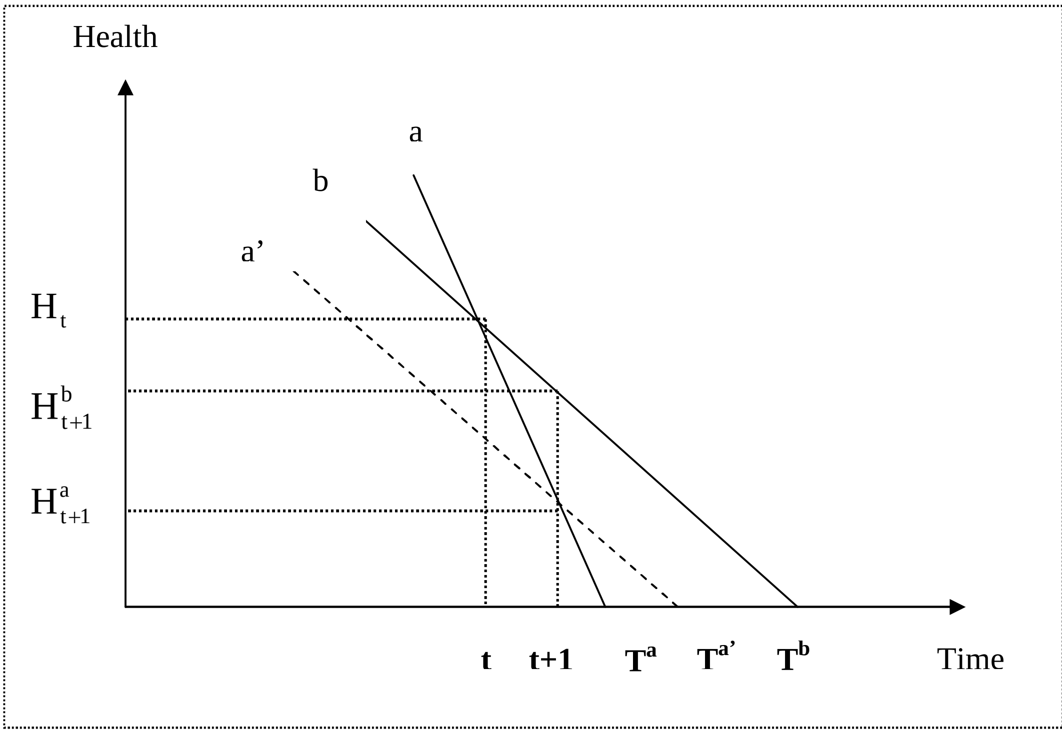

Table 1: Descriptive statistics of health measures and socio-demographic variables.

Variable	Mean	St. Dev
Survival Variables		
Life time (number of years lived by 2004)	59	15.3
Death (1 if has died by 2004, 0 alive)	0.086	0.282
Age in 1993	53	14.89
Age at death	67	8.44
Independent Variables		
Current SAH very good	0.170	0.375
Current SAH good	0.572	0.495
Current SAH fair	0.165	0.371
Current SAH som. good / som. poor	0.080	0.271
Current SAH poor	0.013	0.114
Previous SAH very good	0.171	0.377
Previous SAH good	0.577	0.494
Previous SAH fair	0.162	0.368
Previous SAH som. good / som. poor	0.076	0.265
Previous SAH poor	0.014	0.115
Self reported health change better	0.088	0.283
Self reported health change same	0.805	0.397
Self reported health change worse	0.108	0.310
Computed health change better	0.192	0.394
Computed health change same	0.648	0.478
Computed health change worse	0.195	0.396
High blood pressure	0.117	0.322
Diabetes	0.051	0.220
Cancer	0.017	0.128
Heart Diseases	0.047	0.211
Stroke	0.005	0.071
Lung Diseases	0.096	0.295
Serious Intestine Diseases	0.016	0.127
Stomach Diseases	0.015	0.123
Nervous System Diseases	0.008	0.090
Skin Diseases	0.074	0.262
Ankylosis	0.115	0.320
Rheuma	0.027	0.164
Back Pain / Problems	0.151	0.358
NHP Mental Health Problems (0,1)	0.252	0.434
ADL index (0-6)	0.290	0.885
Mobility problems index (0-4)	0.430	0.931
Male	0.537	0.499
Primary or < primary education	0.170	0.376
Low vocational education	0.219	0.413
Middle education	0.405	0.491
High Education	0.200	0.400
Employed	0.402	0.490
Unemployed	0.038	0.190
Disabled	0.069	0.254
Retired	0.229	0.420
Housework	0.224	0.417
Living from investments	0.007	0.086
Student	0.029	0.168
Married	0.740	0.439
Divorced	0.055	0.228
Widowed	0.056	0.230
Single (Never Married)	0.149	0.356
High Income	0.384	0.486
Middle Income	0.445	0.497
Low Income	0.170	0.376
N	6148	

Table 2: Comparison of prospectively computed with retrospectively reported health changes and proportions dying during follow-up through 2004 by category of health change.

Prospectively Computed Health Changes	Retrospectively Reported Health Changes Better	 Same	 Worse	Total # of Observations	Proportion dying during follow-up
Better	3.05%	**14.68%**	**1.36%**	1175	9.10%
Same	*4.35%*	52.42%	*4.61%*	3775	7.07%
Worse	**1.36%**	**13.35%**	4.76%	1198	11.60%
Total # of Observations	540	4947	661	6148	
Proportion dying during follow-up	9.07%	6.46%	21.78%		8.6%

Table 3: Mortality effects of health levels and changes: hazard ratios and 95% confidence intervals.

Controls		Prospectively Computed Health Changes			Retrospectively Reported Health Changes		
			Hazard Ratio	95% CI	Hazard Ratio	95% CI	
SAH and changes only	SAH	SAH good	1.333	(0.84-2.12)	1.112	(0.71-1.74)	
		SAH fair	2.884***	(1.74-4.78)	1.978***	(1.22-3.22)	
		SAH som. g/p	4.138***	(2.29-7.47)	2.308***	(1.33-4.01)	
		SAH poor	11.72***	(5.46-25.16)	5.358***	(2.65-10.83)	
	Changes	Same	1.386*	(0.99-1.94)	0.860	(0.55-1.35)	
		Worse	2.132***	(1.45-3.13)	1.833**	(1.11-3.03)	
		log L: -189.42	AIC: 422.84	BIC: 570.77	log L: - 186.85	AIC:417.71	BIC:565.64
SAH and changes plus prevalence and onset of chronic conditions	SAH	SAH good	1.119	(0.71-1.77)	1.025	(0.65-1.62)	
		SAH fair	1.655*	(0.97-2.83)	1.363	(0.81-2.30)	
		SAH som. g/p	1.699	(0.89-3.23)	1.255	(0.68-2.33)	
		SAH poor	3.359***	(1.43-7.90)	2.268**	(0.99-5.20)	
	Changes	Same	1.210	(0.87-1.68)	0.950	(0.60-1.50)	
		Worse	1.667***	(1.15-2.42)	1.542	(0.90-2.61)	
		log L: -125.85	AIC: 355.70	BIC: 705.34	log L: -125.80	AIC:355.60	BIC:705.24

Notes: 1. Chronic conditions include: high blood pressure, back problems, diabetes, heart diseases, stroke, cancer, anchylosis, rheuma, lung diseases , stomach diseases, nervous diseases, intestine diseases, skin diseases, mental health;
2. Other controls: male, education (low, middle, high), working status (unemployed, disabled, retired, housework), marital status (married, divorced, widowed), income (middle, high), number of ADL'S, number of mobility problems.

Table 4: Mortality effects of prevalence/onset of chronic conditions: hazard ratios and 95% confidence intervals.

	Prospectively Computed Health Changes		Retrospectively Reported Health Changes	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Prevalence (in previous period) of:				
High blood pressure	1.29	(0.94-1.76)	1.27	(0.92-1.76)
Back Pain / Problems	0.58	(0.40-0.85)	0.59	(0.40-0.87)
Diabetes	1.53	(1.03-2.27)	1.60	(1.07-2.39)
Heart Diseases	2.18	(1.53-3.09)	2.19	(1.53-3.15)
Stroke	1.07	(0.46-2.49)	1.14	(0.47-2.75)
Cancer	2.25	(1.21-4.16)	2.20	(1.16-4.20)
Ankylosis	0.59	(0.39-0.88)	0.56	(0.37-0.86)
Rheuma	1.01	(0.52-1.96)	1.02	(0.52-2.01)
Lung Diseases	1.30	(0.90-1.86)	1.27	(0.88-1.85)
Stomach Diseases	1.20	(0.59-2.42)	1.17	(0.57-2.42)
Nervous System Diseases	1.55	(0.72-3.37)	1.60	(0.70-3.66)
Intestine Diseases	1.06	(0.54-2.09)	1.05	(0.52-2.13)
Skin Diseases	0.95	(0.52-1.72)	0.90	(0.49-1.67)
NHP Mental Health Problems	1.25	(0.91-1.72)	1.22	(0.88-1.70)
Onset of (in current period):				
High blood pressure	0.53*	(0.27-1.07)	0.59	(0.30-1.18)
Onset Back Pain / Problems	1.30	(0.79-2.14)	1.26	(0.76-2.12)
Onset Diabetes	0.90	(0.36-2.25)	0.91	(0.36-2.31)
Onset Heart Diseases	1.01	(0.55-1.87)	1.01	(0.54-1.89)
Onset Stroke	1.30	(0.41-4.13)	1.55	(0.49-4.91)
Onset Cancer	5.70	(2.97-10.95)	5.81	(3.04-11.10)
Onset Ankylosis	0.74	(0.41-1.33)	0.74	(0.41-1.36)
Onset Rheuma	0.53	(0.20-1.39)	0.49	(0.18-1.31)
Onset Lung Diseases	3.00	(1.75-5.14)	3.06	(1.77-5.31)
Onset Stomach Diseases	1.52	(0.53-4.37)	1.52	(0.52-4.42)
Onset Nervous System Diseases	1.74	(0.52-5.84)	1.58	(0.46-5.45)
Onset Intestine Diseases	0.85	(0.31-2.38)	1.04	(0.39-2.80)
Onset Skin Diseases	1.17	(0.70-1.96)	1.09	(0.65-1.85)
Onset NHP Mental Health Prob.	0.95	(0.59-1.54)	0.92	(0.57-1.51)
ADL index	1.08	(0.94-1.23)	1.04	(0.91-1.20)
Mobility problems index	1.16*	(0.99-1.37)	1.18**	(1.01-1.40)
Log Likelihood	-125.85		-125.80	
AIC	355.70		355.60	
BIC	705.34		705.24	
N	6148		6148	