



When I'm 104:
The Determinants of Healthy Longevity among the Oldest-Old in China

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Working Paper Number 34

July 2006

COLLEGE OF WILLIAM AND MARY
DEPARTMENT OF ECONOMICS
WORKING PAPER # 34
July 2006

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Abstract

This study uses the China Healthy Longevity Survey of Oldest-Old to investigate the health status of the oldest-old in China. We found that the different measures of health collected in the survey were only moderately related. That is, there is not a single construct called "health". We found that work history was modestly related to some measures of health. We also found that childhood health and socioeconomic status were correlated with health even at advanced ages. To the best of our knowledge, this is the first study to examine this connection in developing countries and at such advanced ages.

JEL Codes: J14, I10

Keywords: Aging, oldest-old, longevity

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Forty years ago Lennon and McCartney speculated about what it would be like to be 64. Today it is appropriate to speculate about what it will be like to be 84 and not too far-fetched to contemplate one's state of well-being at 104. Such speculations are particularly relevant in China where the predicted rapid growth of the "oldest-old" (those aged 80 and older) has raised a number of social and economic concerns for individuals, families, and the state. The population of oldest-old is conservatively predicted to increase from about 12 million currently to 27 million in 2020 and about 100 million in 2050 (United Nations 2001). Concern over aging in China is based on the facts that the oldest-old consume a disproportionate share of medical care, social services, personal assistance, and government and private transfers because the ability to lead an active daily life declines and disability rates increase dramatically with age (Zeng et al. 2002).

Relatively little is known about the health status of the elderly in developing nations and almost nothing about the numbers or health of the oldest-old. One exception is China where an international collaborative study of the oldest-old was initiated in 1997 (Zeng et al. 2001). Our study uses data from this collaboration to investigate different measures of health that may measure "healthy longevity" and the social, behavioral, and economic factors associated with these measures of health. A better understanding of these factors should allow better predictions of the likely impact of the rapid growth of the oldest-old population on private and public resources in China.

Data

The Chinese Healthy Longevity Survey was conducted in 1998 in 631 randomly selected counties and cities in 22 provinces that are predominantly Han Chinese. This sampling strategy was chosen because age reporting, particularly at older ages, among Han Chinese is very accurate (Coale and Li 1991; Zhenglian et al. 1997). The survey collected extensive demographic, socioeconomic, health, and lifestyle data on those aged 80 and above. Because Zhenglian et al. (1997:94) found that age reporting among semi-super and super-centenarians is questionable, we restrict our study to those between 80 and 105 years of age. Ninety three percent of the sample is Han, 4.4 percent Zhuang, and 1.3 percent Hui. For a detailed description of the data and sampling procedures see Zeng et al. (2001, 2002).

Measures of Health

There is no universally agreed upon measure of health status because health is generally not directly observable. Health status is often thought of as a multidimensional concept which “reduce(s) to a single statistic or two only with great difficulty” (Murray 2000:512). Various measures of health have been used by researchers in the literature both at micro-level and macro-level of analysis. Generally speaking, health measures can be roughly categorized in three dimensions: subjective/objective; physical/psychological; and global/specific. However, these three dimensions are often intertwined (Miller 2001).

Subjective measures of health (self-rated health) represent subjective feelings about wellness or illness which are generally obtained by asking subjects to rate their own health conditions. Many researchers agree on the validity of self-rated health as a health measure because they have found that self-rated health is highly correlated with

objective measures, such as clinical measures of morbidity, and it is a good predictor of mortality (Dwyer and Mitchell 1999; Farmer and Ferraro 1997; Geronimus, et al. 2001; Idler and Benyamini 1997; Lynch, 2003; Schoenfeld et al. 1994).

Many health studies include only physical health measures, like functional limitations, chronic conditions, physical fitness (Malina, 2001), Body Mass Index (Murray 2000), or adulthood height (Murray 2000). A few also include measures of psychological health, such as depression (e.g., Karasek 1990; Lennon, 1994). Among the physical health measures, functional limitations and chronic conditions are most often-used. Functional limitations include three types of disabilities: disability in work, in mobility and in personal activities (e.g., Geronimus 2001). Chronic conditions generally cover the most common health problems that threaten survival, function, and quality of life: heart disease, high blood pressure, lung disease like emphysema or lung cancer, breast cancer, any other type of cancer, diabetes, arthritis or rheumatism, osteoporosis (brittle bones), allergies or asthma, and ulcers, ulcerative colitis, or other digestive problems. Introducing psychological well-being into measures of health contributes to the literature on health measures by focusing researchers' attention on psychological health issues. However, it confounds the study of health effects because depression and other psychological well-beings lead to physical ailments (Hayward 2000).

Global health measures refer to a composite measure containing information on different aspects of a person or a group of persons' health status, for example, global self-rated measure of overall health status, a person's number of chronic conditions, or an index formed from several health measures (Ross and Mirowsky 2001; Ross and Wu

1995). In contrast, specific health measures are used to probe the effects on specific diseases, impairments and disabilities (Hayward et al. 2000).

In this study, we employed six measures of health: self-reported health (selfhealth); Activities of Daily Living (ADL); chronic conditions (diseasestatus); self-reported quality of life (selfqol); objective health status (intvhealth) and the number of times an individual has suffered from serious illness during the past 2 years (illness). The question “How do you rate your health at present?” was addressed to each subject to assess their self-reported health. The respondent chose one of the following answers: “very good”, “good”, “so-so”, “bad”, or “very bad”. Since there were only a small percentage of people reported “very bad” (0.57%) and “bad” (8.43%), we combined these two groups and formed a four-scale self-reported health measure.

Measurement of ADL indicates an individual’s functional capacity with respect to eating, dressing, getting in and out of a bed or chair, using the toilet, bathing, and continence (e.g., Katz et al. 1983; Zeng et al. 2002). Respondents were asked whether they have difficulties in (1) bathing, (2) dressing, (3) toilet, (4) transfer, (5) continence, and (6) feeding. Various ADLs are collinear to some degree because of co-morbidity which, in older populations, often occurs as a multiplicity of disease conditions rather than as a single form of co-morbidity (Kaplan et al. 1999). This collinearity suggests some form of combination of ADLs into more compact measures. We follow the suggestion of Zeng et al. (2002) who classified an individual as “active” if he or she needs no assistance in any ADL; if one or two activities need assistance, he or she is classified as “mildly disabled”; if he or she needs assistance in at least three of these ADLs, the individual is classified as “severely disabled”. They use ADLs as an indicator

of functional capacity because they are “a reasonable proxy of health status, and a key element in attempts to measure quality of life” (Zeng et al. 2002:264). ADLs are also closely related to care giving needs and health care use.

The measurement of chronic conditions is based on the respondent’s answer to the question “Are you suffering from any of the following (chronic diseases)” and “disability in daily life (due to the chronic disease)”. The types of chronic diseases listed in the survey include: (1) hypertension, (2) diabetes, (3) heart disease, (4) stroke, cerebrovascular disease, (5) bronchitis, pulmonary emphysema, asthma, pneumonia, (6) pulmonary tuberculosis, (7) cataract, (8) glaucoma, (9) cancer, (10) prostate tumor, (11) gastric or duodenal ulcer, (12) Parkinson’s disease, (13) bedsore, and (14) others. The respondent is classified as “well” if none of the above chronic diseases caused disability in daily life; if he or she suffered disability from any chronic disease, the individual is classified as “mild chronic condition”; “severe chronic condition” refers to an individual who suffered disability from two or more chronic diseases.

Self-reported quality of life is measured by asking the respondent “How do you rate your life at present” in terms of “very good”, “good”, “so-so”, “bad”, and “very bad”. Only a small percentage of people reported “very bad” (0.21%) and “bad” (2.83%), so we combined these two groups and formed a four-scale measure of quality of life. The respondent was also asked whether and to what extent they suffered from the serious illness in the past 2 years. The survey question was “how many times have you suffered serious illness which required hospitalization or caused you to be bedridden at home in the past 2 years?” The individual was classified as “no serious illness” if he or she answered no serious illness; “some serious illness” if he or she reported some serious

illness but not causing them to be permanently bedridden; and the individual was classified as “bedridden all year around” if that was the response given.

At the end of the survey, the interviewer was asked whether “the interviewee was: ‘surprisingly healthy (almost no obvious ailments); or ‘relatively healthy (only minor ailments)’; or ‘moderately ill (moderate degrees of major ailments or illnesses)’; or ‘very ill (major ailments or diseases, bedridden, etc.)’”. Our “objective” measure of health status was thus based on the interviewer’s assessment of the respondent’s health status.

The majority of measures of health refer to prevalence or incidence but provide little information on severity. The count measures for ADLs and chronic diseases used here do capture severity to some extent. Because of co-morbidity, people with more severe symptoms tend to score higher on counts of ill-health conditions and ADLs (Dwyer and Mitchell 1999).

The distribution of the different health measures is shown in Table 1. Almost two-thirds of respondents report no ADL constraints and ninety percent report no serious illnesses, although over half report at least one or more chronic diseases. Although 57% report that their health is good or very good, 74% report that their quality of life is good or very good. Clearly, while good health is valued it is not a necessary prerequisite to having a good quality of life, and this may speak to respondents’ expectations about their health status. Interviewer’s rating of respondent health appears to be heavily influenced by the respondent’s disease status.

(Table 1 here)

We investigated the correlation structure of the six measures of health used in this study to see if they could be combined to constitute a single measure of health status.

The correlation structure and results of a factor analysis are shown in Table 2. In general, the correlations among the various measures are low. The correlations among the more objective measures are 0.2 to 0.3 and the correlation between self-rated health and quality of life is 0.43. Clearly, respondents value more than just good health. The correlations between quality of life and objective measures of health are very low. Thus, respondents' quality of life is affected more by their subjective evaluation of their health than by more objective evaluations of it. Based on the correlations, it appears that the interviewers weigh both objective measures of health and the respondent's own evaluation in forming their view of the respondent's health. The first eigenvalue is only slightly greater than one and no other eigenvalue is greater than one, so the factor-analytic evidence to suggest a single health measure is weak.¹ The results suggest that the different measures of health collected in the survey capture different aspects of health status and that they cannot be combined into a single measure of health.

(Table 2 here)

Factors Associated with Healthy Longevity

Work history may affect morbidity and mortality through the type of work performed, the working conditions, or the fringe benefits associated with work, such as access to health care facilities or health insurance. Early studies of the effects of work on morbidity or mortality estimated occupational effects and assumed that any such differences are due to differences in the physical conditions encountered in different occupations such as pollution or risk of occupational injury. However, a more nuanced view is now taken. Occupations can differ on complexity (creativity, autonomy, and

¹ Only respondent and interviewer global health reports have factor loadings of 0.6 or above, generally taken as the cut-off level to be considered as loading on a factor.

cognitive-skill demands), physical and environmental demands, social skill demands, and manipulative skill demands (Hayward and Gorman 2004; Karasek 1990; Marmot et al. 1997; Moore and Hayward 1990). Job complexity and job control emerge as having positive effects on health, though we note that it also is possible that occupation proxies for lifetime earnings (Zissimopoulos and Karoly 2003).

In this study we investigate the effects of work through two variables in addition to a set of occupational indicators. Respondents were asked whether they had ever undertaken any physical work and, if so, when they started and when they stopped. A dummy variable was created for ever did physical work and a continuous variable for years of physical work was constructed. The occupational categories were: professional or government (7.4%), industrial (6.8%), commercial or service (9.1%), military or other (2.2%), housework (19.3%), and agriculture, forestry, or fisheries (55.2%, the excluded category in the regressions).

Childhood Influences on Healthy Longevity

Some research suggests that adult morbidity is related to childhood life circumstances (in utero environment, nutrition, exposure to infectious diseases and environmental toxins, social and economic deprivation)². Initially, the effects were thought to be indirect and negative: childhood socioeconomic status (CSES) affects adult SES (ASES) which directly affects health (Kuh and Wadsworth 1993). Hayward and Gorman (2004) suggest that CSES can also affect education and that CSES and education shape preferences for major lifestyle behaviors such as smoking, drinking, diet, and exercise which affect health. Recent research has suggested that there may also be direct

² See, for example, Elo and Preston (1992), Fogel (1993), Kuh and Ben-Shlomo (1997), Hayward et al. (2000), Blackwell et al. (2001), and Hayward and Gorman (2004).

effects of childhood health even after CSES and ASES are controlled for³. Blackwell et al. (2001) found that the type of childhood illness differentially affects adult health. What matters most are infectious diseases. The importance of these findings is that health care policies targeted at children can have considerable long-term benefits for adult health.

We capture childhood health and socioeconomic conditions with a number of variables. Respondents were asked whether they were sick enough as a child to require care (childhood illness) and whether they went to bed hungry as a child (nutrition). These variables were coded one if the answer was “yes”. Almost half of the sample reported being sick enough in childhood to require care and 56 percent reported that they often went to bed hungry when a child. We also included a variable for the respondent’s parity, because a number of studies in developed and developing countries have found that later children received a smaller share of household resources than earlier children because of constraints on household resources and they may suffer higher morbidity as a consequence. Childhood SES is proxied for by father’s occupation. Preston and Haines (1991) found that rates of infant mortality in the U.S. in 1900-1910 were lowest in households in which the father was a farmer or a salesman and in which at least one parent was literate. We lack information on other potentially useful measures of CSES, such as parent’s education and childhood household income. We do, however, have information from the respondent as to whether they received inadequate care when sick as a child. Fully 16.5 percent of respondents had been sick enough as a child to require care but did not receive it. This variable should indicate a deprived childhood, either

³ See, *e.g.*, Blackwell et al. 2001; Kuh and Wadsworth 1993; Martyn et al. 1996.

socially or economically, or residence in an area that lacked medical facilities. In an effort to control for the latter possibility we include a set of region of birth dummy variables and a urban/rural dummy variable.

Finally, regional differences in socio-economic factors and in the interpretation of the survey's health questions may occur between areas. There may also be urban/rural differences in the disease environment, so we include indicator variables for urban childhood residence and province of childhood residence in our regression analyses.

Demographic and Personal Factors

A number of other factors may affect longevity and are controlled for in our study. Health declines with age and may do so “quickly” for ADLs for the oldest-old and “slightly or moderately” for their self-rated health (Zeng et al. 2002). Zeng and Vaupel (2002) found that satisfaction with current life was almost unchanged between ages 80 and 94 years but declined slightly after that. Thus we add an age variable to our regression equations and also test for non-linear age effects by including age squared. Zeng et al. (2002) also find the health of oldest-old men to be better than that of women and speculate that this could reflect the fact that men work outdoors and therefore increase their capacity for maintaining the capabilities of daily living. It is also possible that the male advantage comes from higher education, pension, and income or adverse selection of more frail males.

Education may affect health through its impacts on risk taking, deferring gratification, and sense of control over one's environment (Preston and Elo 1992) or through its impact on preferences for lifestyle behaviors and its impact on adult

socioeconomic achievement (Haywood et al. 2000). We use a set of dummy variables to measure education. The categories are: zero (excluded category), few years (1-3 years), some (4-6 years), more (7-9 years), and well-educated (10 or more years).

We also control for a number of lifestyle variables that may be related to health, including having ever smoked, drank alcohol, or exercised. The survey asked respondents if their marriage had been “happy”, “so-so”, or “bad”. If there is an effect of marriage on the morbidity of the oldest-old, we would expect to find lower morbidity and higher reports of quality of life among those who report being happily married.

Few studies of health investigate the impact of personality on health. An exception is Hayward et al. (2000) who suggested that significant differences between blacks and whites on satisfaction with friends and financial situation and on a depression scale may contribute to racial differences in health. The Healthy Longevity Survey asked seven questions related to the respondent’s personality. We factor analyzed the responses and all load with a factor loading of 0.79 or more on a single factor. We combine these variables with equal weights to construct a personality index and expect that people with a more positive personality will report better health and quality of life.

Although longevity is moderately heritable in human populations (Ahlburg 1998; McGue et al. 1993; Mitchell et al. 2001), longevity is thought to contain only limited information on functional status, since some individuals can exhibit healthy functional survival but others disability-associated survival (Hadley 2000). However, Duggirala et al. (2002) have shown that at least one measure of biological aging in the Mennonite population has substantial genetic determinants. The Healthy Longevity Survey asked respondents if their parents were still alive and, if not, their age at death. Unfortunately,

about one-third of the observations on parent's age at death are missing. Despite this limitation, we attempted to test for an association between parent's longevity and the respondent's health by including variables for mother's and father's age at death and dummy variables for missing values of these variables.

(Table 3 here)

Results

We find only modest support for the hypothesis that healthy longevity is related to work history, at least among the oldest-old. Whether a respondent has ever engaged in physical labor is positively associated with better ADL status (at the 0.01 level), self-reported health (at the 0.10 level), and interviewer rating of health (at the 0.06 level) but is not associated with the other three, arguably more objective, measures of health. It could be that physical work "hardens" the individual and protects them from health insults or it could be that selection is operating. That is, only the hardiest survive physical labor and report relatively good health at advanced ages. When we added a measure of the number of years a respondent had done physical labor, the duration variable was positive and significant for most of the health measures and the variable for ever engaged in physical labor was now negative and significant for three of the health measures. When the duration variable was broken down into a series of dummy variables measuring work duration in decades, we found that the duration result was driven by the 13 percent of the sample who reported working 60 years or more. It is highly likely that the duration effect reflects causation from health to work not from work to health. That is, only those who are healthy can work for very long durations. We attempted to instrument for work duration using the age at which the respondent first started physical

work but the instrument was not significant in any of the health regression equations. Either this is a poor instrument or the duration of work has no effect on health.

There are significant differences in several measures of health associated with different occupations. Professional and government workers report worse ADL status, and more diseases and illnesses than those who worked in agriculture, forestry, or fisheries. Industrial workers report worse ADL status and more diseases, commercial and service workers report fewer illnesses, military personnel report more diseases, and those who worked in the household report worse ADL status. It is interesting to note that these occupational differences in more objective measures of health do not translate into worse subjective reports of health or quality of life. As noted above, it is not clear whether these differences reflect occupational differences in working conditions, income, or occupation-related differences in access to health care. The relatively better health of primary-sector workers could reflect better nutrition due to better access to food.

Being sick as a child or going to bed hungry does not appear to affect adult health, at least among the oldest-old. However, not receiving adequate care when sick as a child is associated with poorer health at older ages and is statistically significant for all health measures except interviewer reported health. This finding could reflect either economic deprivation in childhood or a lack of local medical facilities. The regional and urban/rural dummies should control to some extent for differences in the availability of facilities. Birth parity is not related to health, except in the case of respondents who were fourth and higher order births. These individuals report better global health and quality of life. Further support for the importance of childhood SES comes from health differences related to father's occupation. Children of farmers, foresters, and fishermen

tend to have better ADL status and fewer diseases. The one exception is children who reported their father's occupation as "housework"; they tend to report better health.

A number of personal characteristics are associated with some measures of health status at advanced age. Like Zeng et al. (2002), we found that ADL status declines with age but we did not find evidence of non-linear decline. Nor did we find a significant effect of age on self-reported health. Two other significant age effects were found, a significant negative association with interviewer rating and a positive association with self-reported quality of life, although the latter association was negative and insignificant in a regression including only age and sex. No non-linear age effects were found for these other health measures. Unlike Zheng and Vaupel (2002), we did not find a decline in reported quality of life after age 94. In fact, we found those over 94 years to report a better quality of life. We did find those over 94 years to report fewer ADLs and more illnesses and interviewers to rate their health as poorer than younger respondents.

(Table 4 here)

In general, males reported better health than females but males reported lower quality of life than did females, although the latter association is positive and significant in a regression including only age and sex. The better educated had higher self-reports of health and quality of life than the less well-educated. Interviewers also rated the health of the more educated to be better. As noted above, the channels through which education is assumed to work, lifestyle choices, adult SES, and personality are controlled for here, so the impact of education is in addition to any effect through these channels. We found that reporting that one's first marriage was a "good" marriage was associated with better reported health.

Those who survive to very old ages seem to be little affected by life style choices with one very important exception. Exercise may impart benefits on more objective measures of health status (ADLs, illnesses) and on global reports of health and well-being. However, reverse causation is also a possibility because those who are healthy are more able to exercise. A positive personality appears to be good protection against the ravages of time. Irrespective of the specification of the model or the estimation technique, those with an optimistic personality not only reported a more positive outlook on their health and quality of life but they also reported fewer ADLS, diseases, and illnesses. This could be because they set a higher threshold for what constitutes a “disease” or “impairment” or it could be that a more positive outlook somehow mediates other factors that can lead to poorer health.

We also tested a statement made by Zeng et al. (2002:268) in their study of the same population we have studied. They concluded that “exceptionally long-lived people are likely to consider health to be good and view life as satisfactory, relatively independently of their capacity to perform daily activities.” We added the ADL status variable to each regression as an explanatory variable (ignoring the fact that it was an endogenous variable). For all health measures except self-reported quality of life, those with better ADL status reported better health. So, in addition to finding support for at least part of the conclusion reached by Zeng et al, we find that their conclusion generalizes to other measures of health. This reinforces our conclusion that the health measures collected in the Healthy Longevity Survey capture different aspects of health.

Finally we checked the robustness of our findings to different estimation approaches. We re-estimated the ADL and disease regressions by ordinary least squares,

ordered probit (without grouping responses), and as count models (Poisson and negative binomial). Our results were robust to estimation technique.

Conclusions

The Healthy Longevity Study collected data on six measures of health employed in this study. The correlations among the different measures were quite low and there was little statistical support for combining these measures into a smaller number of measures of “health”. We agree with Murray’s conclusion that health is a “multidimensional concept”. The measures did not break down into a simple pattern of “more objective” measures such as ADLs, number of diseases, and number of illnesses, and “more subjective” self-reports of global health and quality of life. Although the effects of some variables tended to be similar for the more objective measures or the more subjective measures, this was not always the case. That is, the oldest-old in China exhibit different forms of “health”.

To the best of our knowledge, ours is the first study to investigate the impact of childhood health and socioeconomic status in a developing country and to study this relationship for the oldest-old. We found that childhood health and socioeconomic status had independent effects on adult health even at very advanced age and even after controlling for adult socioeconomic status and lifestyle choices. The variable that was most important was whether a child received care for childhood illnesses. Those that did receive care reported better objective and subjective health at advanced ages. The importance of this finding is that the provision of health care services in childhood can have very long-term returns in the form of improved adult health even at quite advanced ages.

Some other variables that were associated with at least some measures of better health were being happily married and exercising. We did not find that smoking and drinking had adverse health effects at advanced age, perhaps because those most susceptible to these “vices” had already been removed from the population.

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