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LONGITUDINAL SURVEYS, RETROSPECTIVE INFORMATION AND POPULATION HEALTH MEASURES

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ABSTRACT

In order to measure the health of populations over time, data from a panel survey that follows and interview the same individuals annually are most preferred. However, often, panel data are collected at intervals of two years or more instead of every year. When intervals between the base year survey and the first follow-up or between two consecutive follow-ups are longer than a year, data for the years skipped by the follow-up surveys may be collected retrospectively. Our study shows that estimates based on data with retrospective information closely approximate estimates based on data with prospective health information.

KEY WORDS: Summary measure of health; Longitudinal survey; Retrospective information on health; Multi-state life table, Healthy life expectancy

1. INTRODUCTION

Although it is preferable to calculate healthy life expectancies based on health data from longitudinal surveys, such data are rarely available. Even in the United States most of the health data that are being collected are based on cross-sectional surveys (Sondik, 2002). This is partly because longitudinal surveys are more difficult to conduct, time consuming and expensive (Freedman et al., 1988). In addition, even when longitudinal surveys are conducted, follow-ups to the baseline survey may occur at longer intervals than required for some analyses. One cost-effective and efficient way of overcoming both the lack of data and the problem associated with a lengthy duration between two consecutive rounds of a longitudinal survey is to collect retrospective information on health and to use such data to augment data on current health.

Retrospective information collected both in longitudinal and cross-sectional surveys has long been used in social science and clinical research. Retrospective information has been used for example to summarize mortality and fertility (Bogue et a., 1993). Such information has also been employed to analyze life cycle events (Peters, 1988), to determine treatment outcomes (Aseltine et al., 1992) and in the analysis of prenatal and perinatal events (Buka, et al., 2004). Data with retrospective information use the same statistical techniques that are used for analyzing data with current information. With the availability of computer software that uses maximum likelihood and a statistical method for interpolating the Markov Chain, collecting additional health information retrospectively, provides data that are very useful for healthy life expectancy estimates.

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Health measures based on data from cross-sectional surveys do not reflect changes in the health of an individual over his or her life course. In order to estimate health measures that reflect the health of an individual over time, a continuous registration system in which relevant health related events are reported, or a panel survey that follows and interviews the same individuals over time is needed (Freedman et al. 1988). Panel data are rarely available, even when they are, they may be collected at intervals that are longer than desired, for example every two years or more instead of every year. When intervals between the base year survey and the first follow-up or between two or more consecutive follow-ups are longer than a year, the estimation of healthy life expectancies and especially health transitions becomes more difficult (Crimmins et al., 1994). One cost-effective solution is to collect retrospective data on the health of respondents for the years skipped by the follow-up surveys.

This study is based on two major propositions. First, health transitions and healthy life expectancies can be calculated using data augmented with retrospective information on health, and second, healthy life expectancies calculated using such data will closely approximate healthy life expectancies calculated using current health information only. We will take advantage of the fact that the Medicare Current Beneficiary Survey (MCBS) asks respondents both about their health a year ago as well as at the time of annual interviews, to show how past health status from recalled information can be used to estimate expected years in different health states. First, we will infer the health status of respondents retrospectively using assumptions made about the relationship between current and past health. Second, we will illustrate the method by estimating life expectancies in three different health states using a four health-state model and data with retrospective health status information. Finally, we will compare life expectancies in each of the three states estimated using data with retrospective health status information with life expectancies in the same health states calculated using current health status information only.

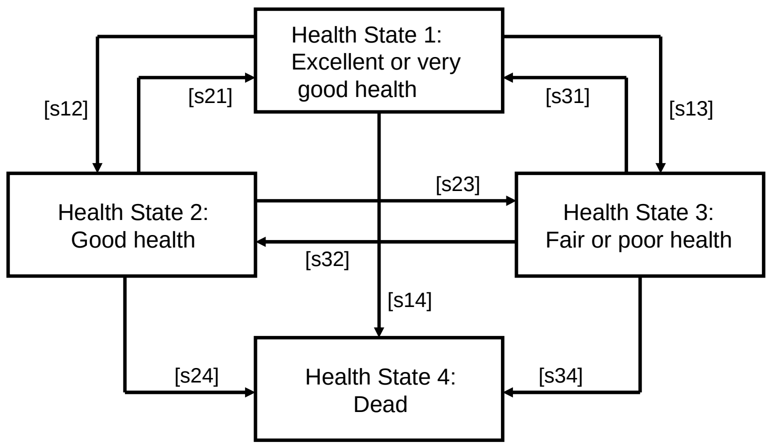
2. DATA AND METHOD OF ANALYSIS

Figure 1 schematically presents the four health-state model. Health state 1 includes those who are either in excellent or very good health. Those who are in good health are included in health state 2. Health state 3 includes those in fair or poor health and those who are dead end up in state 4. The first three health states are *transient* and hence individuals are expected to move from one health state to the other in between any two consecutive rounds. Death is assumed to be an *absorbing* state. Transitions from health state "i" to health state "j" and vice versa are denoted by s_{ij} and s_{ji} respectively.

The study sample consists of 4,446 non-Hispanic white males and females of age 70 and older who were sampled in 1998 and 1999 and were interviewed in the September to December rounds of the years 1999, 2000 and 2001. The number of persons in other race groups was too small to analyze separately. Expected years in each of the three health states were calculated for the total study sample, for males and females separately and also for those with lower level of education (a high school diploma or lower or no education) and higher level of education (at least one year of college education).

The data used to illustrate the application of the method are from the 1999, 2000 and 2001 Medicare Current Beneficiary Survey, (MCBS). The MCBS is a longitudinal panel survey that is sponsored by the Centers for Medicare and Medicaid Services (CMS). The annual sample size is about 12,000 completed interviews and includes

Figure 1. Health states and transitions across states: A four health-state model



both community dwellers as well as the institutionalized population. It is a continuous, multipurpose survey of a representative sample of the Medicare population (CMS, 2000).

The application of the method will be illustrated by calculating expected years in excellent or very good health, expected years in good health and expected years in fair or poor health. Expected years in each health state will be calculated using a PC based program called **IMach** (**I**nterpolated **MA**rkov **CH**ain). The program calculates expected life in various health states using longitudinal data and incorporates a statistical method developed by Laditka and Wolf (1998) for estimating health transition probabilities with intervals shorter or longer than a year. The program also adjusts for data with delays between interviews or missing values using interpolation or extrapolation. The program calculates expected years in different health states based on health transition probabilities (Lièvre and Brouard, 2003). The program defines health transition probabilities as:

$$P_{ij} = pr(STATUS_{t+1} = j \mid STATUS_t = i) . \qquad (1)$$

That is, the probability of occupying any health state at any given age in year (t+1) depends on the health state occupied in year (t). In this study, “STATUS” stands for “excellent or very good”, “good”, or “fair or poor”, health.
For each population subgroup, a synthetic cohort of 100,000 individuals exactly 65 years old was created and used to generate life expectancies in the various health states (Laditka and Wolf, 1998; Lièvre and Brouard, 2003). The expected years spent in health state j by an individual who was in health state i at age x, is defined as

$$e_x^{ij} = \sum_{x=1}^{\omega} {}_n p_x^{ij} \ , \qquad (2)$$

where ω is the age at which the oldest member of the cohort dies.

3. RESULTS

The data were analyzed using a four-state model where the four health states were "excellent or very good health", "good health", or "fair or poor health" and "dead". Measures used to make the comparison included change in the distribution of the health status of observed participants between two consecutive rounds, health transition probabilities of moving from one health state to another and life expectancies in each of the three different health states. Irrespective of the measure used, estimates using retrospective health information were remarkably similar to estimates using current health information and whenever differences between equivalent measures occurred, they were generally very small.

Life expectancies in each of the three health states were estimated for males and females separately using data with and without retrospective information. Life expectancies in each health state estimated based on retrospective information are very close to corresponding estimates based on current health status information. This is true for almost all ages and both for males and females. As expected, both for males and females, the proportion of life expectancy in excellent or very good health falls with age whereas, the proportion of life expectancy in fair or poor health increases with age. The proportion of expected years in good health hardly varies with age. No matter which data are used to estimate life expectancy, both males and females can expect about a third of their remaining years to be spent in good health. Expected years in each health state for females are presented in Table 1.

Table 1. Percent of life expectancy in each health state: females

	retrospective information			current information		
Age	[1]	[2]	[3]	[1]	[2]	[3]
70	41.0	33.6	25.4	39.6	33.3	27.1
75	37.6	34.2	28.2	37.2	33.3	29.5
80	34.4	34.5	31.1	34.8	33.0	32.1
85	31.3	34.4	34.2	32.4	32.6	34.9
90	28.5	34.2	37.4	30.0	32.0	37.9
95	25.9	33.6	40.5	27.6	31.2	41.1

[1] = in excellent or very good health, [2] = in good health, [3] = in fair or poor health

Life expectancy in the various health states were also estimated for those with at least one year of college education and those with no college education. Again, corresponding estimates from the two data sets do not differ significantly. The share of life expectancy to be spent in excellent or very good health declines with age for both groups and the share of life expectancy expected to be spent in fair or poor health increases with age. The share of remaining life expected to be spent in good health varies little with age.

Table 2. Percent of life expectancy in each health state: persons with at least one year of college education

	retrospective information			current information		
Age	[1]	[2]	[3]	[1]	[2]	[3]
70	51.7	30.2	18.1	51.4	30.9	17.7
75	49.0	30.9	20.1	49.2	31.3	19.4
80	46.3	31.5	22.3	46.9	31.6	21.4
85	43.6	31.8	24.6	44.6	31.6	23.6
90	41.1	32.0	26.9	42.1	31.8	26.1
95	38.6	32.0	29.4	39.5	31.6	28.9

[1] = in excellent or very good health, [2] = in good health, [3] = in fair or poor health

Expected years in each health state for those with at least 1 year of college education are presented in Table 2. Whenever differences between corresponding estimates existed, the differences were small and they might have been either due to the underlying assumptions made to infer health status retrospectively or due to the fact that respondents might have assessed health status at a certain time differently when looking back than when asked about it at that time.

4. CONCLUSION

Our study shows that retrospectively assessed health information based on a one-year recall period can be used to estimate years of life in various health states and estimates based on such information will closely approximate estimates based on current health information. Several points emerge for future studies. First, although we have used retrospectively inferred health status to illustrate the application of the method, retrospective information can be collected in all areas of health including activity and functional status. Second, collecting information on retrospective health status could be considered for longitudinal as well as cross-sectional surveys both for those who are alive at the time of the second and all subsequent interviews as well as those who die between interviews to obtain more detailed information on changes in status. Collecting retrospective information on the health of both survivors as well as those who die between interviews (through a proxy or next-of kin) could prove to be both parsimonious and cost-effective.

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