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HEALTH TRAJECTORIES AND THE QUANTUM OF AGING: The Consequences of Childhood Health and Socioeconomic Factors[*]

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ABSTRACT

Few studies have examined health trajectories *as such* or estimated the extent to which childhood health and social conditions are related to the pace and progression of disability. In other words, scant research has looked at whether childhood health and disadvantaged social back ground increase the *quantum* of aging. This study examines how circumstances associated with early life may shape the level and progression of morbidity in old age. Employing data from the Health and Retirement Study (HRS), it estimates Latent Growth Curve models (LGM) of self-rated health and functional limitations. Health trajectories in old age continue to be shaped by childhood health and socioeconomic circumstances. Poor health in childhood is associated with both the baseline level and the rate of change in functional limitations and self-rated health over time. This association is orthogonal to baseline adult chronic disease and socioeconomic status.

INTRODUCTION

The health of individuals is not temporally static, nor can it be divorced from the cumulative impacts of lived experience, which include exposures associated with the physical environment and those derived from individual placement within social and economic hierarchies. Because its basic theoretical and methodological insight is to recognize that individual life circumstances and the events that shape them are best understood in the context of previous events and circumstances, the life course perspective has the potential to provide great insight into the factors and processes that shape health (Elder 1985). This study examines health and functional status with the goal of better understanding how circumstances associated with early life may shape the level and trajectories of morbidity in old age.

BACKGROUND

Functional Limitation and Disability

Much of the research on functional health over the last few decades has involved the controversy surrounding the so-called compression of morbidity (Fries 1980). The assumption underlying the compression of morbidity hypothesis is that as increasing life expectancy approaches some biological limit and because many chronic diseases can be minimized or eliminated, fewer and fewer ‘premature’ deaths occur, leading to an increasing rectangularization of the survival curve and a compression of morbidity into the oldest ages. Despite the fact that there is little empirical evidence to suggest either a biological limit to life expectancy or the compression of morbidity (Manton, Stallard, and Tolley 1991; Crimmins, Hayward, and Saito 1994; Kannisto et al. 1994; Manton and

Singer 1994), much of the research on morbidity broadly and disability specifically has attempted to track trends over time.

The empirical evidence as to trends in morbidity has been mixed, though this is often confounded by differences in measurement and the time period under consideration. Verbrugge (1984) and Riley (1990) observed a substantial decline in mortality in the US and a simultaneous increase in morbidity since the 1950s. However, Crimmins, Saito, and Reynolds (1997) found no clear evidence suggesting a downward trend in disability during the 1980s. Others have documented improvements in functional health in the late 1980s and 1990s (Manton, Corder, and Stallard 1993; Freedman and Martin 1998; Waidman and Liu 2000; Schoeni, Freedman, and Wallace 2001; Freedman, Martin, and Schoeni 2002; Freedman et al. 2004).

Besides documenting trends in disability, the other major challenge to health researchers, and the one taken up by this study, is to explicate the factors most associated with the onset and progression of what has come to be known as the disablement process (Verbrugge and Jette 1994). Disability cannot be divorced from the pathological effects of the larger disease processes. For this reason, a large body of research has established the connection between disability and the chronic conditions associated with aging, including arthritis (Guccione, Felson, and Anderson 1990; Verbrugge, Lepkowski, and Konkol 1991), stroke (Jette et al. 1988), diabetes (Moritz et al. 1994), heart disease (Nickel and Chirikos 1990; Kaplan 1991; Guccione et al. 1994), and depression (Lenze et al. 2001). In addition to the pathological effects associated with particular disease sequelae, researchers have investigated the link between body weight and functional status. The findings relating BMI and disability have been inconsistent. While some studies have found elevated BMI to be positively associated with disability (Galanos et al 1994; Launer et al. 1994; Ferraro and Booth 1999; Himes 2000; Ferraro et al. 2002), not all studies have confirmed this relationship (Kaplan et al. 1993; Lawrence and Jette 1996).

Previous research has also identified the social and demographic correlates of morbidity. Blacks report higher levels of disability (House et al. 1994; Peek et al. 1997) as do women (Himes 2000). The evidence of a marital advantage to functional status is mixed. While some have found the married older adults had lower levels of disability (Himes 2000), others have no association (Peek and Coward 2000). As is almost universally the case, socioeconomic status has been found to be inversely related to functional limitation (Himes 2000; Peek and Coward 2000).

Early Life Health and Socioeconomic Circumstances

There is growing literature on the relationship between early life circumstances and adult health. This includes the work of epidemiologists such as Barker (1994) and his controversial Fetal Origins Hypothesis concerning the pathogenesis of cardiovascular disease. Likewise, demographers and other social scientists are beginning to investigate the myriad ways in which adult health and mortality risk are linked to early life exposures (Blackwell et al. 2001; Hayward 2004). This literature suggests that substantial gains in understanding adult health and mortality outcomes can be made from better knowledge of the determinants of health over the life course. They also suggest that the broad parameters of health trajectories may be forged very early in life, as unhealthy children become unhealthy adults and healthy children healthy adults.

Unfortunately, to date this literature has been limited to the estimation of the effect of a given childhood exposure on health or the cumulative mortality risk at some singular point in adulthood. Few studies have examined health trajectories *as such* or estimated the extent to which childhood health and social conditions are related to the pace and progression of disability. In other words, scant research has looked at whether childhood health and disadvantaged social background increase the *quantum* of aging. This study attempts to fill this empirical gap by estimating the impact of early life circumstances on health trajectories in older adults. In particular, it investigates the effects of poor childhood health and of parental socioeconomic status on the overall level of adult health and disability, as well their trajectories over time. Using a unique combination of retrospective and prospective data from the Health and Retirement Study (HRS) and latent growth curve models (LGMs), I estimate the effects of early life health and social circumstances on the overall level and slope of health trajectories.

There is distinct reason to suspect that childhood circumstances may influence adult health trajectories. First, Blackwell, Hayward, and Crimmins (2001) have previously shown serious illness in childhood to be associated with adult chronic disease. Because chronic conditions are the most important determinant of functional limitation and disability in old age, it is to be expected that anything that increases the risk of chronic disease will have adverse effects on functional health. In addition, because of its important role as a determinant in individual health variation, to the extent that poor childhood health and disadvantaged childhood socioeconomic circumstances lead to diminished adult socioeconomic attainment, they are also likely to lead to increased functional limitation and variation in individual trajectories therein.

DATA

The Health and Retirement Study (HRS) is a long-term panel study of near-elderly Americans begun in 1992. The HRS was designed to investigate the economic and health transitions of those approaching retirement (Juster and Suzman 1995; Wallace and Hertzog 1995). It combines extensive information on both socioeconomic and health status. The original data collection took place using in-home face-to-face interviews and a standard survey instrument. Follow-up takes place every second year via telephone interviews. The original HRS cohort was composed of those born between 1931 and 1941. composes the. In 1998, after three waves of follow up, these two samples, the HRS and the AHEAD, were merged together with.

In 1998 the HRS was merged with the Asset and Health Dynamics among the Oldest Old (AHEAD), a complementary sample of persons aged 70 and over in 1993 and two new samples, the Children of the Depression (CODA) born between 1924 and 1930 and the War Babies (WB) born between 1942 and 1947. Because it now includes six waves of data, this study utilizes data on the original HRS cohort members. Approximately 12,000 respondents comprised the original HRS sample. The analyses that follow utilize the complete case sample of those with non-missing data on the outcome variables. For models of self-rated health, this includes 8,029, while for functional limitations this includes 4,682 respondents.

MEASUREMENT

Outcome Measures

Functional Limitations are based on reports as to whether respondents have some difficulty performing a series of physical tasks, including-

-Walking several blocks
-Sitting for two hours
-Getting up from a chair after having sat for a while
-Climbing several flights of stairs
-Climbing a single flight of stairs
-Stooping, kneeling, or crouching
-Lifting or carrying 10 lbs.
-Picking up a dime off of a table
-Raising one's arms above one's shoulders
-Pushing or pulling large objects such as furniture

A summary score potential ranging from 0-10 is created by summing over all tasks.

These functional limitations compose a different set of tasks than is often used in investigations of disability. Often, scales of Activities of Daily Living (ADLs) or Instrumental Activities of Daily Living (IADLs) are used to measure inability to perform a set of socially defined roles and household tasks essential to independent living (Katz 1963; Nagi 1965). However, these measures have some characteristics that limit their utility for this context. First, the level of impairment typically measured by ADLs and IADLs is actually quite severe and are really an indicator of an individual's ability to live independently. Not being able to bathe or toilet by oneself represents a significantly more severe level of disability than not being able to walk several blocks or climb stairs. For this reason, ADLs and IADLs are more appropriate for assessing disability among the very old than for relatively younger and robust populations. Given the age spectrum of the HRS sample, the level of disability indicated by ADLs and IADLs is still relatively rare. Second, because ADLs and IADLs measure disability as opposed to functional limitation, they are by design more sensitive to the use of assistive technology and by the social and physical environment (Verbrugge and Jette 1994; Clark, Stump, and Wolinsky 1997).

Self-Rated Health status was measured on the typical Likert scale from 1 (excellent) to 5 (poor). Previous research has shown that self-reported health status is a reliable and valid measure of general physical well-being that is highly correlated with objective measures of physical health, including mortality risk and physician's assessments (Davies and Ware 1981; Mossey and Shapiro 1982; Liang 1986; Kaplan 1987; Idler and Kasl 1991). Self-reported health is used here because of these measurement properties and because it provides a global indicator of overall health.

Predictors of Health Trajectories

Childhood Health

The measure of childhood health used in this study is based on the response to the following question: "Consider your health while you were growing up, from birth to age 16. Would you say that your health during that time was excellent, very good, good, fair, or poor?" Values of 1(excellent) - 5 (poor) were then assigned to these categories. To maximize sample size, the childhood health measure is based on the 2001 report except for a very small number of cases that had missing data in 2001, which use the 1999 report.

The investigation of the effects of childhood health on later-life health, mortality, and SES has thus far been limited primarily by the lack of true life course data. Due to these data constraints, researchers must find alternative and indirect ways of assessing these effects. The method used in this analysis and by others is to use measures based on retrospective reports (Elo 1998; Blackwell, Hayward, and Crimmins 2001). Asking adults to retrospectively report on their health in childhood may seem like a reasonable and relatively straightforward thing to do; however, these reports are potentially subject to recall bias and measurement error. As it turns out, previous research has shown that the retrospective health measures used here are of sufficient quality to warrant their use. It has been shown using data from the PSID and the HRS that retrospective reports of childhood health are reliably reported over time, especially when the measure is dichotomized into a good/very good/excellent vs. fair/poor comparison (Haas 2003). Quality of measurement did not vary substantially between men and women or across age groups. However, as is often the case in survey research, those with higher levels of education were more consistent reporters of childhood health. Elo's (1998) analysis of these measures found that responses also demonstrated a high level of internal consistency between the report of general health and reports of specific long-term health limitations in childhood. Another study validated the retrospective self reports of childhood communicable diseases and other illness among adults at age 50 against longitudinal childhood health records (Krall et al. 1988). In general, most illnesses were recalled with a high level of accuracy. While investigators examined the recall of specific illnesses rather than a general recall of childhood health, their findings lend support to the validity of retrospective childhood health reports. Finally, the analysis that follows also provides positive evidence as to their validity.

Childhood Socioeconomic Circumstances

Parental education is measured as a set of 3 dummy categories each for mother and father. These categories include less than high school (0-11 years) (reference group), high school and above (12+ years), and a missing category. In addition, respondents were asked to retrospectively report on the family's socioeconomic status when they were growing up. Dummy categories indicate whether the respondent's family was well off

(1=yes; 0=no), average (referent group), poor (1=yes; 0=no), or if it varied (1=yes; 0=no). Dummy variables also indicate whether the respondent's father was present in the household (1=yes; 0=no), and whether the father ever experienced a period of unemployment during the respondent's childhood (1=yes; 0=no).

Adult Socioeconomic Status

Multiple measures of adult socioeconomic status at baseline are included. These include educational attainment measured as years of completed schooling, as well as total household income, and net household assets, both of which are measured on a log scale.

Chronic Health Conditions and Health-Related Risk Factors

In the HRS, respondents were asked to report as to whether a doctor had ever told them they had various chronic conditions. These included diabetes, cancer, chronic bronchitis or emphysema, ulcer, heart disease, stroke, arthritis, and asthma. A summary score indicates the respondent's number of chronic conditions ever diagnosed. The analysis also controls for a set of health-related risk factors: baseline measure of body mass index (BMI) as the ratio of weight in kilograms to height in meters squared (kg/m^2) and smoking history (1=ever smoked regularly; 0=not).

Demographic Background

In addition to the above covariates, the analysis also includes a standard set of demographic characteristics that may potentially influence the shape of health trajectories. Among these are race (1=black; 0=white), Hispanic ethnicity (1=Hispanic; 0=not), gender (1=male; 0=female), birth year, and marital status at baseline (1=married; 0=single/divorced/widowed).

ANALYSIS

The analysis proceeds in a two-step fashion. The first step is to estimate a series of unconditional latent growth curve models of functional limitations and self-rated health under various functional forms. This step is mostly a descriptive undertaking designed to establish the mean initial level, mean rate of change, and appropriate functional form for the sample as a whole. The other purpose is to estimate the extent to which individual trajectories differ from the average. This is done through testing for significantly non-zero variances in the intercept and slope components to determine if further investigation of covariates is in order. If there is not significant variability in the initial level or slopes then there is no need to pursue conditional models. The second step therefore is to estimate conditional models to examine what is responsible for individual deviations from the mean trajectory.

Latent Growth Curve Models

A central goal of many social and demographic investigations is the analysis of intra- and inter-individual change over time. Various analytic frameworks have been developed to deal with such change over time. Among the most frequently used are residual change or auto-regressive models. Auto-regressive models typically involve modeling the outcome of interest at time 2 while controlling for the level of that same variable at time 1 thereby estimating the predictors of the residual change in the outcome.

Auto-regressive models have a number of limitations with regard to their application to the analysis of trajectories of change over time. First, because they can really only deal with change between two time periods at once, they are not sufficient to model change over multiple time points (Duncan et al. 1999). Second, auto-regressive models can also be problematic for investigating the relationship of covariates to the outcome. When the initial level of the outcome is controlled for in the model, only those covariates that predict change in the rank order of observations tend to remain as statistically significant. As Meredith and Tiask (1990) point out, this may be particularly problematic for outcomes that demonstrate monotonic change in which all observations tend to change over time but in which the rank order of observations is nonetheless stable.

An increasingly common alternative to auto-regressive models are latent growth curve models (LGM) within a structural equation modeling framework, also known as latent change analysis (LCA) or latent trajectory models (LTM). Latent growth curve models have a number of characteristics that make them ideal for the study of trajectories of change over time. First, they take mean structures as well as covariance structures into account, which allows for the modeling of both individual and group trajectories. Second, because it can accommodate multiple time points at once, it can model and test complex functional forms in the outcome. The estimation of the intercept and slope(s) as latent variables allows for the analysis of both random slopes as well as random intercept models.

Following Curran and Hussong (2002), a linear model of repeated measures of functional limitations (Y*)* for individual *i* at time *t* can be expressed in a structural equation framework as

$$Y_{it} = \eta_{\alpha i} + \lambda_t \eta_{\beta i} + \varepsilon_{it} \qquad (1)$$

Where $\eta_{\alpha i}$ and $\eta_{\beta i}$ respectively represent the intercept and slope for individual *i*, λ_t = [0, 2, 4, 6, 8, 10], corresponds to factor loadings for T=6 time periods observed at 2-year intervals, and ε_{it} are the individual and time-specific random errors. Individual intercepts (slopes) can then be expressed as a function of the overall mean group intercept (slope) μ_α (μ_β) and their individual deviation from it $\zeta_{\alpha i}$ ($\zeta_{\beta i}$).

$$\eta_{\alpha i} = \mu_\alpha + \zeta_{\alpha i} \quad (2)$$
$$\eta_{\beta i} = \mu_\beta + \zeta_{\beta i} \quad (3)$$

Figure 1 presents an example of a latent growth curve model in the form of a path diagram for an unconditional linear model described in equations 1-3 above.

[Figure 1 about here]

The model can be extended to include nonlinear trajectories such as quadratic

$$Y_{it} = \eta_{\alpha i} + \lambda_t \eta_{\beta 1i} + \lambda_t^2 \eta_{\beta 2i} + \varepsilon_{it} \quad (1a)$$
$$\eta_{\alpha i} = \mu_\alpha + \zeta_{\alpha i} \quad (2)$$
$$\eta_{\beta 1i} = \mu_{\beta 1} + \zeta_{\beta 1i} \quad (3)$$
$$\eta_{\beta 2i} = \mu_{\beta 2} + \zeta_{\beta 2i} \quad (4)$$

or a third-order functional forms

$$Y_{it} = \eta_{\alpha i} + \lambda_t \eta_{\beta 1i} + \lambda_t^2 \eta_{\beta 2i} + \lambda_t^3 \eta_{\beta 3i} + \varepsilon_{it} \quad (1b)$$
$$\eta_{\alpha i} = \mu_\alpha + \zeta_{\alpha i} \quad (2)$$
$$\eta_{\beta 1i} = \mu_{\beta 1} + \zeta_{\beta 1i} \quad (3)$$
$$\eta_{\beta 2i} = \mu_{\beta 2} + \zeta_{\beta 2i} \quad (4)$$
$$\eta_{\beta 3i} = \mu_{\beta 3} + \zeta_{\beta 3i} \quad (5)$$

Finally, if there is significant variance in $\eta_{\alpha i}$ or $\eta_{\beta 1i}$ then to estimate the predictors of this variability the model can be extended as

$$\eta_{\alpha i} = \mu_\alpha + \mathbf{\Gamma X} + \zeta_{\alpha i} \quad (2a)$$
$$\eta_{\beta i} = \mu_\beta + \mathbf{\Gamma X} + \zeta_{\beta i} \quad (3a)$$

where the vector **Γ** represents the effects of **X**, a vector of covariates, on the latent intercept and slope(s).

RESULTS

Observed Health Trajectories

Over the 10 years of observation, the mean number of functional limitations more than doubled from 0.89 per respondent at wave 1 to 2.08 in wave 6. At first glance, the shape of that change appears to be non-linear over the entire period. As seen in Figure 2, growth appears to be faster in the initial and the last periods and more or less linear in the middle. The amount of variation in the number of functional limitations also increased over the time period, suggesting that the disablement process is not uniform across individuals. Figure 3 highlights large amount of variation in initial levels of specific functional limitations and in their trends. Though nearly 18% of those sampled reported difficulty climbing several flights of stairs, only 1.4% had difficulty with fine motor activities such as picking up a dime from a table. While all activities saw an increase in the number of respondents having difficulty over the period, some such as sitting for two hours saw relatively modest increases (45%), while others such as raising one's arms above the shoulders experienced dramatic increases (379%).

Self-rated health showed similar trends over the period. Figure 4 presents the trend in the mean and the standard deviation in self-rated health. There is an overall trend toward worse health though this change is not constant over the period. There is one noticeable difference between the trend in self-rated health compared to functional limitations, unlike functional limitations, which saw an increase in the variance over the period, there was a slight trend toward decreased heterogeneity in self-rated health in the sample. Figure 5 breaks down the distribution of self-rated health over time. The proportion of the sample that reported being in excellent health declined by one-half over the period. In addition, the portion in fair or poor health increased by more than 40%. While the overall trend was for the sample to have increasingly worse health on average, even at the end of the period about three-quarters of the sample reported being in excellent, very good, or good health. Therefore the overwhelming majority of respondents still consider themselves to be in good overall health.

[Figures 2-5 about here]

Unconditional Latent Growth Curves

Table 1 presents model fit indices and curve parameters for a series of alternative unconditional models of functional limitations and self-rated health assuming different functional forms derived from equations 2 and 3 above. For each outcome, the results of a linear, quadratic, and 3rd order model are presented. For neither outcome does the linear model fit particularly well. Though some of this is driven by the large sample sizes (4,682 for functional limitations and 8,029 for self-rated health), the models do not fit the data particularly well even by the Bayesian Information criterion (BIC), which accounts for this distortion. Adding a latent non-linear quadratic term to the model improves the fit of the model substantially. This is especially true for functional limitations where the χ^2 improves by more than two-thirds from 1514.49 to 480.72. For self-rated health there is a 30% improvement in χ^2. Also, for both functional limitations and self-rated health, the mean of the quadratic term is statistically significant. While the quadratic term improves the fit of the model tremendously, a third-order or cubic model fits even better. Again, the inclusion of a cubic term results in a significant decline in χ^2 for both functional limitations (from 480.72 to 88.10) and self-rated health (from 398.30 to 329.12) at the cost of 5 degrees of freedom. Finally, the variance in the intercept and the linear, quadratic, and cubic terms are all statistically significant, indicating that there is substantial variability across individuals in both the initial level of health at wave 1 and different rates of change.

[Table 1 about here]

The Determinants of Health Trajectories

Functional Limitations

Having shown above that there is significant variation in the level and shape of health trajectories, it is important to understand what factors are important determinants of that variation. Table 2 presents estimates of the determinants of trajectories in functional limitations based on a third-order model derived from equations 4 and 5 above. This model fits the data extremely well on all indices of model fit (χ^2 (*df*)=153.93 (87); BIC=-628.27; CFI=1.00; RMSEA=0.009). The model also does a good job of explaining variation in individual health trajectories, explaining nearly 70% of the variance in the intercept and more than 60% of the linear dimension of the curve. Parameter estimates are interpreted as reflecting deviation from the average underlying trajectory. Positive effects on the intercept increase the level at baseline, while negative ones reflect lower initial levels. For example, being black has a negative effect (-1.049) on the intercept, meaning on average blacks report 1 less functional limitation than do whites at outset.

The initial level of functional limitation is influenced by both early life and more proximate factors. Childhood health is significantly associated with disability. A one-unit increase in childhood health (indicating poorer childhood health) is associated with a 0.186 unit increase in disability. Childhood socioeconomic background does not appear to be directly linked with the level of disability in old age. However, it still has an indirect effect via childhood health (lower childhood SES is correlated with poorer childhood health—not shown) and especially through adult SES. There is a distinct economic gradient in functional limitations. Those with higher levels of education and household income and wealth also have substantially lower levels of functional limitations at baseline. As is often the case, men report fewer limitations than women. As would be expected, baseline limitations are also positively associated with previous smoking, higher BMI, and the number of chronic conditions at baseline.

[Table 2 about here]

Childhood health and socioeconomic conditions are also associated with the shape of disability trajectories in a linear fashion. Those who experienced worse childhood health and those who reported coming from a poor family have significantly steeper linear slopes. Childhood conditions are not associated with the curvilinear components of change over time. Baseline SES is also an important determinant of the shape of disability curves. Those with higher levels of education and wealth have shallower curves. While baseline income is associated with the initial level, it is not associated with shape components of the curve. The curves for males are substantially less steep than are those for women. Though the level of the curves does not differ by age at baseline, the cohorts born more recently have curves that are less steep than those of their older peers. Finally, more rapid accumulation of functional disability is associated with elevated BMI and the number of baseline chronic conditions.

Self-Rated Health

As with functional limitations, the third-order latent growth curve model of self-rated health with covariates fits extremely well on all indicators of model fit (χ^2 (*df*)=153.93 (87); BIC=-628.27; CFI=1.00; RMSEA=0.009). Though it does explain over half of the variance in the intercept, the model does not do as good of a job explaining individual level variation in the shape of health trajectories as it does for functional limitations.

Childhood health and economic circumstances also have a strong influence on trajectories of self-rated health. Those who experience poor childhood health have higher (worse) levels of self-reported health at baseline. Similarly, those whose mother did not complete high school or were missing information on mother's education also have worse initial self-reported health. These effects are independent of current socioeconomic status, which also is an important determinant of health at baseline. Those with higher levels of education, income, and accumulated wealth have worse health at wave 1. Unlike with disability, where they reported fewer functional limitations than whites, males and blacks report worse self-rated health at baseline, as do Hispanics. Wave 1 self-rated health is also strongly influenced by contemporaneous health-related factors. As expected, those who have a higher number of chronic health conditions report themselves as being in poorer health, as do current and former smokers and those with higher levels of BMI.

[Table 3 about here]

Childhood health is also significantly associated with the shape of the self-rated health trajectory. However, this association is more complicated than that for functional limitations. The effect of childhood health on the linear term is negative, suggesting that worse childhood health is associated with a shallower, not steeper, trajectory. The picture is more complicated, though, as it has a positive effect on the quadratic term and a negative (although extremely small) effect on the cubic term. Therefore, to the extent that trajectories in self-rated health tend to curve upwards and then level off slightly, those who had poor childhood health tend to have slightly shallower slopes that then have stronger upward curves. Another difference between functional and self-rated health is that current socioeconomic status does not appear to influence the shape of health trajectories on the intercept.

There are also interesting racial and ethnic differentials in the shape of self-rated health curves. Blacks tend to have slopes that are not as steep as those for whites. Hispanics have a significantly steeper linear component but also have a relatively strong negative quadratic component (-0.101), which actually reverses the overall quadratic effect. The average quadratic effect for self-rated health listed in table 1 is 0.005, reflecting a concave curve. For Hispanics, trajectories of self-rated health are convex.

DISCUSSION

Few studies have examined if the social, physiologic, and economic circumstances of early life shape health trajectories at older ages. This study attempts to fill an empirical void by examining the extent to which early life circumstances influence the level and shape of health trajectories in functional limitation and self-rated health in the near-elderly employing data from the HRS and Latent Growth Curve models (LGM). The results demonstrate that old age trajectories in functional limitations and self-rated health continue to be shaped by childhood health and socioeconomic circumstances. Poor health in childhood is associated with both the baseline level and the shape of the trajectory of functional limitations and self-rated health over time. Childhood socioeconomic status also exerts a direct effect on the shape of the functional limitation curve. These associations are orthogonal to baseline adult chronic disease and socioeconomic status. They also represent only the direct effect of early life circumstances, as childhood health and SES also influence the level and shape of health trajectories through their influence on adult chronic disease and socioeconomic status.

The results also complement and extend other recent studies that have demonstrated a relationship between early life conditions and adult health and mortality. Using the HRS, Blackwell, Hayward, and Crimmins (2001) have previously shown poor childhood health to be associated with various adult chronic diseases. This is important as chronic disease is the leading the cause of functional limitation and disability in old age. The present study confirms that this increased risk of chronic disease does result in increased functional limitation and leads to lower subjective appraisals of overall health. Also, while Blackwell et al. (2001) examined adult health at one point in time, this study explicitly measures the dynamics of change in adult health over time. It shows that childhood health influences both the overall level and trajectories in health over time.

A limitation of the preceding analysis is that while it represents a step forward by explicitly modeling change in health over time, when it comes to estimating the covariates of that change it treats these as static effects. Though baseline values of the covariates do a fairly good job of explaining variance in the initial levels of health in wave 1 they are less able to explain the variability in change over time, especially for self-rated health. There is ample reason to suspect that change in some of these factors would also affect the shape of trajectories. While obviously the effect of childhood health and socioeconomic conditions represent a temporally fixed effect, an increase in the number of chronic health conditions would likely lead to substantial increase in the slope of health trajectories over time. Future analysis will investigate the effect of time-varying covariates on the dynamics of morbidity over time.

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TABLE 1. MODEL FIT INDICES AND CURVE PARAMETERS FOR UNCONDITIONAL LATENT GROWTH CURVES OF FUNCTIONAL LIMITATIONS AND SELF-RATED HEALTH UNDER VARIOUS FUNCTIONAL FORMS (HRS 1992-2002)

	Model Fit Indices				***Growth Curve Parameters***							
					Intercept		Linear Term		Quadratic Term		Cubic Term	
	X^2 (*df*)	BIC	CFI	RMSEA	Mean	Variance	Mean	Variance	Mean	Variance	Mean	Variance
Funtional Limitations												
Linear Model	1514.49 (21)	1336.46	0.96	0.13	1.11***	2.66***	0.10***	0.02***	–	–	–	–
Quadratic Model	480.72 (17)	366.60	0.99	0.08	0.99***	2.01***	0.19***	0.12***	-0.01***	0.001***	–	–
Cubic Model	88.10 (12)	-13.63	1.00	0.04	0.90***	1.87***	0.39***	0.28***	-0.06***	0.01***	0.004***	0.000***
Self-Rated Health												
Linear Model	572.56 (21)	383.75	0.99	0.06	2.45***	0.91***	0.03***	0.003***	–	–	–	–
Quadratic Model	398.30 (17)	245.46	0.99	0.05	2.43***	0.93***	0.05***	0.02***	-0.002***	0.000***	–	–
Cubic Model	329.12 (12)	221.23	0.99	0.06	2.44***	0.94***	0.03**	0.03***	0.005**	0.001**	-0.004***	0.000*

Notes
** $p< .05$; ** $p< .01$; *** $p< .001$*
*BIC= X^2 - (ln(N) * df)*
All models assume constant error variances

TABLE 2. MAXIMUM LIKELIHOOD PARAMETER ESTIMATES FROM CONDITIONAL GROWTH CURVE MODEL OF FUNCTIONAL LIMITATIONS (HRS 1992-2002)

	Intercept	SE	Linear	SE	Quadratic	SE	Cubic	SE
Childhood Health	0.186***	0.039	0.078*	0.036	-0.004	0.009	0.000	0.001
Childhood SES								
Mother Educ. Missing	-0.727	0.823	0.268	0.767	0.143	0.192	-0.017	0.013
Mother Educ. <12 Years	0.031	0.201	-0.121	0.187	0.048	0.047	-0.003	0.003
Mother Educ. >12 Years	-0.147	0.442	-0.054	0.412	0.032	0.103	-0.003	0.007
Father Educ. Missing	0.665	0.629	0.605	0.585	-0.189	0.146	0.014	0.010
Father Educ. <12 Years	0.323	0.212	0.216	0.197	-0.056	0.049	0.003	0.003
Father Educ. >12 Years	-0.007	0.421	0.143	0.391	-0.110	0.098	0.010	0.007
Family SES Well Off	1.165	0.743	1.255†	0.691	-0.198	0.173	0.009	0.011
Family SES Poor	0.002	0.197	0.383*	0.183	-0.053	0.046	0.002	0.003
Family SES Varied	3.741	4.213	-4.093	3.922	1.119	0.980	-0.078	0.065
Father Ever Unemployed	-0.125	0.248	0.346	0.231	-0.005	0.058	-0.002	0.004
Father Absent	0.024	0.551	-0.035	0.513	-0.003	0.128	0.000	0.009
Current SES								
Education (years)	-0.028***	0.005	-0.017***	0.005	0.003*	0.001	-0.000†	0.000
Household Income (log)	-0.159***	0.027	-0.037	0.025	0.007	0.006	0.000	0.000
Household Wealth (log)	-0.045***	0.005	-0.013**	0.005	0.002	0.001	0.000	0.000
Demographic								
Black	-1.049**	0.385	-0.260	0.358	0.091	0.089	-0.007	0.006
Hispanic	-0.592	0.710	-0.364	0.661	0.018	0.165	0.000	0.011
Male	-1.338***	0.166	-1.274***	0.155	0.209***	0.039	-0.011***	0.003
Birth Year	-0.001	0.001	-0.005***	0.001	0.001***	0.000	0.000***	0.000
Married	-0.161	0.328	0.149	0.306	-0.030	0.076	0.001	0.005
Health Factors								
Ever Smoked	0.663***	0.162	0.253†	0.151	-0.031	0.038	0.001	0.003
BMI (Baseline)	0.019***	0.002	0.016***	0.002	-0.003***	0.000	0.000***	0.000
# Chronic Conditions (Baseline)	0.535***	0.025	0.240***	0.024	-0.036***	0.006	0.002***	0.000
R^2	.68		.63		.36		.22	

X^2 (*df*)=153.93 (87); BIC=-628.27; CFI=1.00; RMSEA=0.009

† *p* < .10; * *p< .05; ** p< .01; *** p< .001*

SE= Standard Error

Model assumes constant error variances

TABLE 3. MAXIMUM LIKELIHOOD PARAMETER ESTIMATES FROM CONDITIONAL GROWTH CURVE MODEL OF SELF-RATED HEALTH (HRS 1992-2002)

	Intercept	SE	Linear	SE	Quadratic	SE	Cubic	SE
Childhood Health	0.165***	0.011	-0.018*	0.008	0.004*	0.002	-0.000*	0.000
Childhood SES								
Mother Educ. Missing	0.529*	0.206	-0.147	0.140	0.034	0.034	-0.002	0.002
Mother Educ. <12 Years	0.160**	0.061	0.027	0.042	-0.008	0.010	0.001	0.001
Mother Educ. >12 Years	-0.111	0.144	0.075	0.098	-0.028	0.024	0.002	0.002
Father Educ. Missing	0.051	0.162	0.144	0.110	-0.032	0.027	0.002	0.002
Father Educ. <12 Years	0.051	0.065	-0.020	0.044	0.005	0.011	0.000	0.001
Father Educ. >12 Years	-0.152	0.139	0.083	0.094	-0.021	0.023	0.001	0.002
Family SES Well Off	0.337	0.223	-0.019	0.152	-0.010	0.037	0.002	0.002
Family SES Poor	-0.024	0.057	0.056	0.038	-0.009	0.009	0.000	0.001
Family SES Varied	-0.353	1.229	-0.231	0.835	0.190	0.205	-0.017	0.013
Father Ever Unemployed	0.059	0.075	0.068	0.051	-0.014	0.012	0.001	0.001
Father Absent	-0.078	0.147	-0.029	0.100	-0.002	0.024	0.001	0.002
Current SES								
Education (years)	-0.020***	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Household Income (log)	-0.058***	0.007	0.003	0.005	0.000	0.001	0.000	0.000
Household Wealth (log)	-0.011***	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Demographic								
Black	0.817***	0.100	-0.150*	0.068	0.025	0.017	-0.001	0.001
Hispanic	0.945***	0.171	0.325**	0.116	-0.101***	0.028	0.007***	0.002
Male	0.116*	0.050	-0.040	0.034	0.012	0.008	-0.001	0.001
Birth Year	-0.001†	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Married	0.061	0.087	-0.089	0.059	0.022	0.014	-0.002	0.001
Health Factors								
Ever Smoked	0.120*	0.048	0.023	0.033	-0.007	0.008	0.001	0.001
BMI (Baseline)	0.006***	0.000	0.000	0.000	0.000	0.000	0.000	0.000
# Chronic Conditions (Baseline)	0.365***	0.009	-0.042***	0.006	0.006***	0.001	-0.000**	0.000
R^2	.54		.13		.12		.14	

X^2 (*df*)=134.31 (112); BIC=-816.48; CFI=1.00; RMSEA=0.006

† *p* < .10;* *p* < .05; ** *p* < .01; *** *p* < .001*

SE= Standard Error

Model assumes constant error variances

Figure 1. Measurement Model of Unconditional Linear Latent Growth Curve

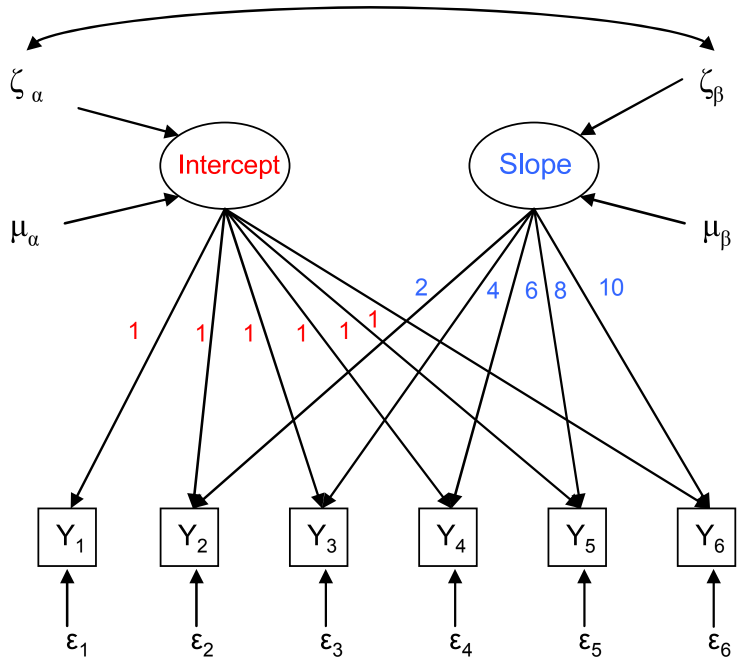

Figure 2. Trend In Mean Functional Limitations (HRS 1992-2002)

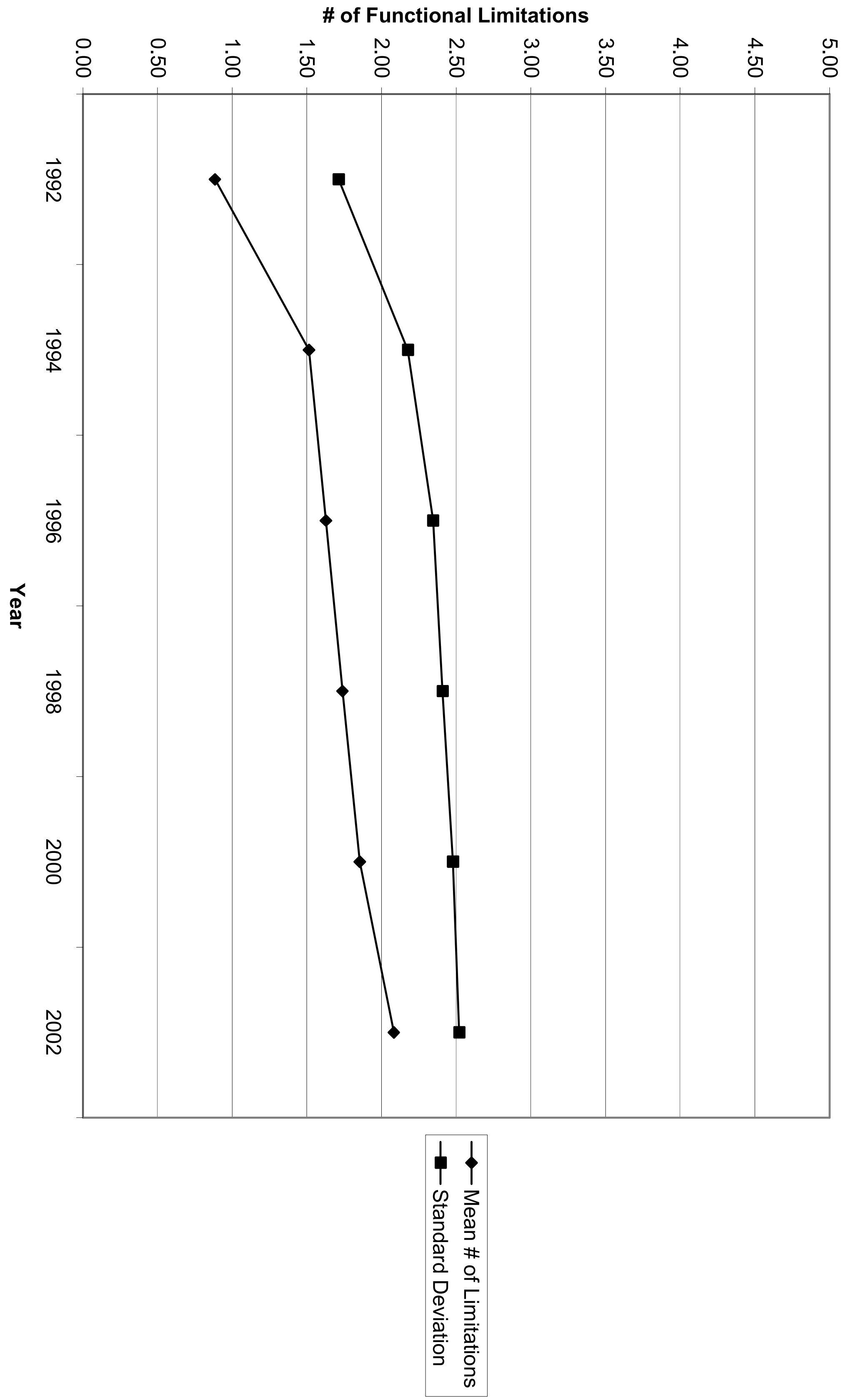

Figure 3. Trends In Specific Functional Limitations (HRS 1992-2002)

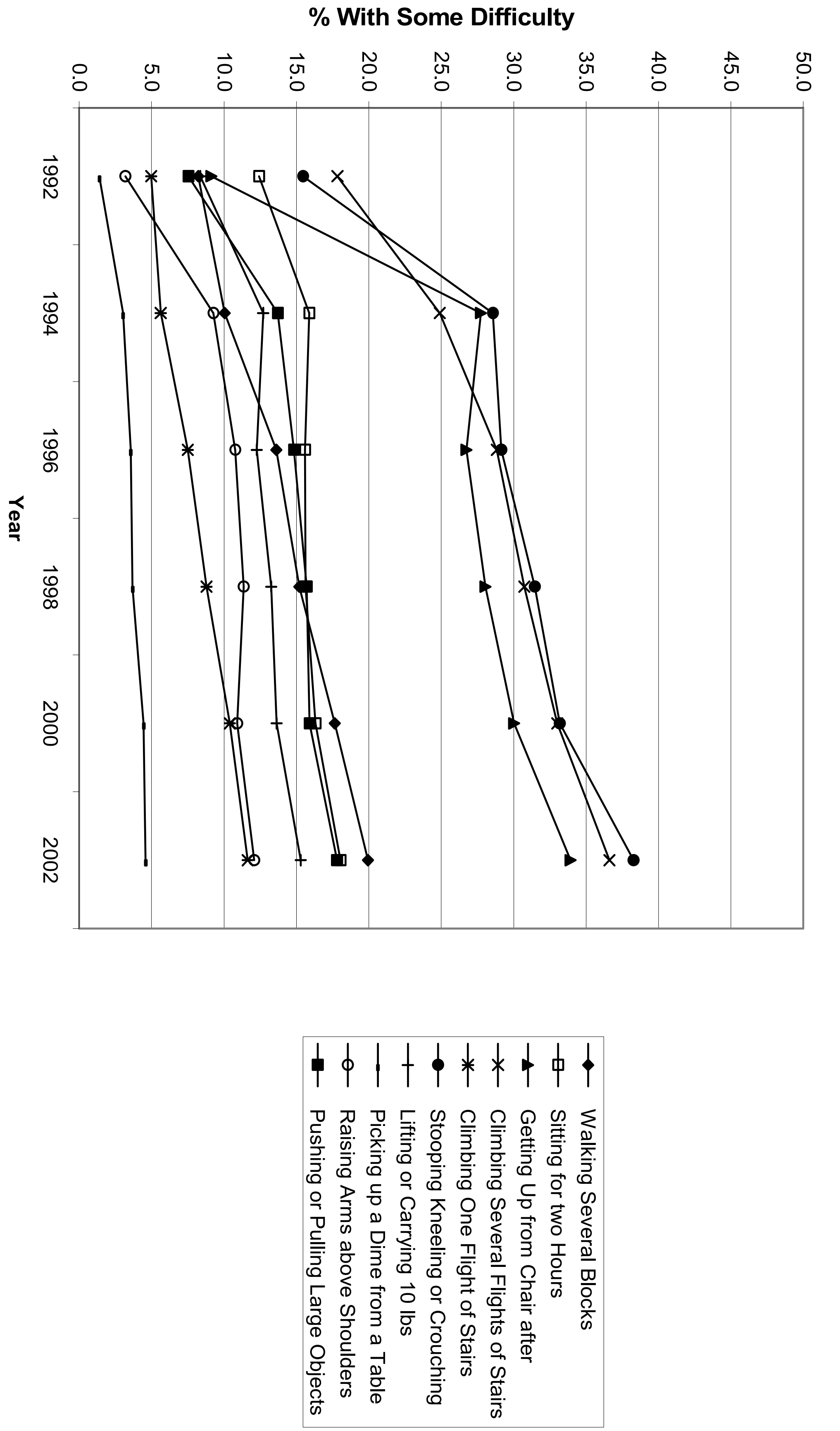

Figure 4. Trend In Self-Rated Health (HRS 1992-2002)

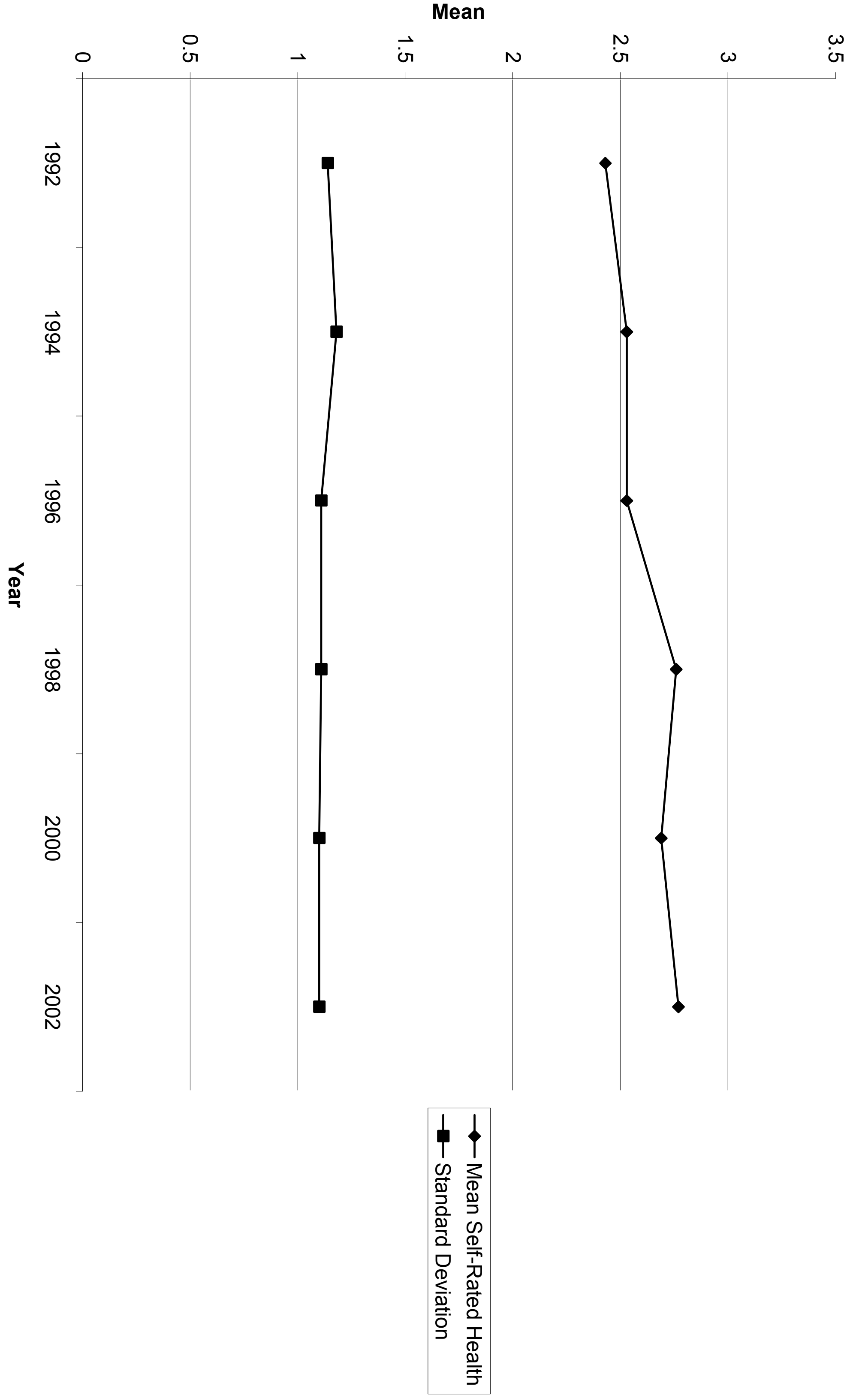

Figure 5. Trend in Distribution of Self-Rated Health (HRS 1992-2002)