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How Does Self-Assessed Health Change With Age? A Study of Older Adults in Japan

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Objectives. This research examines how the trajectories of self-rated health evolve among elderly Japanese individuals and how socioeconomic status (SES), social relations, and baseline health differentiate these trajectories.

Methods. Data came from a five-wave panel study of a national sample of 2,200 Japanese old adults between 1987 and 1999. Hierarchical linear models and cluster analysis were employed to depict major patterns of temporal changes in self-rated health.

Results. Overall perceived health becomes worse, but only slightly, between ages 60 and 85, whereas it appears to improve a little bit after age 85. Underlying the observed age norm are four subtrajectories including constant good health, early onset of perceived health decline, late onset of perceived health decline, and a course of recovery from poor self-assessed health.

Discussion. Diverse subjective health trajectories exist in old age, extending well into the 90s. Prior observations of the effects of SES, social relations, and baseline health on health states and transitions can now be extended to trajectories of subjective health. Our analysis of Japanese data provides important benchmarks for comparisons with observations made in other developed nations.

SUBJECTIVE ratings of health have been a focus of intense research in gerontology for decades (Maddox & Douglas, 1973). They not only correlate cross-sectionally with diseases, functional status, and mental health but also predict mortality prospectively. Furthermore, people with perceived poor health make more outpatient visits and use more hospital services (Idler & Benyamini, 1997; Idler, Hudson, & Leventhal, 1999). Consequently, self-ratings have often been regarded as a valid indicator of health status (Ferraro & Farmer, 1999).

Empirical findings concerning how subjective health changes with age are, however, very mixed. First, self-assessed health has exhibited considerable stability over periods ranging from 2 to 15 years (Idler, 1993). Second, older people are more likely than the young to rate their health as excellent or very good at any given level of chronic conditions or functional disability (Ferraro, 1980). For instance, Idler (1993) observed a "linear, positive association of age with better self-assessed health" (p. S297). Third, perceived health worsens with age except at the advanced ages (i.e., 70 and older) (Hoeymans, Feskens, Van den Bos, & Kromhout, 1997). Finally, according to recent meta-analyses, subjective health declines with age, but this decrement is greater in the old–old (75+ years) than the young–old (60–75 years) samples (Pinquart, 2001).

Research on subjective health could benefit significantly by adapting a life course perspective (Clipp, Pavalko, & Elder, 1992; Crosnoe & Elder, 2002). This requires an examination of the shape of intrapersonal changes or trajectories (i.e., intercept and rate of change) over an extended period of time. In addition to the age norm or aggregated health trajectory for the total population, one needs to ascertain the increasing heterogeneity of health changes in old age (Nelson & Dannefer, 1992). For instance, some individuals have shown little health decrement until very late in life, whereas others have begun to show marked impairment in middle age (Rowe & Kahn, 1987). Individuals may vary not only in the initial state but also in the timing, duration, and ultimate level attained for a given attribute. As a result, temporal variation in subjective health is best understood as a number of distinct trajectories, whereas their average constitutes the age norm.

Existing studies have yielded only limited information regarding interpersonal variation in trajectories of subjective health. In cross-sectional studies of health states at one point in time (e.g., Ferraro & Feller, 1996), intrapersonal change cannot be distinguished from interpersonal differences. On the other hand, some investigators have examined transitions in self-rated health between two points in time by using an autoregressive or residual change model (e.g., Hoeymans et al., 1997; Idler, 1993). This approach depends on the covariance matrix of repeated observations of the same measures (e.g., subjective health) over time, whereas the underlying growth curve or trajectory is not analyzed (Rogosa, 1988). A more complete understanding dictates an analysis of the initial level as well as the rate of change with age.

This research aims to contribute to current knowledge in three respects. We first offer quantitative estimates of the growth parameters associated with the aggregated trajectory of subjective health. Second, we delineate the multitude of subtrajectories underlying this age norm. Finally, we focus on the effects of socioeconomic status (SES), social networks, and baseline health status in differentiating subtrajectories of health.

To the best of our knowledge there has been no published research that employs growth curve models in examining the multiple trajectories of subjective health.

Japan provides a useful context for understanding how subjective appraisal of health evolves in old age, particularly in contrast with the United States. Similar in economic development, both nations are experiencing rapid population aging. However, with the highest life expectancy at birth in the world, Japanese outlive Americans by 4–6 years (World Health Organization, 2004). Psychological processes in Japanese culture may differ significantly from those in European and American cultures. In Western cultures, individual identity is defined by personal choice and achievement, whereas in Japan, a collectivistic model is assumed, emphasizing connections with others, empathy, reciprocity, belongingness, loyalty, and respect (Fiske, Kitayama, Markus, & Nisbet, 1998). Despite these differences, findings concerning self-rated health among older Japanese largely parallel those from the United States (Fujita & Hatano, 1990; Haga et al., 1988; Liang et al., 2002). As the vast majority of research on subjective health has been conducted in the United States and other Western developed nations, data from a non-Western country such as Japan would provide valuable benchmarks for evaluating the external validity of current research.

Hypotheses

We hypothesize that subjective health declines in old age, with the decrement accelerating after age 75. Because the prevalence of health problems accelerates as one ages, it is more difficult to maintain good subjective health (Pinquart, 2001). Therefore, self-rated health is unlikely to evolve in a linear fashion.

We also theorize that there exist multiple trajectories of self-rated health. Although many physiologic variables show substantial losses with advancing age, there is great variability across individuals. Many people can be regarded as aging successfully because they experience minimal physiologic loss or none at all in old age. They should be differentiated from those who show nonpathologic age-linked losses. The latter can be designated as experiencing usual or normal aging (Rowe & Kahn, 1987, 1998). Other investigators have distinguished normal aging from pathologic aging, which is a result of diseases (Kane, Ouslander & Abrass, 1999, pp. 4–7).

Accordingly, subjective health evolves along several pathways. Successful aging would suggest that self-rated health is consistently good, stable, and characterized by only modest decrement, if any, as one moves into the late 80s or early 90s. In contrast, usual aging implies a similar course of subjective health but with an onset of accelerated health decrement in the mid or late 70s. Finally, an early onset of acceleration in perceived poor health in the mid-60s would signify pathologic aging (Liang et al., 2003b). The notions of usual and pathologic aging parallel prior observations that self-assessed health declines with age. However, investigators differ in their hypotheses regarding whether such decrements become more accelerated or not in advanced ages (Hoeymans et al., 1997; Pinquart, 2001). Other types of trajectories might also exist. For instance, those with poor health initially may experience significant improvement of perceived health because of recovery (Clipp et al., 1992). Idler (1993) also described a linear trajectory of age-related improvement in self-rated health.

In addition, we aim to examine key factors that distinguish among these trajectories. Current knowledge is based almost exclusively on studies of health states at one point in time or transitions between two points in time. It is presently unknown whether the effects of these risk factors could be generalized to health trajectories. Nevertheless, several hypotheses may be advanced by extrapolating from current literature. Important risk factors for differentiating subjective health trajectories may include SES, social networks, and baseline health status.

House, Lepkowski, Kinney, Mero, Kessler, and Herzog (1994) suggest that SES differences in health increase with age until relatively late in life. According to the theory of cumulative advantage, those with higher SES are more likely to experience good health well into old age, whereas those with lower SES are likely to experience significant health decline (Ross & Wu, 1996). Health trajectories associated with different SES diverge increasingly with age. Accordingly, we hypothesize that persons with higher SES are less likely to follow a course of accelerated health decline.

The quantity and quality of social relationships have been widely recognized as risk factors of mortality and morbidity. Prospective studies consistently show increased risk of death among persons with a low quantity, and sometimes low quality, of social relationships (House, Landis, & Umberson, 1988). We hypothesize that those with strong social networks have a greater probability to maintain good health into their late 80s. We recognize that health may affect social relationships as well. In this research, we focus on the effects of social relationships on health.

Given the extensive research on the linkages between subjective and objective health measures (Ferraro & Farmer, 1999), we hypothesize that poor baseline physical health conditions (i.e., disease, functional status) are significantly associated with an accelerated decline in self-rated health. Moreover, we postulate that poor baseline mental health (i.e., depressive symptoms and cognitive impairments) exerts a similar effect, as there is substantial evidence that negative emotions and cognitions can lead to poor health (Pinquart, 2001). Finally, we include gender as a control variable because men and women differ significantly in self-rated health and various risk factors (Liang et al., 2003a).

In our specifications, we focus on the effects of various factors on health trajectories. Given the prospective nature of our data (to be described later), the time sequence is well defined. Theoretically, however, reciprocal causal linkages are likely to exist. For instance, health trajectories may well influence one's employment status and income.

Methods

Sample and Data

Data came from a five-wave panel study of older adults in Japan. The baseline survey, conducted in November 1987, involved a national probability sample of 2,200 Japanese persons aged 60 and over. With a response rate of 69%, the sample was found representative of the total elderly population in Japan (Jay, Liang, Liu, & Sugisawa, 1993). After the

Table 1. Response Type by Waves of Follow-Up Surveys

Survey	N (Follow Up)[a]	Response Type: Self	Proxy	Nonresponse	Deceased	Response Rate 1[b] (%)	Response Rate 2[c] (%)
Wave 2 (1990)	2,200	1,671 (76.0)	152 (6.9)	210 (9.5)	167 (7.6)	82.8	90.4
Wave 3 (1993)	2,033	1,532 (75.4)	173 (8.5)	140 (6.9)	188 (9.3)	83.9	93.1
Wave 4 (1996)	1,845	1,247 (67.6)	199 (10.8)	180 (9.8)	219 (11.9)	78.4	90.2
Wave 5 (1999)	1,626	1,005 (61.8)	215 (13.2)	178 (10.9)	228 (14.0)	75.0	89.1

Note: Values in parentheses are percentages.

[a]At the baseline in 1987, a complete interview was obtained from each of the 2,200 respondents. With the exception of the deceased, all respondents (i.e., self, proxy, and nonresponse) were followed up at subsequent waves.

[b]Response rate 1 is computed as (Self + Proxy respondents) ÷ Total contacts.

[c]Response rate 2 is computed as (Self + Proxy + Deceased respondents) ÷ Total contacts. In this context, death is treated as a type of health outcome that should be included in the analysis.

baseline survey, except those deceased, all subjects were followed up once every 3 years (i.e., in 1990, 1993, 1996, and 1999). Proxy interviews were obtained for those unable to complete the survey themselves. In addition, a nonresponse questionnaire was utilized to gather information in the case of death or other reasons for nonparticipation. A significant number of those who did not respond at a given wave were recovered at a subsequent follow-up. Between waves 2 and 5, the proportion of self-respondents ranged from 62% to 76%, whereas proxy interviews varied from 7% to 13% and death accounted for 8–14%. Accordingly, we were able to keep the proportion of nonrespondents to < 10% of the total number of subjects contacted at each follow-up (i.e., waves 2–5; Table 1).

Measures

As the dependent variable, self-rated health was assessed via three indicators: (a) a rating of physical health (coded: excellent [1]; fairly good [2]; average [3]; not very good [4]; and poor [5]), (b) health comparisons with other people one's age (better [1]; about the same [2]; and worse [3]), and (c) a report of overall satisfaction with one's health (coded: very satisfied [1]; relatively well satisfied [2]; can't say [3]; not very satisfied [4]; and not at all satisfied [5]). Health compared with others' was scaled to reflect a 5-point scale, and then the three items were summed to form a composite of perceived ill health, with Cronbach alpha values ranging from .82 to .86 across five waves.

Gender was defined as a dummy variable (1 = female), whereas SES was measured by education in terms of the total number of years of schooling. In addition, marital status and employment at the baseline were included as dummy variables (1 = married and 1 = working, respectively). These can be regarded as indicators of social networks. Because the time sequence between these two measures and health trajectories is well defined, we avoid the possibility of endogeneity in causal inference.

With reference to baseline health conditions, cognitive impairment was assessed using Pfeiffer's (1975) Short Portable Mental Status Questionnaire. A count of the number of incorrect responses across nine questions covering short- and long-term memory, orientation to surroundings, knowledge of current events, and ability to perform mathematical tasks was obtained. Unanswered questions were counted as incorrect (Fillenbaum, 1980). Depressive symptoms were represented by seven items ($\alpha = .807$) drawn from the Center for Epidemiological Studies–Depression scale (Radloff, 1977). These items included the following: (a) appetite was poor, (b) sleep was restless, (c) could not get going, (d) everything I did was an effort, (e) felt depressed, (f) felt lonely, and (g) felt sad (coded: most of the time [3]; sometimes [2]; and rarely [1]). The selection of these items was based on findings that a brief form taps the same symptom dimensions as does the original scale, and reliability measures indicate little sacrifice of precision (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993).

Based on a checklist of conditions, an index of serious conditions was generated by including diabetes, heart disease, hypertension, and stroke, whereas the remaining conditions were grouped to be chronic conditions, consisting of up to 13 types, including, for example, arthritis, eye disease, asthma, and Parkinson disease. Serious and chronic conditions are measured separately because there is some evidence that serious illnesses have stronger relationships than chronic illnesses with mortality and self-rated health (Ferraro & Farmer, 1999). Finally, functional status at baseline was assessed by a composite of six items measuring difficulties with activities of daily living or instrumental activities of daily living (i.e., bathing, climbing stairs, walking a half mile, using the phone, shopping, and traveling by bus, train, or subway) scored in the following manner: no difficulty at all (0), slightly difficult (1), fairly difficult (2), extremely difficult (3), and unable to do at all (4). All mental and physical health covariates as well as the dependent variable self-rated health status were coded to reflect greater morbidity, impairment, or poor health. Table 2 presents the descriptive statistics of all the baseline covariates.

Table 2. Descriptive Statistics for 1987 Baseline Covariates

Variable	*M*	*SD*
Gender (female = 1)	.55	—
Age	69.16	6.75
Education, in years (range: 0–≥17)	8.62	2.82
Currently married (married = 1)	.64	—
Currently working (working = 1)	.26	—
Depressive symptoms (CES-D) (range: 7–21)	8.49	2.03
Cognitive impairment (range: 0–9)	.68	1.16
No. of serious health conditions (range: 0–4)	.43	.63
No. of chronic health conditions (range: 0–7)	.70	.99
Functional status (range: 0–24)	.86	2.94

Notes: CES-D = Center for Epidemiological Studies–Depression scale. For the table, $N = 2{,}200$.

Data Analysis

Hierarchical linear modeling was used to estimate parameters associated with health trajectories (Raudenbush & Bryk, 2002). In particular, individual health trajectories were modeled as follows (Level 1 or repeated-observation model):

$$Y_{iA} = \pi_{0i} + \pi_{1i}A + \varepsilon_{iA} \quad (1)$$

where Y_{iA} is self-rated health for Individual i at age A (at a given survey); π_{0i} is the intercept of subjective health for individual i; π_{1i} is the rate of change (slope) in self-rated health for Individual i across age; and ε_{iA} represents random error in self-rated health for individual i at age A.

An important feature of Equation 1 is the assumption that the intercept and growth parameters vary across individuals. Thus, these parameters become dependent variables in the level 2 (or person-level) model, where individual or group attributes can be included as predictors. This is represented in the following model for each of the individual growth parameters:

$$\pi_{pi} = \beta_{p0} + \sum \beta_{pq}X_{qi} + r_{pi} \quad (2)$$

Here X_{qi} is a covariate (e.g., gender and education) associated with Individual i, and β_{pq} represents the effect of Xq on the pth growth parameter (π_{pi}). r_{pi} is a random effect with a mean of 0.

For the sample as a whole, both linear and nonlinear changes in self-rated health were considered. Linear change was evaluated by estimating Equation 1 as it appears above, whereas nonlinear change was evaluated in a separate pass through the data by adding one or more appropriate polynomial terms (e.g., $\pi_{2i}A^2$ for a quadratic age effect) to Equation 1. Age was standardized (M = 73.88, SD = 7.31) to minimize the collinearity among various age-related effects (i.e., intercept, linear and nonlinear effects).

To identify major patterns of self-rated health changes in old age, K-means cluster analyses were used to create categories of individuals with similar growth parameters from Equation 1 (i.e., $\pi_{0i} + \pi_{1i}$). The goal was to choose a solution that used the fewest number of clusters possible to identify distinctive and meaningful subjective health trajectories. These trajectories were then used as the dependent variable in a multinomial logistic regression analysis assessing the effects of baseline covariates. Finally, to validate the identified subtrajectories, they were included in the level 2 equation in conjunction with various predictors in analyzing interpersonal differences in self-rated health.

Item Missing, Attrition, and Mortality

To minimize the loss of subjects due to item missing and attrition, multiple imputation was undertaken. There was little item missing at the baseline survey. Missing values on all baseline measures were imputed by using data collected in 1987. Across waves 2–5, the proportion of cases with at least one of the three self-rated health items missing ranged from 17% to 25% at each wave, with the vast majority containing one or two missing items. Different procedures were followed depending on the type of response. For those with proxy interviews and those who did not respond at a given wave, we imputed their missing values on subjective health by using baseline data and prior observations of subjective health. For those who died, self-rated health was imputed for the time period between the previous wave of data collection and death. Three complete data sets were imputed with the NORM software developed by Schafer (1997), and analyses were run on each of these three data sets. Parameter estimates and their standard errors were derived by averaging across three imputations and by adjusting for their variance.

Findings

Age Norm of Self-Rated Health

We examined the aggregate trajectory of subjective health by evaluating several progressively more complex (i.e., linear, quadratic, and cubic) models and choosing the most appropriate model on the basis of the statistical significance of various age-related effects. For the sample as a whole, the age norm can be best described by a cubic function (Table 3). In this function, fixed effects associated with all growth parameter estimates except the quadratic slope are statistically significant (i.e., intercept = 7.86, $p < .001$; linear slope = .55, $p < .001$; cubic slope = –.06, $p < .05$). Between ages 60 and 85, subjective health becomes only slightly worse, ranging between 7.388 and 8.836 (Table 4; Figure 1). From age 85 to 95, it appears to improve a little bit (i.e., from 8.836 to 8.503). To gauge how much confidence one should give to the parameter estimates, we present both the total age range and the effective age range associated with all health trajectories in Table 3. Although the total age range is from ages 60 to 102, the effective range is between 60 and 95 where at least 20 observations at each age are required.

Subtrajectories of Subjective Health

In addition to the age norm, we examined the heterogeneity in subjective health changes. To accomplish this, the statistically significant random effects parameters (i.e., intercept and linear slope associated with the aggregate trajectory in Table 3) for all respondents were subsequently subject to K-means cluster analyses. Because K-means cluster analysis requires that the number of clusters be fixed a priori, it was repeated with different numbers of clusters selected (i.e., from 2 to 10). The goal was to choose the solution that involved the fewest clusters possible to detect distinctive and theoretically meaningful differences in health trajectories. The four-cluster solution seems to fulfill this criterion best. Solutions involving more than four clusters generally contain minor clusters, which are very similar to each other. The four identified trajectories are described in the following.

Constant good health.—Consisting of 899 respondents (41% of the total sample), this trajectory has a positive quadratic age effect (slope = .20, $p < .001$) and a negative cubic age effect (slope = –.05, $p < .01$; see Table 3). It is characterized by a somewhat higher level of perceived ill health (i.e., 7.769) at age 60 and remains stable until age 90 (see Table 4; Figure 1). Indeed, self-rated health improves (or perceived ill health decreases) slightly between ages 60 and 75, whereas it becomes a bit worse between 75 and 90 years. Although this trajectory does not exhibit the best subjective health before age 80, it appears to mirror what Clipp and associates (1992) termed as a trajectory of "constant good health," which is quite similar to

Table 3. Trajectories of Self-Rated Health, Japan: 1987–1999

Variable	Age Norm	Constant Good Health	Early Onset of Decline	Late Onset of Decline	Recovery
Size (%)[a]	1,845 (84%)	899 (41%)	452 (21%)	225 (10%)	270 (12%)
Age (*M*)	73.88	72.87	71.26	80.48	76.52
Age (*SD*)	7.31	6.93	6.16	6.42	7.13
Total age range	60–102	60–99	60–94	60–102	60–99
Effective age range	60–95	60–90	60–85	65–90	65–90
Growth curve parameter estimates (Level 2 equation, unconditional model)					
Intercept					
Fixed effect	7.86***	6.60***	9.04***	7.50***	10.25***
Variance–random effect	3.61***	.83***	1.79***	3.45**	1.65**
Linear slope					
Fixed effect	.55***	−.03	2.08***	2.92***	−1.48***
Variance–random effect	1.90*	.03*	2.67	1.24**	.49**
Quadratic slope					
Fixed effect	.06	.20***	.07	.23***	−.13
Variance–random effect	.19	.05**	.01	.02**	.03
Cubic slope					
Fixed effect	−.06*	−.05**	−.15**	−.20*	.00
Variance–random effect	.06	.001***	.001	.01**	.02

[a]There were 355 individuals (16%) who died between 1987 and 1993. Because they had fewer than 4 repeated observations, they were excluded from the growth curve analysis involving a cubic function. Numbers of subjects of all trajectories may not add up to 2,200 because of multiple imputation and rounding.

*$p < .05$; **$p < .01$; ***$p < .001$.

"successful aging," as characterized by Rowe and Kahn (1987, 1998). Further discussion of our rationale will be presented later.

Early onset of worsening health.—This course is distinguished by a positive linear age effect (slope = 2.08, $p < .001$) and a negative cubic age effect (slope = –.15, $p < .01$; see Table 3). Older adults following this trajectory have better initial self-rated health (i.e., 6.388 at age 60) than those with consistent good health. However, from age 60 on, subjective health begins to worsen steadily until age 85 (i.e., self-rated ill health score: 12.363 in Table 4). Constituting 21% of the total sample ($N = 452$), this trajectory can be viewed as pathologic aging because of the unusually early onset of accelerated health decline.

Late onset of worsening health.—This trajectory ($N = 225$ or 10%) has a positive linear age slope (2.92, $p < .001$), a positive quadratic age slope (.23, $p < .001$), and a negative cubic age slope (–.20, $p < .05$; see Table 3). After an initial period of excellent health between ages 65 and 70, health begins to deteriorate significantly thereafter (to an ill health score of 11.684 at age 90).

Table 4. Self-Rated Health by Age According to Major Trajectories, Japan: 1987–1999

Age	Age Norm	Constant Good Health	Early Onset of Decline	Late Onset of Decline	Recovery
60	7.443	7.769	6.388	—	—
65	7.388	7.004	7.158	4.600	12.302
70	7.594	6.655	8.619	4.216	11.495
75	7.945	6.611	10.295	5.300	10.560
80	8.327	6.758	11.704	7.283	9.497
85	8.836	7.252	12.363	9.670	8.306
90	8.721	7.176	—	11.684	6.987
95	8.503	—	—	—	—
Effective age range	60–95	60–90	60–85	65–90	65–90

Recovery from poor health.—Finally, 270 respondents, or 10% of the total sample, had very poor perceived health initially at age 65 (ill health score = 12.302; see Table 4). Interestingly, their perceived health improved substantially in a linear fashion (slope = –1.48, $p < .001$) during the following three decades (ill health score = 6.987 at age 90; see Table 3).

Predictors of Subtrajectories of Subjective Health

Multinomial logistic regression analyses were employed to evaluate the effects of key risk factors (Table 5). To control for competing risk of mortality, the four identified subtrajectories were analyzed in conjunction with two groups of individuals: those who died between 1987 and 1990 ($n = 167$) and between

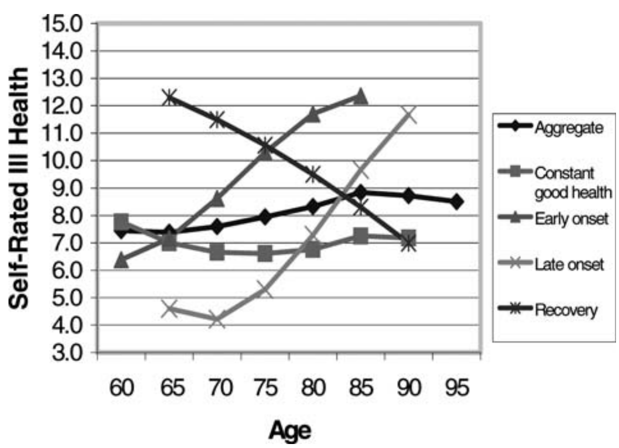

Figure 1. Trajectories of self-rated ill health.

Table 5. Relative Risk Ratios From the Multivariate Multinomial Logistic Regressions

Variable	Died Between 1987–1990 (n = 167)	Died Between 1990–1993 (n = 188)	Early Onset (n = 452)	Recovery (n = 270)	Late Onset (n = 225)
Gender	.198***	.197***	.919	.755	.487
Education	.894**	.990	1.002	.922*	.922*
Married	.564*	.491**	1.138	.930	.487*
Working	.464**	.508**	1.070	.431**	.682
Cognitive impairment	1.448***	1.443***	1.071	1.161	1.184
CES-D	1.141**	1.106*	1.050	1.224***	.911
Serious conditions	1.819***	1.834***	1.392**	2.361***	1.099
Chronic conditions	1.212*	1.131	1.084	1.571***	.659**
Functional impairment	1.317***	1.310***	1.077	1.275***	1.133

Notes: CES-D = Center for Epidemiological Studies–Depression scale. Reference category is constant good health (n = 899). Numbers of subjects of all trajectories may not add up to 2,200 because of multiple imputation and rounding.

*$p < .05$ ($t \geq 1.96$); **$p < .01$ ($t \geq 2.576$); ***$p < .001$ ($t > 3.65$).

Table 6. Predictors of Interpersonal Differences in Growth Curve Parameters

Predictors	Level 2 Dependent Variables: Intercept	Linear Slope	Quadratic Slope	Cubic Slope
Intercept				
Fixed effect	5.79*	.90	−.02	−.04
Random effect	.91**	.25**	.05**	.01**
Female	.11	.02	.03	.03
Education	.00	.00	.00	.00
Married	.23*	.10	−.07	−.02
Working	−.15	.14	.01	.00
Cognitive impairment	.02	−.02	.03	−.01
CES-D	.06*	−.02	.02	−.01
Serious conditions	.32***	−.10	.05	−.01
Chronic conditions	.21***	−.13	.06	−.01
Functional impairment	.09*	−.03	.00	.00
Early onset of health decline[a]	3.24***	2.41***	−.25**	−.13
Late onset of health decline[a]	−1.60***	2.17***	.59	−.16
Recovery[a]	3.61***	−1.09***	−.44**	.02

Note: CES-D = Center for Epidemiological Studies–Depression scale.
[a]Constant good health is the reference category.
*$p < .05$; **$p < .01$; ***$p < .001$.

1990 and 1993 (n = 188). Because at least four repeated observations are required to estimate a cubic function, those who died before 1993 had to be excluded from the analysis of growth curves. Within this context, early death can be conceptualized as two distinct health trajectories different in the timing of death.

In contrast to the trajectory of consistent good health, older Japanese individuals with higher education have a significantly lower risk of dying by 1990 ($e^b = .894$, $p < .01$), experiencing recovery from poor health ($e^b = .922$, $p < .05$), or a late onset of poor health ($e^b = .922$, $p < .05$). These results are generally consistent with our hypothesis that higher SES is less likely to be associated with more accelerated health decline. However, education does not discriminate between those with consistent good health and those experiencing an early onset of poor health.

There is some evidence that social relations reduce the risk of having a more accelerated health decline. Those who were married at the baseline are significantly less likely to have an early death by either 1990 or 1993 ($e^b = .564$, $p < .05$; $e^b = .491$, $p < .01$) and to have a late onset of health decline ($e^b = .487$, $p < .05$). In addition, employment at the baseline leads to a significantly lower probability of dying by 1990 or 1993 ($e^b = .464$, $p < .01$; $e^b = .508$, $p < .01$) and recovery ($e^b = .431$, $p < .01$). Nevertheless, those who experience an early onset of poor health do not differ from those with constant good health in terms of marital status and employment.

There is strong evidence that poor baseline health leads to either early death or a course of recovery. In comparison with those who enjoyed constant good health, those who died before 1990 and those who recovered had more cognitive impairment, depressive symptoms, serious and chronic conditions, and functional impairment (Table 5). On the other hand, older Japanese who experienced an early onset of poor self-rated health had more serious conditions at the baseline ($e^b = 1.392$, $p < .01$) than those with consistent good health. Finally, somewhat paradoxically, those with more chronic conditions ($e^b = .659$, $p < .01$) were less likely to experience a late onset of poor health than consistent good health.

To what extent are the effects of SES, social relations, and baseline health confounded by the competing risk of dying before 1996? Ideally, the risk of dying was randomly distributed, and thus the estimated effects of various risk factors would not be biased. However, as shown in Table 5, this is not the case. Those who were female, had more education, were married or employed, and had better health at the baseline were significantly less likely to die. As a result, the effects of various risk factors are likely to be somewhat understated because of mortality. On the other hand, death during the periods of 1987–1990 and 1990–1993 can be viewed as distinct health trajectories themselves.

Interindividual Differences in Age Norm of Subjective Health

We also examined interpersonal variations in the age norm of self-rated health. If the identified subtrajectories of subjective health are valid, then we can expect that they will all have substantial and statistically significant effects on the growth curve parameters. Indeed, there is strong evidence that this is the case (Table 6). For instance, early onset of poor health ($b = 3.24$, $p < .001$) and recovery ($b = 3.61$, $p < .001$) are both associated with a higher initial level (i.e., intercept) of perceived ill health, whereas late onset of poor health is associated with significantly better subjective health ($b = -1.60$, $p < .001$). Furthermore, those experiencing early ($b = 2.41$, $p < .001$) and late ($b = 2.17$, $p < .001$) onset of poor health have a greater linear increment of ill health with age. Finally, older Japanese persons who recover from poor health experience a significant reduction in perceived ill health over time ($b = -1.09$, $p < .001$). After controlling for these subtrajectories, none of the slope parameters is significantly related to the baseline risk factors. This further suggests that interpersonal variation in the curvature of the age norm is fully explained by these subtrajectories.

Nevertheless, the subtrajectories do not explain all interpersonal differences. In particular, more depressive symptoms ($b = .06$, $p < .05$), serious conditions ($b = .32$, $p < .001$), chronic conditions ($b = .21$, $p < .001$), and functional limitations ($b = .09$, $p < .05$) at the baseline lead to greater initial level of perceived ill health. On the other hand, being married at the baseline is associated with a relatively higher level of ill health ($b = .23$, $p < .01$). Furthermore, the random effects associated with the intercept, linear, quadratic, and cubic age slopes remain significant, even when all risk factors and subtrajectories are taken into account.

Discussion and Conclusions

A major contribution of this research lies in its quantitative depiction of the age norm of subjective health after age 60. Subjective health worsens gradually, but only slightly, between ages 65 and 85. Interestingly, subjective health improves a little bit after age 85. This could be due to the fact that these individuals were hardy survivors. This finding reinforces previous observations that subjective health deteriorates until advanced ages, where it becomes stabilized or even improved (Ferraro & Feller, 1996; Hoeymans et al., 1997). In addition, this research is among the first to trace the longer-term trajectory of self-assessed health in older adults. It offers valuable benchmarks for cross-validating previous findings.

Prior investigators focused only on the age norm of self-rated health, and there was little understanding of its underlying heterogeneity. This research explicates the considerable interpersonal variations underlying the observed age norm of subjective health. We identified four subtrajectories: (a) constant good health, (b) early onset of poor health, (c) late onset of ill health, and (d) a course of recovery.

How do these subtrajectories map onto the concepts of successful, usual, and pathologic aging? "Constant good health," as described by Clipp and colleagues (1992), is quite similar to "successful aging" characterized by Rowe and Kahn (1987, 1998). However, prior investigators described this trajectory qualitatively without providing quantitative estimates of the parameters of the growth curve. Our decision about labeling various trajectories is based on a comparison of all of them between ages 60 and 90. What we have found is that those with a trajectory of "constant good health" do not necessarily have the best self-rated health in comparison with other trajectories before age 80. What is unique about this trajectory is that good subjective health is maintained well into the early 90s. Whereas further research is clearly needed, this also suggests that the typologies developed by Clipp and colleagues and Rowe and Kahn could be qualified with reference to the changes in subjective health in old age.

In contrast, a late onset of perceived health decline seems to correspond to usual aging, whereas those with an early onset of perceived poor health mimic pathologic aging. Interestingly, these two subtrajectories fit rather well with prior observations that subjective health declines with age, and this decline is greater in the old–old (75+ years) than the young–old (60–75 years) samples (Pinquart, 2001). However, these researchers did not focus on the timing of the onset of decrement.

Why were those with more chronic conditions at the baseline more likely to experience constant good subjective health rather than a late onset of poor health (see Table 5)? Before age 80, those with a late onset of poor health actually had better self-rated health than those with constant good health (see Table 4 and Figure 1). More chronic illness at the baseline experienced by older Japanese persons with constant good health may explain this. On the other hand, changes in health conditions after the baseline could be responsible for the late onset of deteriorating subjective health. This suggests the need to include not only baseline health conditions but also their changes as predictors of how subjective health evolves in old age.

On the other hand, there was a small group of older Japanese individuals (12% of the total sample) who had an elevated level of perceived ill health at age 65 but experienced significant improvement thereafter up to 90 years of age. This trajectory appears to correspond well to the frequently observed linear increment in positive assessment of health (Idler, 1993). As poor baseline health led to either death or recovery, this group shared many common determinants (i.e., poor baseline mental and physical health) with those who died (see Table 5). Nevertheless, how could one's self-rated health improve significantly with age despite poor baseline health? There are at least two possible explanations. First, these individuals might indeed have experienced significant improvement in objective health, thus leading to better perceived health. This is unlikely, given recent findings reported by Liang, Shaw, and colleagues (2003) that, on average, there is an accelerated increase in functional limitations after age 60. No subgroup with a significant improvement in functional status between ages 60 and 90 was observed.

Second, the increased health optimism could be explained by psychological adaptation and social comparison (Hoeymans et al., 1997; Idler, 1993; Piquart, 2001). Given sufficient time, an individual may adapt to poor physical health and integrate it into daily functioning, hence leading to improved self-rated health. In addition to physical health, many assess health by focusing more on what the body can do, on social role activities they are capable of, or on emotional and spiritual well-being. On the other hand, individuals often interpret health information through a process of social comparison. People may increasingly assess their health in reference to the conditions of their age peers instead of their objective health (Borawski, Kinney, & Kahana, 1996; Idler et al., 1999).

To analyze how various risk factors are linked with trajectories of subjective health, we follow a person-centered approach by focusing on distinct patterns of intraindividual change (Crosnoe & Elder, 2002). The course of constant good subjective health clearly differentiates itself from the trajectory of recovery from poor health in terms of SES, social networks, and baseline health. However, there is much less distinction in risk factors between constant good health and health decline with either an early or a late onset. On the other hand, relative to those with constant good health, those who were married and with higher education were less likely to follow a course of late-onset perceived health decline. Although SES, social networks, and baseline health have long been shown to be associated with states of subjective health and their transitions, we provide new evidence that these conclusions can now be generalized to trajectories of self-assessed health.

In our analysis, the competing risk of dying was taken into account when analyzing the probabilities associated with the subtrajectories. In this regard, we differentiated those who died by 1990 from those who died by 1993. Our approach is rather unique in that these two groups can also be viewed as representing two distinct health trajectories, and thus, we can examine common as well as unique risk factors associated with them. Nevertheless, these two groups shared virtually all risk factors.

In addition to those who died between 1987 and 1993, 447 respondents in our cohort deceased between 1993 and 1999. These individuals were included in our analysis of health trajectories for sufficient data (i.e., at least four repeated observations) exist on them. One may question our decision because these individuals were not grouped as a separate trajectory, thus leading to an overestimation of those who experienced various health trajectories. On the other hand, excluding those who died between 1993 and 1999 from our analyses may cause us to overlook essential details concerning changes in self-rated health prior to death. To address this concern, we replicated our analysis by treating those who died between 1993 and 1999 as a separate group like those who died before 1993. The results were nearly identical to those presented earlier. Although the age norm follows a quadratic instead of a cubic function, these two functional forms are very similar because of a small cubic slope. More importantly, we were able to identify the same four subtrajectories and, on them, the similar effects exerted by the risk factors. Consequently, our results are fairly robust regardless of whether those who died between 1993 and 1999 were included in the analysis of health trajectories or not.

In addition to the person-centered approach, we applied a variable-centered approach, in which various risk factors are included as predictors in conjunction with the four identified subtrajectories. There is strong evidence supporting the validity of the four trajectories derived from our cluster analysis, as they are all significantly associated with the interpersonal differences in the growth parameters associated with the age norm (see Table 6). Further evidence is provided by the fact that these four trajectories are associated with different predictors (see Table 5).

Our research should be evaluated with reference to some of the most important issues yet to be resolved. First, self-assessed health is but one of the multiple dimensions of health and well-being, including disease avoidance, sustained engagement in life, and maintenance of cognitive and physical function (Rowe and Kahn, 1987; Ryff, Singer, Love, & Essex, 1998; Verbrugge & Jette, 1994). Further explication of the intrapersonal changes and stability is required for dimensions other than self-rated health.

Our approach can be elaborated in several ways. For instance, time-varying covariates could be incorporated in the Level 1 equation (Raudenbush & Bryk, 2002). This may be one way to address the reciprocal linkages that are likely to exist between subjective health and its risk factors (e.g., work status). On the other hand, there appear to be some differences in the interpersonal variations (i.e., random effects) associated with various subjective health trajectories (see Table 4). Further research concerning their causes is certainly warranted.

More importantly, how multiple trajectories interface among themselves over the life span is a very critical but unresolved issue. Some researchers have used measures of life courses to predict outcomes at one point in time (e.g., Crosnoe & Elder, 2002). Conceivably, this approach could be extended to using trajectories of one kind to predict those of the other kind (for a recent example, see McDonough & Berglund, 2003). Other investigators have analyzed the linkages between trajectories by applying latent growth curve models (George & Lynch, 2003; McArdle & Anderson, 1990). However, because of the lack of substantive theories, the causal order between the trajectories is ambiguous, and strong assumptions are often required. A partial solution involves the application of latent difference scores, which imply a variety of dynamic age trajectories and offer some means of comparing propositions (McArdle, 2001).

The present research entails a quantitative analysis of interpersonal differences in intrapersonal changes of subjective health. It would be extremely interesting to relate these processes to higher levels of social structure such as family, neighborhood, formal organizations, and cultures. An example of such a specification would be a three-level hierarchical linear model where interpersonal differences in intrapersonal change and stability are nested within household units or birth cohorts. This would also extend research concerning successful aging to examine the effects of individual factors as well as features of social structure.

Finally, to what degree could our findings be extended to a non-Japanese population (e.g., American population)? Because of the significant sociocultural difference, subjective health trajectories among older Americans may differ substantially. For instance, Japan's population is more homogeneous than that in the United States, and it may be less useful in making cross-national contrasts in terms of the impact of race and ethnicity. On the other hand, class distinction does exist in Japan, though it manifests in different ways. Further research is clearly in order. Nevertheless, given that prior findings concerning self-rated health among older Japanese largely parallel those from the United States (Liang et al., 2002), our results may offer some useful clues regarding how subjective health changes among older Americans.

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