FUNCTIONAL CAPACITY AND SELF-EVALUATION OF HEALTH AND LIFE OF OLDEST OLD IN CHINA[1]

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Abstract

This study is based on data of 8,805 elders aged 80-105 from the healthy longevity survey conducted in 1998 in 22 provinces consisting of 85% of the total population of China. We found that oldest old in rural China are significantly more active in daily living than urban oldest old are; adaptation to poorer facilities, which may force rural oldest old do things themselves, is perhaps the major factor to explain the rural-urban differentials in ADL independence. Female oldest old in China are seriously disadvantaged in functional capacities and self-reported health as compared with their male counterparts, which deserves serious attention from society and government. The percent of being active in daily living, having good physical performance, normal cognitive function and well-being drop dramatically from age 80-84 to 100-105. The proportion of reporting satisfaction in current life, however, remains almost constant from age 80-84 to 90-94 and declines slightly afterwards. This may suggest that being

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more positive in self-feeling of current life is one of the secrets of longevity. Our logistic regression analysis has confirmed that education is a remarkably positive factor significantly contributing to better physical performance, cognitive function, self-reported health, life satisfaction and well-being at oldest old ages.

INTRODUCTION: Why is Study on Oldest Old Important?

The population of China, the most populous country in the world with 1.28 billion people in 2000, is aging at an extraordinarily rapid speed and to a large scale. The proportion of elderly aged 65 and above of the Chinese population was 5.6 and 6.8 percent in 1990 and 2000. However, this proportion will climb quickly to 15.7 and 22.6 percent in 2030 and 2050, respectively, under medium fertility and medium mortality assumptions (U.N. 1999a; 1999b)[3].

It is common knowledge that oldest old persons aged 80 and above are most likely to need help, and most of the younger elderly persons aged 65 to 79 are relatively healthy. Oldest old persons consume amounts of services, benefits, and transfers far out of proportion to their numbers. For example, about a quarter of medicare payments to hospitals were on behalf of the oldest old patients in 1988 in New York City (Suzman et al. 1992: 6). According to a German study, 1.7, 3.2, 6.2, 10.7, and 26.3 percent of the elderly age 65-69, 70-74, 75-79, 80-84 and 85+, respectively, regularly need health care services (Schneekloth et al. 1996). Most oldest old persons are widows or widowers and need a lot of support. There were about 7.7 and 11.5 million oldest old in China in 1990

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[3] Note that medium fertility assumes that the Chinese fertility level will be about 1.9 children per woman in the first half of the 21st century, and medium mortality assumes that life expectancy at birth in China will increase from 71 years in 2000 to 78.7 years in 2050.

and 2000, but the number of oldest old will climb extremely rapidly to about 27, 64, and 100 million in the years 2020, 2040 and 2050, respectively, under the medium mortality assumption. The average annual increase rate of the oldest old between 2000 and 2050 will be 4.4 percent, in contrast to 2.4 percent of the overall elderly population aged 65+, and 0.3 percent of the total population of China during the same period. The percent share of the oldest old among the elderly population in 2050 will be 2.3 times as high as that in 2000 (U.N., 1999b). The demographic driving force of the extremely rapid increase of the oldest old in China is that baby boomers, those born in the 1950s and 1960s, will become oldest old after 2030.

The U.N. population projections discussed above assume that life expectancy at birth in China will increase from 71 years in 2000 to 78.7 years in 2050. This projection is quite conservative, given the fact that life expectancy in Japan in 1995 had already reached 80 years. Some recent research indicates that there might be a significant improvement in mortality in the 21st century because of biomedical advances and breakthroughs, and better personal health practices and life styles. We, therefore, made another more optimistic scenario: life expectancy for both sexes combined is assumed to approach 84.9 years by 2050 (Ogawa 1988), a level that is about 4.5 years greater than that in Japan today. This low mortality scenario is subject to uncertainty, but we believe that it is not impossible, and the medium and the low mortality scenarios bracket an informative range of possibilities in China during the first half of the 21st century. Under the low mortality scenario, the elderly aged 65+ will comprise 17.4 and 26.5 percent of the total Chinese population in 2030 and 2050, respectively, and the oldest old will number 38, 58, 100 and 160 million in the years 2020, 2030, 2040 and 2050, respectively (Zeng and Vaupel 1989; Zeng, 1994).

Note that China is not alone with respect to the extremely rapid increase of oldest old people. In almost all Western countries and in many other developing countries, the oldest old sub-population is growing much faster than any other age group is. For example, according to the most recent U.N. population projection (medium mortality), the annual increase rate of the oldest old persons age 80+ between 1990 and 2050 in U.S., Canada, France, Germany, Japan, India, Korea, and Mexico would be 2.2, 2.9, 1.6, 1.7, 2.4, 4.0, 4.4, and 3.7 percent respectively (Population Division 1999). In contrast, the annual increase rate of the total elderly population age 65+ in the Western countries is around 1 percent, and between 2.1 to 2.7 percent in the above-mentioned developing countries.

Obviously, the oldest old sub-population is growing much faster than any other age group is, and they are the most likely to need help. These factors suggest a need to investigate the factors affecting the health and well-being of the oldest old. However, this topic, and indeed more general study of the oldest old sub-population, has received little attention. In some countries, notably in the United States, efforts have been made to attract academic and policy attention to oldest old people (Suzman et al., 1992). Elsewhere in the world, however, little attention has been paid to ensure sufficient representation of the oldest old in national surveys (Grundy et al., 1996: 144). As summarized by Grundy et al. (1996: 143), most of the elderly studies in the developed countries include few or no subjects aged 80 and over and few or none report results for the oldest old group. In almost all developing countries, very little is known about the oldest old, and all national surveys have not had a large enough sub-sample size to represent the oldest old population. For example, the largest Chinese survey on support systems for the elderly, conducted by China Research Center on Aging in 1992, interviewed 20,083 elderly persons aged 60+. Among them, 1,092 persons were aged 80-

84, and only 470 persons were aged 85 and above. There were about 5.4 million and 2.3 million persons aged 80-84, and 85+ in 1990, and about 7.8 million, and 3.7 million persons aged 80-84, and 85+ in 2000, respectively. Obviously, the sub-sample size for the oldest old in the 1992 survey is insufficient for sound scientific analysis.

To fill in the data gap and gain a better understanding of demographic and socioeconomic conditions, the health status and care-giving needs of the oldest old population, a large longitudinal survey research project on determinants of healthy longevity of oldest old aged 80+ has been conducted in China since 1998. Based on relevant and unique data collected in the first wave of our healthy longevity survey conducted in 1998, this paper intends to shed light on some important aspects of well-being and quality of life of the oldest old in China. Note that the World Health Organization reported in 1995 the completion of pilot work on a 100-question form on quality of life (WHOQOL), based on a broader conception of health as "a state of complete physical, mental, and social well-being, not merely the absence of disease". The WHOQOL consists of six main sections including physical health, psychological health, level of independence, social relations, environment, and spirituality (Orley 1995). Kahneman, Diener, and Schwarz (1999) propose five conceptual levels as relevant for research on well-being: (1) External ("objective") conditions (e.g., income, neighborhood, housing); (2) Subjective well-being (e.g., self-reports of satisfaction/dissatisfaction); (3) Persistent mood level (e.g., optimism/pessimism); (4) Immediate pleasures/pains and transient emotional states (e.g. joy, anger); (5) Biochemical, neural bases of behavior. Note that it is impossible to collect all the information related to quality of life and well-being (as proposed in WHOQOL and Kahneman et al. (1999)) in a single survey. We will thus be able to deal only with some main aspects of the well-being and quality of life of the oldest old in China through

presenting a descriptive analysis on functional and cognitive capacities, self reported health and life satisfaction in this paper. A brief description of the data resource will be presented in the next section. The third section presents our findings on prevalence, age pattern, gender and rural-urban differences of Activities of Daily Living (ADL), Physical Performance, Mini-Mental State Examination (MMSE), self-reported health status, self-reported life satisfaction, and well-being, which is based on a combination of the ADL, MMSE, and the self evaluations of health and life. We wish to indicate that the phrase "well-being" used in this paper is an approximation of the well-being and quality of life of the oldest old Chinese persons. The fourth section discusses the possible explanations and some policy implications of our findings, and concludes the paper as well.

DATA RESOURCES: The 1998 Healthy Longevity Survey

As mentioned earlier, previous larger demographic survey studies on elderly proportionally sampled elderly persons age 60+, which resulted in a too small sub-sample size at oldest old ages, especially 90-99 and 100+. The first wave of the Chinese longitudinal survey on healthy longevity conducted in 1998, which is the main data resource of this paper, tried to overcome these limitations. The survey was conducted in a randomly selected half of the counties and cities of the 22 provinces where Han Chinese people are the overwhelming majority. The 22 surveyed provinces are Liaoning, Jilin, Heilongjiang, Hebei, Beijing, Tianjing, Shanxi, Shaanxi, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shangdong, Henan, Hubei, Hunan, Guangdong, Guangxi, Sichuan, Chongqing, covering 985 million, 85.3 percent of the total population in China. Extensive questionnaire (92 questions on 180 items) data including demographic, family households, activities of daily living (ADL), physical performance, Mini-Mental State Examination (MMSE), life style, diet, psychological characteristics (disposition), economic resource, family support and medical care

services were collected. The survey tried to interview all centenarians, who voluntarily agreed to participate in the survey in the randomly selected counties and cities of the 22 provinces. For each centenarian, the survey tried to match and interview one near-by octogenarian (aged 80-89) and one near-by nonagenarian (aged 90-99) with pre-designated age and sex, if possible. The idea was to have approximately equal numbers of male and female octogenarians and nonagenarians at each age from 80 to 99. We thus over-sampled extremely old persons and over-sampled male oldest old, given the fact that there are fewer persons at more advanced ages, and fewer males than females. The total sample size of the oldest old aged 80 to 105 analyzed in this paper is 8,805. Among them, there are 1,768 and 1,728 male and female octogenarians age 80-89, 1,316 and 1,719 male and female nonagenarians age 90-99, 463 and 1,811 male and female centenarians age 100-105, respectively. A more detailed distribution of sub-sample sizes classified by sex, rural-urban residence and five-year age group is presented in Table A1 in the Appendix. We did not follow the procedure of proportional sampling in order to avoid a too small sub-sample size at more advanced ages, especially for males. Consequently, appropriate weights should be used to compute the overall average and the averages of the age groups (e.g. 80-89 and 90-99), but no weights are needed when computing average for the centenarians. The method for computing the age-sex and rural-urban specific weights and the discussions are presented in Appendix A of another paper (Zeng and Vaupel et al., 2000).

Coale and Li (1991) concluded that the age reporting of oldest old persons in most provinces of China, where Han Chinese who know precisely their birth date constitute the majority, was as reliable as that in the developed countries. But in some regions where the majority or a significant proportion of the population belongs to other ethnic groups, the age reporting is inaccurate. This is exactly the reason why we restrict our survey to

the 22 provinces where Han Chinese are the overwhelming majority. A recent study focusing on age validation of Chinese Han centenarians through rigorous comparison of the demographic indices of the age reporting with Sweden, Japan, France and Italy is consistent with Coale and Li's findings (Wang, Zeng, Vaupel, and Jeune 1998).[4] A fairly close similarity of age distribution between centenarians interviewed in our 1998 survey and Swedish centenarians has been found (see Figure 1 in Zeng and Vaupel et al., 2000), and it leads us to believe that age reporting in our 1998 survey is generally good. A careful data quality evaluation (such as reliability coefficients, factor analysis, the rates of logically inconsistent answers, etc.), has shown that the data quality of our 1998 survey is generally good (see Zeng and Vaupel et al., 2000, for more detailed information).

FINDINGS

Activities of Daily Living (ADL)

The ADL functional statuses of eating, dressing, transferring, using the toilet, bathing, and continence are used to measure the elders' status of independence in daily living. If none of the six ADL activities is impaired, the elder is classified as "active"; if one or two activities are impaired, the elder is classified as having "mild disability"; "severe disability" refers to those elders who have three or more activities impaired. It has been found that elders in developed countries who live in nursing homes are more likely to be disabled. Therefore, some scholars treat "Institutionalized" as one disabled status. However, the active life expectancy of the Chinese oldest old who live in nursing

[4] The age reporting of those "super-centenarians" who reported their age as 106 and above (165 cases in our sample) is somewhat questionable. Because the sub-sample size of the super-centenarians is small, even a very small number of persons exaggerating their ages may result in more serious relative bias (Wang et al. 1998).Therefore, they are not included in the analysis in this paper, and special analysis will be devoted to them later.

homes did not differ substantially as compared with those living in private family households, and institutionalized elders account for a very small proportion of the total (Zeng and Vaupel et al. 2000)[5]. We, therefore, categorize the functional capacity of oldest old persons based solely on their ADL scores, disregarding whether they live in a private household or nursing home.

Proportional distributions of the active and disability status of the oldest old persons classified by sex, age, and rural-urban residence are presented in Table 1. Approximately 88.2, 7.6, and 4.3 percent of the oldest old men aged 80-89 living in rural areas are in active, mild disability and severe disability statuses, respectively. The corresponding figures for the urban male oldest old are 81.5, 12.7, and 5.8 percent. The proportion of active, mild disabled, and severely disabled status for the women aged 80-89 living in rural areas is 84.5, 9.1, and 6.5 percent, respectively. The corresponding figures for their urban counterparts are 78.6, 15.9, and 5.5 percent.

--- Table 1 is about here---

A lower proportion of active status, but similar patterns of rural-urban and gender differentials are found for the nonagenarians and centenarians. About 75.5 and 64.9 percent of the rural male and female oldest old aged 90-99, respectively, are in active status. The corresponding figures for male and female oldest old persons in urban areas are 65.4 and 52.9 percent. About 48.6 and 38.5 percent of the rural male and female

[5] In developed countries, entering a nursing home is most likely due to disability. However, the main reason for entering a nursing home in China today is childlessness (or lacking close-by children), which makes the elder eligible to apply for the limited rooms in the nursing homes subsidized by the government. Those elders who are disabled but have children close-by are supposed to be taken care of by their children (or grandchildren). The commercial nursing homes service industry is growing, but is not yet well developed. Furthermore, in the Chinese cultural context, elders who have close-by children generally do not like to live in nursing homes, and their family members also prefer that the elders remain in their care. These explain why the difference of ADL

centenarians aged 100-105, respectively, are in active status. The corresponding figures for urban male and female centenarians are 39.2 and 27.8 percent. The rural-urban differences are statistically significant for male and female oldest old aged 80-89, 90-99, and 100-105, all at a level of $p<0.001$, except male centenarians at a level of $p<0.063$ (see Table A2 in the Appendix[6]). The gender differences are all statistically significant for rural and urban oldest old aged 80-89, 90-99, and 100-105, except the urban octogenarians (Table A2 in the Appendix).

In addition to ADL statuses (active, mild disability, severe disability) of octogenarians, nonagenarians, and centenarians, as shown in Table 1 and discussed above, we further depict in Figure 1 the age pattern of percentage distribution of active status of oldest old classified by 5-year age groups and gender. The percent of active status in daily living declines quickly after age 80, especially after age 85-89. The four curves (not shown in the Figure due to space limit) of percent of rural-urban and male-female oldest old persons who are active in daily living are almost parallel, and the percent of rural oldest old is substantially higher than that of urban oldest old. The male curve for rural and urban areas combined is substantially above the female curves, except at age 80-84. It is interesting to note that the gender and rural-urban differences are larger for the nonagenarians and centenarians than for the octogenarians.

---Figure 1 is about here---

Physical Performance

The ADL functional statuses based on the questionnaire inquiries concerning eating, dressing, transferring, using the toilet, bathing, and continence are basically subjective

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status between elders who live in private households and those who live in nursing homes do not differ substantially in China.

measurements, which have been proven useful in measuring functional capacity in daily living and service needs by numerous previous studies. Some investigations even indicated that ADL is useful in predicting mortality (e.g. Scott et al. 1997). However, ADL may not always accurately measure oldest old persons' actual capacity in physical performance. As to be discussed later, for example, adaptation to poor service facilities in rural areas may result in better ADL capacity among rural oldest old than that of their urban counterparts, but the rural oldest old may not necessarily be stronger in physical health. Some oldest old people may feel ashamed to admit difficulties in some daily activities such as continence. Therefore, we conducted three objective examinations to measure oldest old subjects' physical performance: standing up from a chair; picking up a book from the floor; turning around 360^0 without help.

Table 2 shows that about 87.8 and 84.1 percent of the male and female octogenarians can stand up from a chair without using hands; this percent decreases quickly after age 85-89 (see Figure 2). About 73.5 and 54.0 percent of the male nonagenarians and male centenarians can stand up from a chair without using hands, in contrast to 62.6 and 36.9 percent for female nonagenarians and female centenarians. The gender differences are all statistically significant -- male oldest old perform better than females do; the gender gap becomes much larger after age 90-94 (see Figure 2). The rural-urban differences are minor and not statistically significant[7] except in the case of urban centenarians (See Table 2 and Table A2 in the Appendix).

--- Table 2 and the page containing Figures 1-8 are about here ---

[6] P-values of statistical tests on the gender differences in rural and urban areas and rural-urban differences among male and female oldest old persons are presented in Table A2 in the Appendix.

[7] The fact that rural-urban differentials are mostly not statistically significant in physical performance, MMSE, self-reported health and life satisfaction has led us to decide to plot male and female curves (with rural and urban combined) in Figures 1-8.

It is interesting to note that the age and gender distributions of the performance of picking up a book on the floor from a standing position are rather similar to those of the performance of standing up from a chair without using hands (see Figure 3 and Figure 2). Male oldest old persons perform picking up a book from the floor significantly better than their female counterparts do (Table 3 and Figure 3). The data not shown in Table 3 and Figure 3 reveal that the rural-urban difference of percent of being able to pick up a book on the floor from a standing position is almost zero at age 80-85. The rural-urban difference becomes visible in favour of urban oldest old at ages 85-89 and 90-94, but diminishes at ages 95-99 and 100-105.

-- Table 3 is about here --

We found that oldest old men perform the objective examination of turning around 360^0 significantly better than the oldest old women did (see Table 4 and Figure 4), and that the rural-urban differences are mostly minor and not statistically significant (see Table A2 in the Appendix).

-- Table 4 is about here --

Unlike the clear pattern of worse ADL scores among urban oldest old as compared to rural oldest old, the urban oldest old persons tend to physically perform slightly better than their rural counterparts do, but the rural-urban differences in physical performance are mostly not statistically significant. Although urban oldest old have worse ADL scores, their physical health may be at least as good as that of the rural oldest old, as shown by our objective examinations data.

Mini-Mental Sate Examination (MMSE)

The mental state of Chinese oldest old was screened by the Chinese version of Mini-Mental State Examination, which was culturally translated and adopted into the Chinese language based on the international standard of MMSE questionnaire, and carefully

tested by our pilot survey interviews. The Chinese version of MMSE tries to meet the cultural and socioeconomic conditions among the oldest old persons in China to make the questions easily understandable and practically answerable if the subject's cognitive function is normal. For example, in the orientation part, we asked, "What is the animal year of this year?" This question is much better than asking what the Western calendar year is, since the non-educated oldest old persons living in rural areas may not know the Western calendar. Instead of asking the subjects to read and write a sentence, we asked the subject to give the name of as many foods as they could. We also simplified the question on calculation. This is because the majority of Chinese oldest old have no education. The total score of MMSE is 30; the methods of determining the score for each item of the orientation, registration, attention, calculation, recall, and language are the same as the international standard. We also use the same cutoffs of the MMSE international standard to define a score of 24+ as "Good", 21-23 as "So so", and <21 as "Poor" for measuring the cognitive function (see, e.g. Deb and Braganza 1999; Osterweil et al. 1994).

For the rural and urban sectors combined, about 85.8, 69.0, and 40.6 percent of male octogenarians, nonagenarians, and centenarians are in "Good" cognitive functional status (MMSE score is 24 or above). In contrast, 73.8, 46.5, and 21.7 percent of female oldest old aged 80-89, 90-99, and 100-105 are in good cognitive functional status, respectively (see Table 5). Table 5 also shows that, when we look at rural and urban areas separately, proportions of male oldest old who have "Good" cognitive function are substantially higher than those of the female oldest old at all age groups of 80-89, 90-99, and 100-105. The gender differences are statistically highly significant ($p<0.001$) for octogenarians, nonagenarians, and centenarians in both rural and urban areas (see Table A2 in the Appendix). Figure 5 demonstrates that the cognitive functional capacity of the

Chinese oldest old declines quickly with the increase of age. The gender gap of cognitive function among the oldest old (rural and urban combined) becomes extremely large (about 20 percentage points) at and after age 85-89. Urban oldest old tend to have a better cognitive functional status than their rural counterparts have, but the rural-urban differences are statistically significant only among female octogenarians, female nonagenarians, and male centenarians (see Table A2 in the Appendix).

-- Table 5 is about here --

Self-Reported Health and Life Satisfaction

Many previous studies have demonstrated that self assessed health acts as a significant and independent predictor of functioning and mortality of older people (e.g. Lee 2000). About 61.6, 59.0, and 54.3 percent of the male oldest old aged 80-89, 90-99, and 100-105 (rural and urban combined) reported "good health", respectively, in contrast to the corresponding percentages of 57.6, 50.1, and 42.9 for the female oldest old (see Table 6). The gender difference is statistically significant for nonagenarians and centenarians, but is not significant for the octogenarians. The gender differences of proportion of self-reporting good health are statistically significant in rural areas; the rural female is clearly in a disadvantaged status. In the urban areas, almost the same proportion (60%) of the male and female octogenarians self-reported good health, but the proportions of self-reporting good health among the male nonagenarians and male centenarians are higher than those of their female counterparts by 7.1 and 4.9 percentage points, respectively (see Table 6). The rural-urban differences in self-reported health are not statistically significant except in the case of female centenarians (see Table A2 in the Appendix).

Figure 6 presents the proportions of male and female oldest old (rural and urban combined) who self-reported good health. The male proportions decline slightly from age 80-84 to 85-89 and then remain constant up to age 95-99, and then decline modestly. The female proportions decline modestly from age 80-84 to 95-99 and then remain constant. It is clear that proportions of self-reporting good health among Chinese oldest old do not decline quickly with the increase of age, which differ from the age pattern of ADL, physical performance and MMSE.

-- Table 6 is about here --

In the survey, we requested that the question about self-rated health be answered only by the subjects themselves. No proxy was permitted to help to fill in this question. We, therefore, believe that the category "not able to answer" (1.1, 4.4, and 15.2 percent at ages 80-89, 90-99, and 100-105, respectively) accounts for the oldest old whose cognitive function or hearing or speaking capacity is very bad. These elders would most likely report "bad" health if they could answer the question. The percentages of reporting "bad" health plus "not able to answer" are 8.5, 9.6, 17.1 for male oldest old aged 80-89, 90-99, and 100-105, respectively. The corresponding figures for the female oldest old of these three age groups are 9.8, 16.0, and 25.4 percent, respectively. Male oldest old in China not only do better in activities of daily living, physical performance, and MMSE cognitive function, but also feel that they have better health, and thus are more likely report "good health".

In addition to self-rated health, we also asked, "How do you rate your life at present?" The results on self-reported life satisfaction are listed in Table 7 and are depicted in Figure 7. Unlike ADL, physical performance, and MMSE, the gender differences in self-reported life satisfaction among Chinese oldest old are mostly rather small and often not statistically significant. Urban oldest old tend to report better life

satisfaction than their rural counterparts do, but the rural-urban difference is not substantive.

About 71.8, 72.1, and 67.3 percent of the male oldest old aged 80-89, 90-99 and 100-105 reported that they were satisfied with current life, respectively. The corresponding figures for the female oldest old are 71.7, 71.4, and 63.2 percent, respectively. Figure 7 shows the very interesting phenomenon that the proportion of being satisfied with current life among Chinese male and female oldest old persons does not decline or declines slightly with the increase of age (see Figure 7).

--Table 7 is about here –

Well-being

As discussed in the introduction, the concept of well-being is complicated; it may include six sections of WHOQOL (Orley 1995) or five conceptual levels (Kahneman et al. 1999). Due to constraints of data availability[8] as well as limit of space in a single paper, we will be able to deal only with some main aspects of the well-being of the oldest old in China. We have thus far discussed ADL, physical performance, MMSE, self-reported health and life satisfaction. Although ADL is basically subjective and physical performance is objective, they both measure the capacity of daily living, and are highly correlated with a correlation coefficient of nearly 0.6. Self-reported health and self-reported life satisfaction deal with the same dimension of self-evaluation on current life quality, although with different focuses. Self-reported health and self-reported life satisfaction are also highly correlated with a correlation coefficient value of nearly 0.5. We, therefore, include ADL (rather than physical performance) to present capacity of

[8] For example, we did not collect detailed income data in our 1998 healthy longevity survey, given the fact that it was extremely hard to collect accurate data on income since people often did not wish to tell exactly how much money they make. Furthermore, most

daily living, MMSE to measure cognitive function, and self-reported health (rather than self-reported life satisfaction) to measure self-evaluation of life quality, to construct a variable of well-being. An oldest old person is defined as experiencing "well-being" if he or she is active (i.e. no impairment in the six daily activities), has good cognitive functional capacity (score of MMSE is 24 or above), and self-reported very good or good health. Otherwise (i.e. impairment in at least one of the ADL, MMSE and self-reported health), he or she is defined as experiencing "unwell-being".

About 52.0, 39.4, and 21.2 percent of the male oldest old aged 80-90, 90-99, and 100-109 (rural and urban combined) are in the status of well-being, respectively. In contrast, the corresponding figures are 41.8, 23.0, and 9.0 percent for the female oldest old. The proportions of well-being status among male oldest old persons are substantially higher than those of their female counterparts at various age groups in both rural and urban areas; the gender differences are statistically significant (see Table 8 and Table A2 in the Appendix). Figure 8 shows that Chinese male oldest old persons are remarkably better off in well-being measured by a combination of ADL, MMSE, and self-reported health. The gender gap at ages 85-89, 90-94, and 95-99 are as large as 20 percentage points; the gap at ages 80-84 and 100-105 is relatively smaller, but still very substantive (>10 percentage points). The rural-urban differences in well-being are not statistically significant.

-- Table 8 is about here --

Association of Education with ADL, Physical Performance, MMSE, Self-Evaluation on Health and Life, and Well-being

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of the Chinese oldest old do not have their own income, but mainly rely on financial support provided by children or other family members.

Multivariate statistical analysis on the effects of socioeconomic, behavioral, life style, and environmental factors on oldest old persons' ADL, physical performance, MMSE, self-evaluation on health and life, as well as well-being is outside the scope of this paper and will be carried out in our subsequent studies. We, however, will present a simple logistic regression analysis to explore the effects of education, which is the major indicator of socioeconomic status. The dependent variables of each of the simple logistic regression models are listed in the first line of Table 9. The definition and coding of dependent variables of each of the models are described in the endnote of Table 9. The independent variables of each of the models are education and demographic controlling variables (age, sex, and rural-urban residence), listed in the first column of Table 9. This is a univariate model plus demographic controls. The purposes of this analysis are mainly twofold. One is to explore the association of education with functional capacity, self-evaluation of health and life among oldest old persons, with controlling for demographic variables of sex, age, and rural-urban residence. Another purpose is to further analyze the age pattern, gender, and rural-urban differentials in oldest old persons' functional capacity, self-evaluation on health and life, while adjusting for the major socioeconomic confounding factor of education. This is useful because the effect of education on a person's life is so substantial (see, e.g., Preston and Taubman 1994; Zeng and Vaupel 2000) that it needs to be adjusted for a better understanding of the age pattern, gender and rural-urban differentials. Furthermore, the age, gender, and rural-urban differentials of educational attainment among Chinese oldest old persons are particularly very large (see Table A3 in Appendix); this fact increases the importance of adjusting for the education effect.

The results of the simple logistic regression analysis with education plus demographic controlling variables as covariates shown in Table 9 has confirmed that

education is a remarkable factor positively associated with better cognitive function, physical performance, self-reported health and life satisfaction, as well as well-being. The odds ratios of impaired cognitive function, the inability to pick up a book from the floor, the inability to stand up, and the inability to turn around 360^0 for educated oldest old are 50, 15, 12, 18 percent lower than those of illiterate oldest old, respectively. The odds ratios of not reporting good health and not reporting satisfaction in current life and experiencing "unwell-being" for educated oldest old persons are 17, 23, and 35 percent lower than those of illiterate oldest old, respectively. The logistic regression estimates of association between education and MMSE, physical performance, self-reported health and life satisfaction, as well as well-being, while controlling for age, sex, and rural-urban residence, are all statistically significant. It is interesting to note that the estimate of association between education and ADL is not statistically significant.

The odds ratios of ADL disability, cognitive impairment, the inability to pick up a book from the floor, the inability to stand up, and the inability to turn around 360^0 for female oldest old are 48, 75, 60, and 55 percent higher than those of male oldest old, respectively. Female oldest old persons' odds ratio of not experiencing well-being is 51 percent higher than that of male oldest old. The gender differences are so dramatic that Chinese female oldest old persons are in a seriously disadvantaged status of ADL, MMSE, physical performance and well-being, while controlling for education, age and rural-urban residence. The female disadvantage in self-reported health is relatively less serious, but is significant. The female oldest old persons' odds ratio of self-reporting dissatisfaction with current life is 7 percent lower than that of the male oldest old, but is not statistically significant.

While adjusting for education, age and sex, the rural oldest old persons' odds ratio of being ADL impairment is 38 percent lower than that of the urban oldest old; this difference is very substantial. The rural-urban differences in the odds ratios of MMSE, turning around 360^0, self-reported life satisfaction, and well-being are statistically significant, but less substantial, as compared with that of ADL. The rural-urban differentials in picking up a book from the floor, standing up without using hands and self-reported health are not statistically significant. After controlling for education, sex, and rural-urban residence, the odds ratios of ADL, physical performance, MMSE and well-being for nonagenarians and centenarians are 100-190 and 460-770 percent higher than those of octogenarians, respectively. However, such dramatic differences linked to age were not found in self-reported health and life satisfaction. The odds ratio of reporting dissatisfaction with current life for nonagenarians is even lower than that of octogenarians by 4 percent, but the estimate is not statistically significant.

---Table 9 is about here—

DISCUSSIONS AND CONCLUSIONS

Possible Explanations for Rural-Urban Differentials in ADL

Why are the oldest old persons in rural China more likely active in daily living than the urban oldest old are? There are four potential explanations. First, facilities to assist oldest old persons in their daily life are less likely to be available in rural than in urban areas. This may force rural oldest old persons to perform daily activities by themselves, and this frequent exercise may enable them to maintain their capacities for daily life for a longer time than their urban counterparts can. This explanation may also help us to understand the fact that the elderly in Indonesia, Malaysia, the Philippines, Singapore, and Thailand were found to be more active than the elderly in developed countries (Ju

and Jones, 1989; Lamb, 1999: 3). A pilot study of our ongoing healthy longevity project found that the ADL functional capacity of centenarians in Beijing, Hongzhou, and Chendu was significantly better than that of Danish centenarians (Wang, 2000). The second potential explanation for the rural-urban differentials found in this study is also related to the frequency with which daily activities are carried out. In Chinese urban areas, a large majority of the population lives in apartment buildings without elevators. It may not be easy for the oldest old who do not live on the ground floor to go out of their apartments. Very few urban residents in China have their own yard or garden. These factors may reduce the amount of physical activity that the urban elderly engage in, and thus limit their capacity for daily living. On the other hand, almost all of the oldest old persons in the rural areas of China live in houses with only one story, and they all have access to gardens and agricultural fields. The oldest old in rural areas of China are likely to continue to perform garden work to grow vegetables or even to perform some light labor in the fields, which may help them to maintain their capacity for daily living. The third explanation is related to the physical environment, which is likely better in rural areas. Industrial pollution in the cities may worsen the capacity of daily living of oldest old persons, who are likely to be sensitive to the physical environment. Fourth, the harder life and higher mortality at younger ages in rural areas have resulted in a population of oldest old persons who are more selected than those in cities and towns. In other words, those who survive to very advanced ages in rural areas are less likely to be frail and thus more likely to be active. As Ju and Jones (1989: 73) noted, in high-mortality populations, the aged are those who have survived the dangers of being born, the risks of infancy and childhood, and the sickness and accidents of middle age. Selection, however, is perhaps not the major factor to explain the better ADL of rural oldest old as compared to that of urban oldest old, given the fact that physical performance, cognitive function, self-

reported health and life satisfaction of rural oldest old do not differ significantly (or somewhat worse) as compared to those of the urban oldest old, while controlling for gender, age and education. Adaptation is perhaps the major factor in explaining the rural-urban differentials in ADL independence among Chinese oldest old persons.

That the association between education and ADL among Chinese oldest old persons is not statistically significant is perhaps also due to adaptation effects. Poorer facilities available to illiterate oldest old people, who are more likely to lack resources due to lower socioeconomic status, may force them to do things themselves, which retains their ADL capacity, although their physical health and cognitive functioning may not be good.

Female Oldest Old in China are Seriously Disadvantaged in ADL, Physical Performance, MMSE and Self-reported health

Based on our unique data set with a large enough sub-sample size at extremely old ages, we are confident in concluding that the female oldest old in China are seriously disadvantaged in ADL, physical performance, MMSE and self-reported health, as compared with their male counterparts. Other studies conducted in China (e.g. Li et al. 1989; Yu et al. 1989; Woo et al. 1996; Wang et al. 2000) and elsewhere (e.g. Andersen-Ranberg et al. 1999; Pi, Olive and Esteban 1994) also demonstrated that although women have lower mortality, they are more disabled than men; this difference is more marked with advancing age. Analyses based on the Chinese census data presented by Zeng and George (2000) have shown that elderly women are much more likely to be widowed, and are more likely live alone. Elderly women are economically more dependent and are less likely to use long-term care facilities. The disadvantages of older women are substantially more serious at oldest old ages. This is an important issue, which needs serious attention from society and government. Any kind of long-term care services sponsored by the

government should take into account the disadvantaged status of elderly women, especially the oldest old women, and give them favorable policy. Very careful attention should be given to ensure that any old age insurance and service programs to be developed or reformed must benefit older women and men equally.

While oldest old women are in a seriously disadvantaged status in terms of ADL, physical performance, MMSE, self-reported health, well-being, marital and socioeconomic status, mortality rates of female oldest old persons are significantly lower than those of male oldest old (Zeng and Vaupel 2000). Why? Three preliminary explanations may shed light on this interesting question. First, a biological system in favour of women's survival at advanced ages may play an important role, but the mechanism is still not clear. Second, the rates of smoking and drinking strong alcohol are much lower among Chinese oldest old women than among oldest old men. In traditional Chinese society it was generally considered inappropriate for a woman to smoke or to attend a formal dinner (or banquet) at which a male host and his male guests drank a lot of strong alcohol. According to the healthy longevity survey conducted in 1998, 81.4, 84.1, and 86.8 percent of the oldest old women aged 80-89, 90-99, and 100-105 had never smoked, in contrast to 35.5, 43.7, and 54.1 percent of the oldest old men of the same age groups, respectively. The percent of oldest old women aged 80-89, 90-99, and 100-105, who never drank were 77.9, 76.5 and 71.9, respectively. The corresponding figures for male oldest old were 49.2, 49.8, and 50.8 percent. Obviously, Chinese oldest old women were subjected to a substantially lower risk of health problems and death caused by smoking and drinking strong alcohol[9]. Third, oldest old men are more likely to perform outdoor physical activities including gardening, farming, exercising, fishing,

[9] Note that people drank mostly strong alcohol rather than beer or wine in traditional Chinese society.

etc., and women are more likely to stay in the house. Oldest old men are also more likely be engaged in reading, writing, meetings, social and cultural activities since their education level is much higher than that of the oldest old women (see Table A3 in the Appendix). These factors give men a better chance of maintaining their capacity of daily living, physical performance and cognitive function. In sum, oldest old women's serious disadvantages in ADL, physical performance, MMSE, self-reported health and well-being plus their longer life and higher percentage share among the oldest old population imply that the society and government should pay more attention to the service needs of oldest old women.

Proportions of self-reporting satisfaction in current life decline only slightly from age 80-84 to 100-105, despite the dramatic decrease in functional capacity – A secret of longevity?

Figures 1-5 and Figure 8 show that the percent of being active in daily living, having good physical performance, normal cognitive function and well-being decrease dramatically from age 80-84 to 100-105. The proportion of reporting satisfaction in current life, however, remains almost unchanged from age 80-84 to 90-94 and then declines slightly afterwards (see Figure 7)[10]. A similar pattern is also found in the age pattern of self-reported health: the proportion of oldest old who reported good health

[10] Quick decline in physical abilities with age was also found in Danish twins and centenarian study (Andersen-Ranberg et al. 1999). A longitudinal study in Berkeley of the United States found that life satisfaction mostly does not decrease until advanced old age (Field & Millsap, 1991:305). Based on a survey of 3,998 elders aged 65+ in the United States, Blazer et al. (1991) indicated that the "oldest-old" suffer fewer depressive symptoms when other confounding variables such as age, gender, income, physical disability, cognitive impairment, and social support are taken into account. Our present findings, based on an unprecedented large data set on the oldest old population in a developing country, are consistent with these previous studies.

declines slightly with the increase in age among males and declines modestly among females. Furthermore, the proportion of self-reporting satisfaction in current life among oldest old women, who are seriously disadvantaged in ADL, physical performance, MMSE, and self-reported health, is almost the same as that of the oldest old men. At the same time, mortality rates of oldest old women are significantly lower than those of men (Zeng and Vaupel 2000). These findings may suggest that being more positive in self-feeling of current life is one of the secrets of longevity. Long-lived people such as nonagenarians and centenarians more likely view their life as "satisfactory", although their capacities in daily activities, physical performance, and cognitive function may not be good. The reason why long-lived people more likely view their life as "satisfactory" is that they more likely look forward positively into the future and think optimistically . The old Chinese saying "Knowing satisfaction leads to constant happiness" (Zhi Zhu Chang Le) explains the connection between life satisfaction and happiness, which may lead to longevity.

Education is a remarkably positive factor contributing to healthy aging at oldest old ages

This study has confirmed that education is a remarkably positive factor significantly contributing to better physical performance, cognitive function, self-reported health and life satisfaction, as well as well-being. Based on the pulled cohort data from the 1998 healthy longevity survey and the 1990 census, Zeng and Vaupel (2000) found that having had primary or higher education would substantially increase the likelihood of survival from age 84-89 to 100-105 and from 92-97 to 100-105 for both men and women. Studies on most adult populations have indicated that people with more schooling may more likely enjoy better health and longer lives (Preston

1994: 279-318). Some other studies also confirm that education is a positive factor for lower mortality (Feldman et al. 1989; Amaducci et al. 1998; Arias and Borrell 1998). Callahan et al. (1996) found that education is independently associated with cognitive impairment and dementia among a representative community-based sample of African Americans aged 65 and above. Based on data from 2,031 respondents aged 18 to 90 and 2,436 respondents aged 20 to 64, Ross and Wu (1996) discovered that the gap in self-reported health, in physical functioning, and in physical well-being among people with high and low educational attainment increases with age. A study on 5,055 elderly persons in Shanghai showed that education attainment has a highly significant inverse relationship with prevalence of cognitive impairments (Yu et al. 1989). Another study in Shanghai on 554 subjects aged 55 to 95 found that low education continued to be associated with increased age-specific risk of dementia (Hill et al. 1993). A new insight derived from our current study is that the positive effects of education on well-being and life quality are dramatic at oldest old ages in 22 provinces consisting of 85% of the total population of China. Educated people tend to know much more about and practice more frequently a healthy life style including appropriate diet, non-smoking, exercise etc., and thus improve health and quality of life, especially at oldest old ages, which largely reduces burdens for individuals, families and society at large. It is clear that enhancing education is not only valuable in socioeconomic development, but is also strategically important in reaching humanity's goal of healthy aging.

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APPENDIX

Table A1. Sub sample size distribution of the 1998 healthy longevity survey classified by sex, age and rural-urban residence

Ages	Urban			Rural			total		
	male	female	total	male	female	total	male	female	total
80-84	464	451	915	516	492	1008	980	943	1923
85-89	332	328	660	456	457	913	788	785	1573
90-94	298	323	621	461	542	1003	759	865	1624
95-99	183	315	498	374	539	913	557	854	1411
100-105	143	493	636	320	1318	1638	463	1811	2274
Total	1420	1910	3330	2127	3348	5475	3547	5258	8805

Note: There are 156 interviewed centenarians aged 106 or above, and 112 interviewed elders aged 78-79 in our 1998 healthy longevity survey. These people are not included in our current analysis. The total sample size of our 1998 survey is 9,073.

Table A2. P-vale of Chi-square statistical test

	sex differences			rural-urban differences		
	Urban	rural	total	male	female	total
	male vs. female	male vs. female	male vs. female	rural vs. urban	rural vs. urban	rural vs. urban
ADL						
Ages 80-89	.190	.038	.028	.000	.000	.000
90-99	.000	.000	.000	.000	.000	.000
100-105	.030	.001	.000	.063	.000	.000
MMSE						
Ages 80-89	.000	.000	.000	.294	.000	.000
90-99	.000	.000	.000	.832	.020	.056
100-105	.000	.000	.000	.045	.283	.016
self-reported health						
Ages 80-89	.997	.006	.118	.422	.220	.856
90-99	.008	.000	.000	.971	.360	.564
100-105	.121	.000	.000	.882	.002	.010
self-reported life satisfaction						
Ages 80-89	.501	.503	.898	.152	.000	.000
90-99	.414	.009	.014	.095	.132	.032
100-105	.015	.015	.003	.932	.000	.000
well-being						
Ages 80-89	.061	.000	.000	.020	.062	.701
90-99	.000	.000	.000	.118	.139	.030
100-105	.001	.000	.000	.189	.247	.147
Stand up						
Ages 80-89	.035	.087	.005	.134	.264	.060
90-99	.002	.000	.000	.791	.938	.752
100-105	.005	.000	.000	.462	.008	.045
pick up a book from the floor						
Ages 80-89	.028	.001	.002	.000	.567	.001
90-99	.000	.000	.000	.268	.009	.003
100-105	.000	.000	.000	.847	.070	.057
Turning around 360°						
Ages 80-89	.000	.000	.000	.293	.663	.284
90-99	.001	.000	.000	.000	.378	.023
100-105	.000	.000	.000	.315	.135	.106

Table A3. Distribution of Years of Schooling of the Elders by Residence, Age and Sex (%)

	Urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
0 year of schooling	19.19	68.34	43.51	39.26	86.48	62.51	30.23	78.28	53.94
1-6 years of schooling	47.37	19.66	33.66	49.96	11.33	30.95	48.79	15.09	32.17
7+ years of schooling	33.45	11.99	22.83	10.77	2.18	6.55	20.98	6.62	13.89
subtotal 80-89	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
0 year of schooling	27.03	79.51	56.78	44.43	91.87	71.23	38.05	87.31	65.91
1-6 years of schooling	47.32	16.42	29.81	46.67	7.33	24.45	46.9	10.68	26.42
7+ years of schooling	25.65	4.07	13.42	8.91	0.8	4.33	15.04	2.02	7.67
subtotal 90-99	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
0 year of schooling	44.06	85.95	76.4	51.1	96.32	87.49	48.91	93.52	84.39
1-6 years of schooling	36.36	11.16	16.91	43.85	3.37	11.28	41.53	5.48	12.85
7+ years of schooling	19.58	2.89	6.69	5.05	0.31	1.23	9.56	1.01	2.76
subtotal 100-105	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 1. The percentage distribution of Activities of Daily Living (ADL)

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
Active	81.45	78.56	79.67	88.17	84.45	85.87	85.65	82.24	83.55
mild disability	12.73	15.92	14.69	7.55	9.07	8.49	9.49	11.64	10.82
Severe disability	5.81	5.52	5.64	4.28	6.48	5.64	4.86	6.12	5.64
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
Active	65.38	52.92	56.26	75.49	64.91	67.86	71.42	59.93	63.08
mild disability	21.17	28.92	26.84	12.13	17.56	16.05	15.77	22.28	20.49
Severe disability	13.45	18.16	16.90	12.38	17.53	16.09	12.81	17.79	16.42
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
Active	39.24	27.77	29.99	48.62	38.51	41.42	45.67	33.81	36.77
mild disability	30.86	31.60	31.46	22.35	22.05	22.13	25.03	26.23	25.93
Severe disability	29.91	40.62	38.55	29.03	39.45	36.45	29.31	39.96	37.31
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 2. The percentage distribution of standing up from chair

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
yes, without using hands	87.51	82.85	85.20	88.08	85.09	86.60	87.82	84.08	85.97

yes, using hands	9.69	13.41	11.53	10.43	12.40	11.40	10.09	12.85	11.46
not able	2.80	3.74	3.27	1.49	2.51	2.00	2.08	3.06	2.57
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
yes, without using hands	72.42	62.05	66.49	74.08	62.84	67.76	73.48	62.55	67.29
yes, using hands	21.78	29.70	26.31	20.43	29.35	25.45	20.92	29.48	25.77
not able	5.80	8.25	7.20	5.49	7.81	6.79	5.60	7.97	6.94
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
yes, without using hands	52.82	40.83	43.57	54.49	35.39	39.07	53.96	36.85	40.32
yes, using hands	36.62	37.50	37.30	31.73	45.73	43.03	33.26	43.52	41.44
not able	10.56	21.67	19.13	13.78	18.88	17.90	12.78	19.63	18.24
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3. The percentage distribution of picking up a book from the floor

	urban			rural			total		
	male	female	Total	male	female	total	male	female	total
ages 80-89									
yes, from standing	85.58	81.86	83.73	85.94	81.07	83.53	85.78	81.43	83.62
yes, from sitting	8.53	12.69	10.59	12.01	14.22	13.10	10.45	13.53	11.98
not able	5.89	5.45	5.67	2.06	4.71	3.37	3.78	5.04	4.40
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
yes, from standing	74.21	62.83	67.69	70.84	56.89	62.99	72.06	59.11	64.72
yes, from sitting	18.57	25.04	22.28	22.43	32.06	27.85	21.03	29.44	25.80
not able	7.22	12.14	10.04	6.73	11.05	9.16	6.91	11.45	9.48
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
yes, from standing	51.41	33.40	37.54	50.49	31.76	35.36	50.78	32.20	35.97
yes, from sitting	29.58	35.71	34.30	32.04	41.41	39.61	31.26	39.88	38.13
not able	19.01	30.88	28.16	17.48	26.83	25.03	17.96	27.92	25.90
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4. The percentage distribution of turning around 360°

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
yes, <= 10 steps	80.71	72.54	76.65	82.74	72.50	77.67	81.83	72.52	77.21
yes, > 10 steps	9.92	16.65	13.26	9.93	17.77	13.81	9.92	17.27	13.57
not able	9.37	10.80	10.08	7.33	9.73	8.52	8.25	10.21	9.22
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
yes, <= 10 steps	59.11	53.81	56.06	68.13	55.54	61.06	64.86	54.89	59.22
yes, > 10 steps	23.32	19.46	21.10	14.70	20.73	18.09	17.82	20.26	19.20
not able	17.58	26.73	22.83	17.17	23.73	20.85	17.32	24.85	21.58
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
yes, <= 10 steps	39.86	24.54	28.01	46.84	28.99	32.45	44.66	27.78	31.21
yes, > 10 steps	23.08	21.47	21.84	22.47	18.87	19.57	22.66	19.58	20.20
not able	37.06	53.99	50.16	30.70	52.14	47.98	32.68	52.64	48.59
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 5. The percentage distribution of scores of cognitive function (Mini Mental State Examination)

	urban			rural			Total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
good (score 24+)	87.24	79.07	83.19	84.57	69.41	77.08	85.77	73.77	79.83
so so (score 21-23)	5.33	11.83	8.55	6.53	13.80	10.12	5.99	12.91	9.41
poor (score < 21)	7.43	9.09	8.26	8.90	16.79	12.80	8.24	13.32	10.75
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
good (score 24+)	70.03	50.88	59.07	68.43	43.97	54.64	69.01	46.54	56.27
so so (score 21-23)	10.46	15.21	13.18	11.21	16.46	14.17	10.94	15.99	13.80
poor (score < 21)	19.50	33.91	27.75	20.37	39.57	31.19	20.05	37.47	29.92
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
good (score 24+)	47.55	23.77	29.16	37.42	20.90	24.12	40.56	21.68	25.53
so so (score 21-23)	13.99	11.89	12.36	11.64	10.83	10.99	12.36	11.12	11.37
poor (score < 21)	38.46	64.34	58.48	50.94	68.27	64.89	47.07	67.21	63.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 6. The percentage distribution of self-reported health

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
good	59.72	60.31	60.01	63.11	55.30	59.25	61.59	57.56	59.59
so so	30.94	30.39	30.67	29.16	34.53	31.81	29.96	32.66	31.30
Bad	8.34	8.27	8.31	6.73	8.98	7.84	7.45	8.66	8.05
unable to answer	0.99	1.03	1.01	1.00	1.19	1.10	1.00	1.12	1.06
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
good	58.31	51.21	54.26	59.33	49.47	53.77	58.96	50.11	53.95
so so	32.30	32.83	32.60	31.00	34.45	32.94	31.48	33.85	32.82
Bad	6.44	11.56	9.36	6.50	10.15	8.56	6.48	10.67	8.85
unable to answer	2.95	4.40	3.78	3.16	5.94	4.73	3.09	5.37	4.38
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
good	52.45	47.55	48.66	55.17	41.20	43.93	54.33	42.92	45.25
so so	30.77	26.12	27.17	27.59	33.74	32.53	28.57	31.67	31.04
Bad	5.59	7.35	6.95	6.58	9.76	9.14	6.28	9.10	8.53
unable to answer	11.19	18.98	17.22	10.66	15.31	14.40	10.82	16.30	15.19

Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 7. The percentage distribution of self-reported life satisfaction at present time

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
good	74.34	77.44	75.88	69.76	66.91	68.35	71.82	71.66	71.74
So so	22.75	19.77	21.27	26.42	28.26	27.33	24.77	24.43	24.60
Bad	1.92	2.03	1.98	2.82	3.55	3.18	2.42	2.86	2.64
unable to answer	0.99	0.76	0.88	1.00	1.28	1.14	1.00	1.05	1.02
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
good	74.62	73.94	74.23	70.68	69.89	70.23	72.12	71.39	71.71
So so	20.18	18.85	19.42	22.45	19.80	20.95	21.62	19.44	20.39
Bad	1.75	3.10	2.52	3.88	4.23	4.08	3.10	3.81	3.50
unable to answer	3.45	4.11	3.83	2.99	6.08	4.73	3.16	5.35	4.40
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
good	67.83	69.39	69.04	66.98	60.86	62.05	67.25	63.18	64.00
So so	19.58	11.22	13.11	21.70	20.26	20.54	21.04	17.80	18.46
Bad	1.40	0.61	0.79	1.57	3.27	2.94	1.52	2.55	2.34
unable to answer	11.19	18.78	17.06	9.75	15.61	14.47	10.20	16.47	15.19
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 8. The percentage distribution of well-being

	urban			rural			total		
	male	female	total	male	female	total	male	female	total
ages 80-89									
Well-being	48.95	44.18	46.59	54.47	39.75	47.20	51.99	41.75	46.92
Unwell-being	51.05	55.82	53.41	45.53	60.25	52.80	48.01	58.25	53.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 90-99									
Well-being	36.64	21.03	27.75	40.98	24.14	31.48	39.40	22.99	30.11
Unwell-being	63.36	78.97	72.25	59.02	75.86	68.52	60.60	77.01	69.89
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ages 100-105									
Well-being	17.48	7.74	9.94	22.88	9.49	12.10	21.21	9.01	11.50
Unwell-being	82.52	92.26	90.06	77.12	90.51	87.90	78.79	90.99	88.50
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 9. Odds ratios of the logistic regression models

Covariates	ADL	Stand up	Pick up a book	Turn around	MMSE	Self-reported health	Life satisfaction	Well-being
Education (no education)								
Had education	0.96	0.88*	0.85*	0.82**	0.50***	0.83***	0.777***	0.65***
Residence (urban)								
Rural	0.62***	0.97	1.10	0.86**	1.19**	1.03	1.29***	0.83***
Gender (male)								
Female	1.48***	1.555***	1.60***	1.53***	1.75***	1.23***	0.93	1.51***
Age (80-89)								
90-99	2.74***	2.888***	2.66***	2.63***	2.87***	1.21***	0.96	1.97***
100-105	8.32***	7.888***	7.64***	8.16***	8.75***	1.59***	1.30***	5.59***

Notes:

(1) *p<0.05 **p<0.01 ***p<0.0001

(2) Coding of the dependent variables in each of the logistic regression models is described as follows (see corresponding subsections for detailed definitions of the categories of the dependent variables):

a. ADL model: “Mild disability” or “severe disability” is coded as 1; “active” is coded as 0.
b. Stand up model: “Standing up from a chair using hands” or “not able to stand up from a chair” is coded as 1; “Standing up from a chair without using hands” is coded as 0.
c. Pick up a book model: “Pick up a book from the floor from sitting” or “”not able to pick up a book from the floor” is coded as 1; “Pick up a book from the floor from standing” is coded as 0.
d. Turn around model: “Not able to turn around 360^0” is coded as 1; “turn around 360^0 with <10 steps” or “turn around 360^0 with more than 10 steps” is coded as 0.
e. MMSE model: “So so” or “Bad” cognitive function is coded as 1; “Good” cognitive function is coded as 0.
f. Self –reported health model: “So so”, or “Bad” or “not able to answer” is coded as 1; “Good” is coded as 0.
g. Life satisfaction model: “So so”, or “Bad” or “not able to answer” is coded as 1; “Good” is coded as 0.
h. Well-being model: “unwell-being” is coded as 1, and “well-being” is coded as 0.

(3) Categories in the parenthesis for each of the covariates are reference groups whose odds ratio is 1.00.

(4) A large majority of female oldest old (86-96% in rural areas, 68-86% in urban areas) and substantial proportion of the male oldest old (39-51% in rural areas, 19-44% in urban areas) had no education (i.e. 0 year of schooling). The percent of those oldest old who

had 7+ years schooling is very small (only 0.3%, 0.8%, and 2.2% for female oldest old aged 100-105, 90-99, and 80-89 respectively). We therefore only define two categories of education: “no education” refers to those with 0 year of schooling; “Had education” refers to those with 1+ years of schooling.

Figure 1. % of being active in ADL

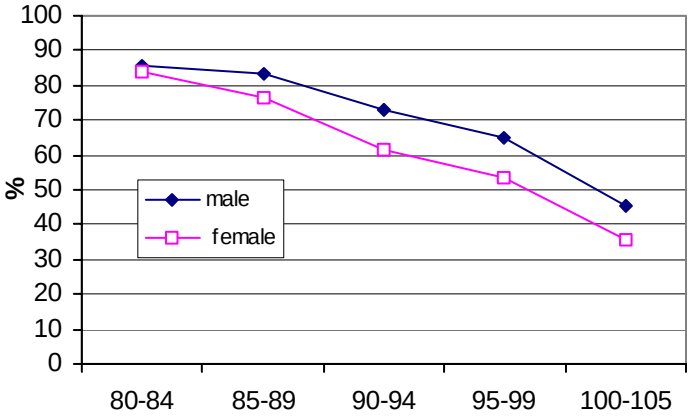

Figure 2. % of standing up from a chair without using hands

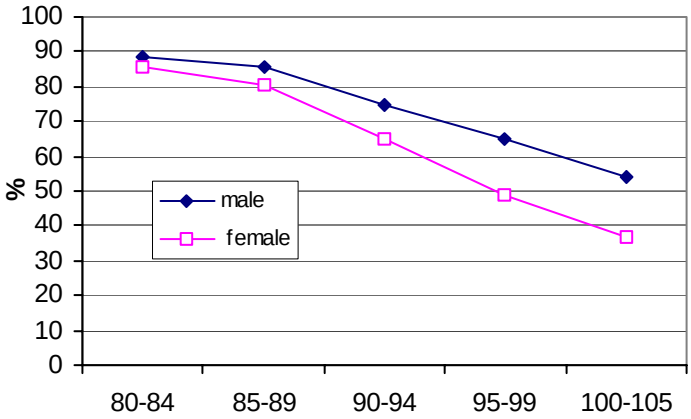

Figure 3. % of picking up a book from standing

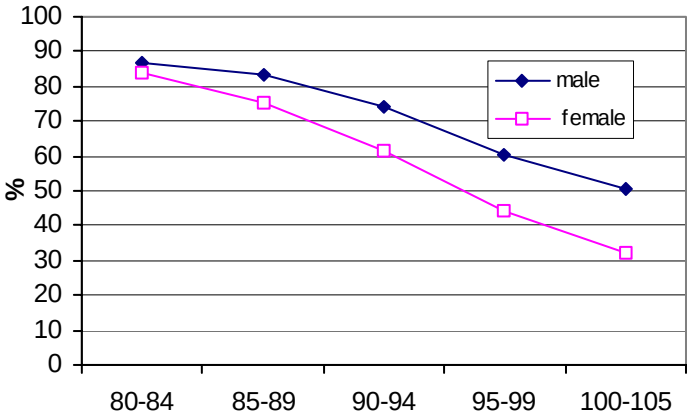

Figure 4. % of being able to turn around 360°

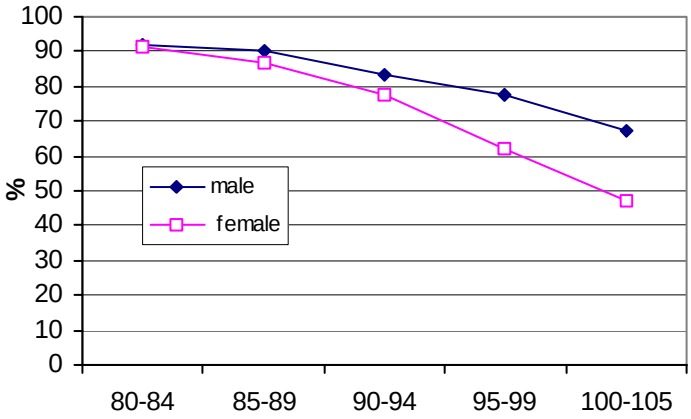

Figure 5. % of good cognitive function (MMSE)

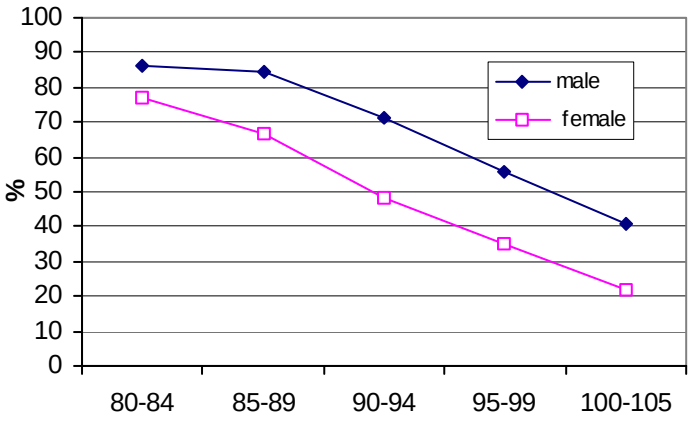

Figure 6. % of self-reporting good health

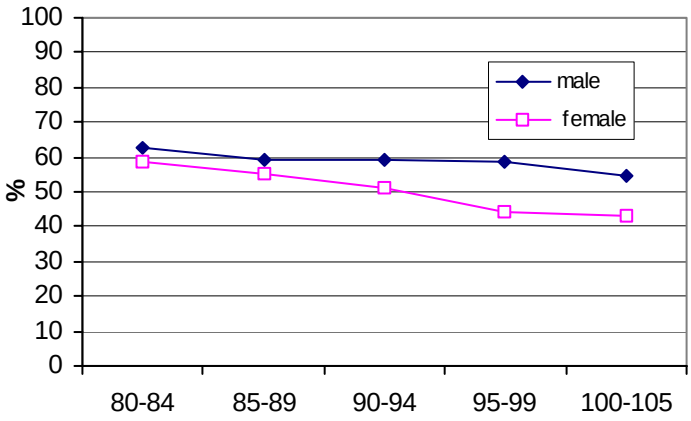

Figure 7. % of self-reporting satisfaction in life

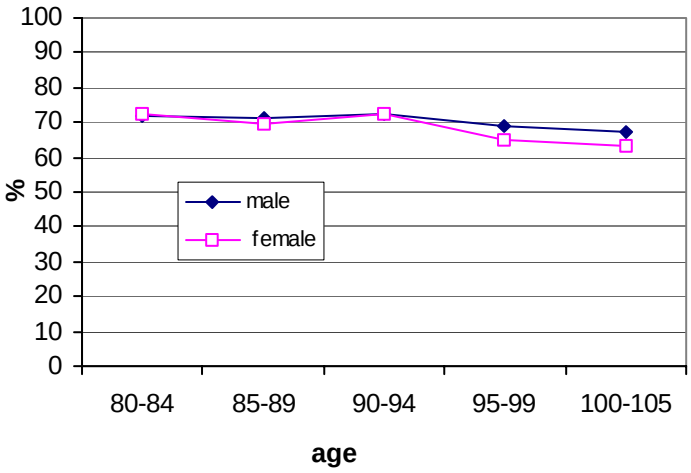

Figure 8. % of well-being