Health Psychology
2004, Vol. 23, No. 6, 651–655

0278-6133/04/$12.00 DOI: 10.1037/0278-6133.23.6.651

Gender and the Natural History of Self-Rated Health: A 59-Year Longitudinal Study

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Self-ratings of health are uniquely predictive of morbidity and mortality, and they encompass people's evaluations of many medical, psychological, and social conditions in their lives. However, the longitudinal trajectory of self-rated health has not been evaluated to date. In the present study, 59-year longitudinal multilevel analyses (1940–1999) of data from 1,411 men and women revealed that self-rated health was relatively stable until age 50 and then began to decrease in an accelerating fashion through the rest of the life course. Men had higher self-rated health throughout most of adulthood than did women but had steeper linear rates of decline. As a result, the gender difference in self-rated health disappeared by late adulthood.

Key words: gender, self-rated health, hierarchical linear models, longitudinal, life course

Frequently, investigators instruct survey respondents to answer the question "How has your health been recently?", choosing among perhaps five options (e.g., *very poor*, *poor*, *fair*, *good*, or *very good*). Despite this simplicity, self-rated health is a useful predictor of mortality (Benyamini & Idler, 1999; Idler & Benyamini, 1997) and health service use (Hansen, Fink, Frydenberg, & Oxhoj, 2002). Even in representative studies with stringent statistical control, the odds of dying for people with "poor" self-rated health are typically 50%–100% higher than are those for people with "very good" or "excellent" self-rated health (Benyamini & Idler, 1999; Idler & Benyamini, 1997). Also, self-rated health is among the best predictors of survival for oncology patients (Fayers & Sprangers, 2002).

Measures of self-rated health may derive their robust predictive utility from the fact that people consider many factors when they assess their general health. Self-rated health is related, of course, to disability and morbidity (Ferraro & Yu, 1995), but it is also associated with many psychological, behavioral, social, and environmental factors that hasten death. Low psychological well-being and negative emotional states are associated with lower self-rated health (Benyamini, Idler, Leventhal, & Leventhal, 2000), possibly in a causal fashion (Croyle & Uretsky, 1987). Moreover, behavioral risk factors such as obesity, smoking, and alcohol use are associated with low self-rated health (Ferraro & Yu, 1995; Meurer, Layde, & Guse, 2001), as are social conditions like living in an area with low social capital (Kawachi, Kennedy, & Glass, 1999) or in a deteriorated neighborhood (Krause, 1996).

In light of the actuarial utility of these measures and their sensitivity to such a broad range of biopsychosocial influences, it is surprising that so little is known about the typical trajectory, or "natural history," of self-rated health across the adult life course. If one were to examine the self-rated health of a group of adults across the entire adult life course, what sort of trajectory would be described by their self-rated health scores? Self-rated health appears to be lower, on average, among older adults than among younger adults (Idler, 1993; Roberts, 1999), but the timing and nature with which this decline occurs is unknown. Does self-rated health simply decline uniformly across adulthood, or does it decline in a more complex fashion? Other researchers have noted a curvilinear relationship between age and self-rated health, although their finding was based on cross-sectional rather than longitudinal data (Ferraro & Yu, 1995). Moreover, some investigators have even conducted studies in which they followed adult participants for as many as 3 or 4 decades (Clipp, Pavalko, & Elder, 1992; Ferraro & Kelley-Moore, 2001; Strawbridge & Wallhagen, 1999), but neither these nor any other studies of which we are aware were designed to describe the normative age trajectory of self-rated health across adulthood.

With repeated assessments of self-rated health on the same set of people over the adult life course, it is possible to model self-rated health as the product of a set of latent growth parameters, with individuals' parameter values varying around sample means for the parameters (Hedeker, 2004; Raudenbush, 2001). For example, longitudinal change in self-rated health might be conceptualized in terms of an intercept and one or more latent growth processes that produce continuous or smooth change in self-rated health as people age.

Describing, with a series of latent growth parameters, a set of repeated measures of self-rated health collected across the life

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This research was generously supported by a grant to Michael E. McCullough from the John Templeton Foundation, National Institute of Mental Health Scientist Development Award 1K01MH064779-01A1 to Jean-Philippe Laurenceau, and funds given by the John D. and Catherine T. MacArthur Foundation to the Murray Research Center. We are grateful to the staff of the Murray Research Center and to Al Hastorf, Eleanor Walker, and Carole Holahan for help in acquiring the data on which these analyses were based. We are also grateful to Sharon Brion, Jo-Ann Tsang, and Andrea Jain for their assistance.

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course offers the possibility of resolving other questions in this literature. For example, some investigators have found that women have slightly lower self-rated health than do men (Kawachi et al., 1999; McDonough & Walters, 2001; Sax, Lindholm, Astin, Korn, & Mahoney, 2001), but others have not (Gold, Malmberg, McClearn, Pedersen, & Berg, 2002; Leinonen, Heikkinen, & Jylha, 1997). Part of the difficulty in isolating gender differences may be that small gender differences at any single point in time belie a consistent, long-term gender difference in one or more of the growth parameters underlying self-rated health. By examining gender differences in latent parameters of longitudinal change rather than in the observed scores themselves, greater statistical power becomes available for detecting small but consistent gender differences and also for isolating the growth processes that produce those differences. We conducted a study to address these issues.

Method

Participants

The Terman Life Cycle Study of Children With High Ability (Terman, Sears, Cronbach, & Sears, 1990), begun in 1921–1922, comprises data from 1,528 intellectually bright boys and girls (all of the participants had IQs exceeding 135) from the State of California. The average birth year for participants was 1910. Since the study sample was first assembled, participants have been recontacted for more than a dozen follow-up surveys.

For the present study, we used 1,411 (57% men, 43% women) of the participants whose data were adequate for the statistical computations described below (i.e., for whom we had at least 1 of the 11 measures of self-rated health in addition to their birth dates and genders), and who were aged 20 years or older (mean age = 29.6 years, $SD = 3.6$; range = 20–40) in 1940. In 1940, these mostly White, middle-class adults were highly educated (approximately 99% had high school diplomas, 89% had some college experience, 70% had at least a bachelor's degree, 45% had at least a master's degree, and 8% had one or more doctoral degrees), and most were married (65% married, 31% single, 3% divorced). The age range of participants who completed the final (1999) survey was 74–94 years.

In 11 different surveys (1940, 1945, 1950, 1960, 1972, 1977, 1982, 1986, 1991, 1996, and 1999), participants completed a 5-point Likert-type item to rate their health (for every item, 1 = *very poor*, 2 = *poor*, 3 = *fair*, 4 = *good*, and 5 = *very good*). The Appendix lists the exact wording for each of the items. Because not every participant completed all 11 surveys, the 1,411 participants completed a total of 9,022 measures of self-rated health during the 59-year period. Because of the initial age differences in the sample, the 59-year observation period incorporated observations from people aged 20–94 years.

Analyses

We used the HLM 5.04 statistical software (Raudenbush, Bryk, Cheong, & Congdon, 2000) to fit both (a) within-person longitudinal models for each of the 1,411 individuals that specified their self-rated health scores as resulting from smooth longitudinal trajectories that are created by a set of growth parameters and (b) between-persons models that evaluated whether men's and women's mean values for the estimated growth parameters differed. Hierarchical linear modeling is ideal for this application because it yields growth parameter estimates from incomplete data (e.g., for participants who died prior to the last survey, or who missed one or more surveys), although participants with relatively large amounts of missing data make relatively small contributions to the estimation of the trajectory components and their variances. More specifically, HLM allows for missing data on outcome variables, assuming that the data are missing at random (MAR; Schafer & Graham, 2002). Within the context of this study, *MAR* refers to the situation in which "missingness" is not related to future unobserved measurements of self-rated health but is related to previous measurements of self-rated health or other measured covariates. In more practical terms, the MAR condition renders missingness "ignorable" because missingness can be correlated with any or all of a participant's earlier measurements and still produce unbiased and efficient parameter estimates using maximum-likelihood estimation (Schafer & Graham, 2002). We used full-information maximum-likelihood estimation.

The within-person (or Level 1) models specified the trajectory of self-rated health from ages 20–94 years with a small set of latent growth parameters. The Level 1 models took the form

$$\mathrm{SRH}_{ij} = \beta_{0j} + \beta_{1j}(\mathrm{year}_{ij}) + r_{ij}, \qquad (1)$$

where SRH_{ij} represents Person j's self-rated health score at a given age i; β_{0j} represents Person j's estimated self-rated health at the y-intercept, which was set at the midpoint of the age range, or 57; β_{1j} represents the amount of linear change per year in self-rated health for Person j; and r_{ij} represents the residual in Person j's self-rated health score at time i that cannot be accounted for by estimated self-rated health at age 57 or linear change.

Because self-rated health might not change at a uniform rate across adulthood (Ferraro & Yu, 1995), we also computed a quadratic model that took the form

$$\mathrm{SRH}_{ij} = \beta_{0j} + \beta_{1j}(\mathrm{year}_{ij}) + \beta_{2j}(\mathrm{year}_{ij})^2 + \mathrm{r}_{ij} \qquad (2)$$

as well as a cubic model that also contained a parameter for the cubic effect of time. For all three within-person models, the coefficients for longitudinal change were centered on age 57, and we used orthogonal polynomials to represent the growth parameters to minimize their intercorrelation and facilitate statistical computation of parameter estimates (Hedeker, 2004).

To determine which model yielded the best fit to the data, we computed a deviance statistic for each model (Raudenbush & Bryk, 2002). Deviance statistics are approximately chi-square distributed, with larger deviances implying worse overall model fit. The relative fit of two models can be compared by examining the difference in their deviances. These differences in deviances are approximately chi-square distributed and can be evaluated for statistical significance against the chi-square distribution, with degrees of freedom equal to the number of parameters estimated in the more complex model minus the number of parameters estimated in the simpler model. If a more complex model yields a significant reduction in deviance relative to a simpler model, the more complex model is deemed to yield an improvement in model fit.

After choosing among the unconditional linear, quadratic, and cubic models, we estimated a between-persons (or Level 2) model to explore gender differences in the underlying growth parameters. The Level 2 model was specified as a set of equations that took the form

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\mathrm{gender})_j + u_{0j}. \qquad (3)$$

Equation 3 specifies estimation for β_{0j}, which captures individual differences in estimated self-rated health at age 57. The mean estimated self-rated health at age 57 for the entire sample is represented by γ_{00}, γ_{01} represents the strength of the relationship between the between-persons differences in estimated self-rated health at age 57 and gender, $(\mathrm{gender})_j$ = Individual j's gender (where 0 = male and 1 = female), and u_{0j} is a residual reflecting between-persons differences in estimated self-rated health at age 57 that are not accounted for by the sample's estimated self-rated health at age 57 and gender. Similar equations were used to estimate between-persons differences in the change parameters.

Results

Estimating the Trajectory of Self-Rated Health Across the Life Course

Linear model. The linear model, corresponding to Equation 1, specified self-rated health as a function of an intercept (here centered on age 57) plus a linear effect for time. The coefficients for this model imply that for the typical participant, self-rated health at age 57 would be 4.185524 (slightly above *good*), and this score would be expected to decline at a steady rate of 0.008456 units per year. The significant chi-square values in Table 1 indicate that there was reliable variability in people's estimated intercept and linear change estimates.

Quadratic model. Then we modeled self-rated health with parameters for the intercept, linear change, and quadratic change. In this model, the coefficient for the intercept was 4.106230. The mean linear decrease (−0.011504) is accompanied by a negative quadratic trend (−.000139). The negative sign attached to the quadratic coefficient indicates that curvature is concave downward. This model yielded a statistically significant reduction in deviance (350.51, $df = 4$, $p < .001$) relative to the linear model, indicating a superior fit to the data.

Cubic model. Finally, we included a parameter for capturing cubic change. This parameter appeared to have very little variance (and failed to converge) in initial runs, so we constrained its variance to zero (Raudenbush & Bryk, 2002). In this model, the estimates for the intercept, linear change, and quadratic change were similar to those in the quadratic model, but there was also a significant cubic effect (−0.000008). The cubic model yielded a statistically significant reduction in deviance compared with the quadratic model (change in deviance = 23.02, $df = 1$, $p < .001$), indicating a superior fit to the data. As would be expected, given that HLM provides unbiased estimates of fixed effects under MAR assumptions, similar cubic models were obtained when we fit growth curves only for individuals who provided observations after their 70th birthdays ($n = 857$), after their 80th birthdays ($n = 428$), and after their 85th birthdays ($n = 191$). These additional results bolster the conclusion that self-rated health changes in a curvilinear fashion through the adult life course.

Gender Differences in Growth Parameters

To account for variance in individuals' intercept, linear change, and quadratic change parameter estimates (but not the cubic change parameter estimates, because these latter parameter estimates did not vary significantly among participants), we reran the cubic model with gender-specific coefficients using the complete data set to examine whether men and women had different means for the intercept, linear change, or quadratic change parameters. The gender-specific coefficient was statistically significant ($p = .02$) for the intercept and marginally so ($p = .07$) for linear change but not for quadratic change ($p = .59$). The parameter estimates in Table 2 show that men had a mean self-rated health score of 4.125707 at age 57. Women's mean self-rated health was very slightly (i.e., 0.082564 scale units) lower. However, the linear rate of decline was, with marginal statistical significance, less steep for women: Men's self-rated health scores were expected to decrease at the rate of 0.015211 units per year. For women, the expected rate of linear decline was −0.015211 + 0.002461 = −0.01275 scale units per year.

Figure 1 depicts the resulting mean trajectories of self-rated health from age 20 to age 94 for men and women. This figure shows that men tend to have slightly higher self-rated health throughout most of life, but because men have marginally steeper rates of linear decline than do women, around age 80 the curves for men and women intersect. These curves also show that self-rated

Table 1
Linear, Quadratic, and Cubic Models of Change in Self-Rated Health

Parameter	Coefficient	t	SD	χ^2	Deviance	Change in deviance
			Linear model			
Intercept	4.185524	255.93**[a]	0.5248	6,600.33**	19,323.57[b]	—
Linear change	−0.008456	−14.42**[a]	0.0148	2,987.63**		
			Quadratic model			
Intercept	4.106230	234.95**[a]	0.5333	1,312.44**	18,973.06[c]	350.51**[d]
Linear change	−0.011504	−17.25**[a]	0.0166	507.23**		
Quadratic change	−0.000139	−13.37**[a]	0.0002	299.02**		
			Cubic model			
Intercept	4.090047	230.73**[a]	0.5390	1,345.09**	18,950.04[e]	23.02**[f]
Linear change	−0.014067	−16.78**[a]	0.0170	526.75**		
Quadratic change	−0.000157	−13.82**[a]	0.0002	297.31*		
Cubic change	−0.000008	−4.41**[g]	—[h]	—[h]		

[a] $df = 1{,}410$. [b] $df = 6$. [c] $df = 10$. [d] $df = 4$. [e] $df = 11$. [f] $df = 1$. [g] $df = 9{,}108$. [h] The cubic change component was constrained to be equal for all individuals. Therefore, the standard deviation and chi-square were not computed.
* $p < .01$. ** $p < .001$.

Table 2
Final Parameter Estimates and Female-Specific Coefficients for Cubic Model of Change in Self-Rated Health

Parameter	Estimate	*SE*	*t*	*p*
Intercept	4.125707	0.023045	179.03[a]	.00
Female	−0.082564	0.035747	−2.31[a]	.02
Linear change	−0.015211	0.001073	14.18[a]	.00
Female	0.002461	0.001363	1.81[a]	.07
Quadratic change	−0.000162	0.000015	−10.74[a]	.00
Female	0.000011	0.000021	0.539[a]	.59
Cubic change	−0.000008	0.000002	−4.49[b]	.00

[a] $df = 1{,}409$. [b] $df = 9{,}015$.

health stays fairly constant for individuals before age 50 but enters a period of accelerating decline around age 50. We estimated the exact age where the change in acceleration occurs by solving the second derivative for the men's and women's cubic equations. The second derivative equals zero for men at age 50.25 and for women at age 50.71, indicating that the rate of acceleration prior to age 50 is different from the rate of acceleration thereafter. In our subsamples of individuals who provided data after their 70th, 80th, and 85th birthdays, respectively, the inflection points also occurred at approximately the same point in the life span (e.g., between ages 50 and 53). These data suggest that the typical person in our sample entered a period of accelerating decline in self-rated health in his or her early 50s.

Discussion

The Typical Trajectory of Self-Rated Health

Investigators have noted that self-rated health declines with age (Roberts, 1999). The present investigation helps to specify the nature of these age-related declines. From age 20 until age 50, men and women appear to maintain relatively high levels of self-rated health. After age 50, self-rated health begins to decline in an accelerating fashion for both men and women. These curvilinear trends in the longitudinal trajectory of self-rated health suggest that scientific understanding of self-rated health should be revised to recognize that although there is a net decline in self-rated health during the adult life course, this net linear decline actually belies a more interesting pattern of relative stability during the first 30 years of adulthood followed by more precipitous declines as people enter older adulthood. It may be that in the first of these two periods, a relative lack of illness and disability allows people to maintain relatively optimistic impressions of their health, whereas in the 50s and beyond, actual declines in physical health begin to exert an ever-increasing effect on self-appraised health. Alternatively, these changes in self-rated health may reflect developmental changes related to the life course (e.g., retirement) that influence well-being in more subtle ways, thereby influencing people's perceptions of their health.

Gender Differences in the Growth Parameters Underlying Self-Rated Health

Men had higher intercept values for self-rated health, indicating a small gender difference in self-rated health at age 57. There was also a small and marginally significant gender difference in the mean rates of linear change, with women's self-rated health declining slightly less quickly over time than did men's. Because of these two gender differences, the gender difference in self-rated health essentially disappeared by age 80. The notion that the gender difference in self-rated health is largest in early adulthood and smallest (perhaps even nonexistent) in older adulthood may help to explain why freshmen men in U.S. colleges and universities have had higher self-rated health every year since at least 1985 (Sax et al., 2001), but many studies of older adults find no consistent evidence for gender differences in self-rated health (Gold et al., 2002; Leinonen et al., 1997). If the present findings are replicable in nationally representative data sets, they may help resolve this apparent inconsistency in the literature.

Future work on the longitudinal course of self-rated health would benefit from two types of inquiries. First, it would be useful to search for fixed characteristics of individuals (e.g., gender, personality traits, physical characteristics) that influence the growth parameters underlying self-rated health as well as the biological, psychological, social, or environmental mechanisms that might account for such differences. Second, it would be useful to examine whether episodic fluctuations in self-rated health are correlated with episodic changes in their physical, psychological, and interpersonal lives (e.g., temporary bouts with illness or disability, disruptions in marital or family life). The method of time-varying covariates that others have used recently to study the relationship between self-rated health and survival (Ferraro & Kelley-Moore, 2001; Strawbridge & Wallhagen, 1999) may be helpful in this regard (Hedeker, 2004).

Limitations

It should be noted that participants in the Terman study were not randomly sampled but rather were a highly selective group of intelligent, largely middle-class children who became well-educated adults. Also, it should be noted that the gender differences found herein were small in magnitude and thus may be difficult to detect in other studies that do not have the benefit of many hundreds of participants. Nevertheless, extensions of the present work using representative samples, along with greater attention to the characteristics of individuals and their social en-

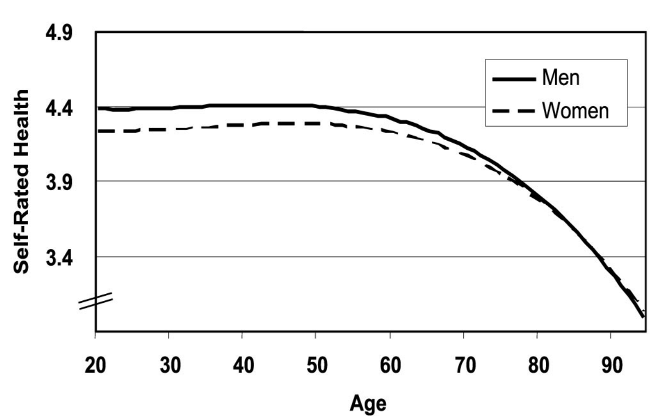

Figure 1. Best-fitting cubic trajectories of self-rated health across adulthood for men and women.

vironments that predict change in self-rated health over the life course, would help refine understanding of how self-rated health unfolds as people age and how their individual characteristics might influence these developmental changes.

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Appendix

Stems for the Self-Rated Health Items, 1940–1999

Survey year	Exact wording of self-rated health item
1940	Your general health since 1936 has been
1945	General health since 1940: Physical condition has been
1950	Your general health since 1945: Physical condition has been
1960	Your general physical health since 1955
1972	Please check to indicate your general health during 1970–72
1977	Please check to indicate your general health recently
1982	Your general health since 1976
1986	Your health since 1981
1991	Your health since 1986
1996	Your health since 1986
1999	Your health since 1996

Note. Items are from Terman et al. (1990). Despite variations in stems from year to year, each item was rated on the same 5-point scale (1 = *very poor,* 2 = *poor,* 3 = *fair,* 4 = *good,* and 5 = *very good*).