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Chapter 6

Assessment of Reliability of Mortality and Morbidity in the 1998-2002 CLHLS Waves[1]

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ABSTRACT

This chapter assesses the reliability of mortality and self-reported morbidity in the first three waves of the Chinese Longitudinal Healthy Longevity Survey (CLHLS). Results indicate that the observed rates of all-cause mortality reported in the CLHLS are underestimated by 15 to 20 percent between 1998 and 2000 and by 5 to 20 percent for ages 80 to 90 when based on hazard-model estimates; however, no such differences are found between the 2000 and 2002 waves. Our analyses further show that mortality rates over age 90 in the CLHLS are more reliable than those obtained from the census. The quality of self-reported morbidity and its population prevalence is

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generally quite good compared to other national data sets. However, the analyses suggest that information collected from next-of-kin should be interpreted with caution. We find that cause-specific mortality rates estimated from reports by the next-of-kin are substantially biased and that the prevalence of the decedents' morbidity reported by the next-of-kin is somewhat underestimated.

Keywords: accuracy of mortality data, age exaggeration, age reporting, all-cause mortality, bias, cause of death, cause-specific death rates, census data, China National Disease Surveillance Point System, complex sampling design, data assessment, ethnic minorities, extrapolation, first year death, first-year mortality rate, Han Chinese, hazard model, healthy longevity, Health and Retirement Study, Kannsito model, lost to follow-up, lunar calendar, morbidity, mortality, National Long-Term Care Survey, next-of-kin, reliability, relative bias, sample selection, sample attrition, Second National Health Service Survey, second year death, second-year mortality rate, self-reported chronic conditions, simulation, underestimation, underestimation of mortality

1. INTRODUCTION

The accuracy of mortality rates at old ages is critical for an understanding of human aging and longevity. Numerous studies have documented distinct patterns of mortality at older ages (Horiuchi and Wilmoth 1998; Kannisto 1994; Thatcher, Kannisto, and Vaupel 1998; Vaupel et al. 1998; Zeng and Vaupel 2003). For example, countries with high-quality data frequently show that age-specific mortality rates after age 80 tend to follow logistic, Kannisto, or quadratic patterns (Kannisto 1994; Thatcher et al. 1998; Vaupel et al. 1998). Departure from these patterns may signify age misreporting and produce inaccurate mortality estimates that will bias predicted outcomes and lead to erroneous conclusions.

Unlike respondent deaths in most longitudinal surveys in Western nations, which can be linked to a national death database with relatively accurate mortality reports, the survival status of respondents in longitudinal surveys in most developing countries are often collected through interviews. Consequently, mortality data from studies in developing countries may introduce inaccuracies due to age exaggeration and age-at-death misreporting by proxies, which are further confounded by sample attrition and selection. Such inaccuracies may well introduce biases in the estimation of associations between the study variables and mortality and lead researchers to draw incorrect conclusions. The first part of this chapter assesses the accuracy of mortality recorded in the first three waves (1998, 2000, and 2002) of the Chinese Longitudinal Healthy Longevity Survey (CLHLS).

The quality of morbidity data in surveys is important because it captures a major dimension of health and aging and is crucial for understanding healthy longevity. Conversely, inaccurate morbidity data will tend to produce biases in the associations between risk factors and disease (and other health indicators), as well as model misspecifications in the risk factors predicting subsequent mortality. However, age-specific patterns of morbidity at old ages are less well documented in the literature and, to date, there are no established criteria for comparing morbidity rates at the oldest-old ages across populations or nations. Indeed, the age patterning of chronic conditions among old persons tends to vary depending on the stage of the epidemiological transition, advances in medical technology, public awareness, and personal knowledge (see Klabunde et al. 2005; Myers, Lamb, and Agree 2003; Robine and Michel 2004). The second aim of this chapter is to compare several external data sources to assess the accuracy of chronic morbidity reported in the first three waves of the CLHLS.

2. MORTALITY RELIABILITY

2.1 Observed All-cause Mortality

Han Chinese, as well as several ethnic minorities who are culturally and residentially integrated with the Han (e.g., Korean and Manchu), use the lunar calendar (animal year) to recall the date of their birth. This unique system for remembering an individual's age makes age exaggeration less common (see Chapter 4 of this volume for more detail), ensuring that the mortality rates of Han and related Chinese ethnicities are generally reliable at advanced ages. As such, Coale and Li (1991) showed that mortality rates at the oldest-old ages were generally accurate in the third national census (in 1982) when excluding the Xinjiang Province, which has a heavy concentration of ethnic minorities. Some recent studies, however, show that the accuracy of mortality rates from censuses in China is improving (e.g., Banister and Hill 2004). Below we present comparative analyses of observed and estimated mortality using the CLHLS and data from the 2000 Chinese census in the 22 provinces where the CLHLS has been conducted. We also address the effects of potential age exaggeration by ethnic minorities on overall mortality risk in the CLHLS.

We calculate the person-years lived by each respondent for a specific period according to the date of birth, dates of the interviews for survivors, and the date at death for those who died between the survey waves. All analyses are weighted to account for the complex sampling design. We divide the weighted number of deaths at each age in a given period by the total weighted number of person-years lived during this period to obtain separate age-specific death rates for males and females.[2] Figure 1 compares the age-sex-specific death rates for the oldest-old in the CLHLS for the period of November 1999 thru October 2000 and for the period of January 2001 thru December 2001. For the 22 provinces in the 2000 census, the period is from November 1999 through October 2000.[3] Using the same estimation method for the CLHLS and 2000 census, we find no major differences in mortality between the CLHLS and the 2000 census during the period from November 1999 to October 2000 (the CLHLS produces higher mortality rates than the 2000 census, especially after age 94)[4]. However, we find that compared to the

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[2] This chapter does not use $\frac{N_{x+n}^{t+n}}{N_x^t} = e^{-\int_x^{x+1}\mu(t)dt)}$ to estimate the central death rate which was employed by Zeng, Gu, and Land (2004). However, the results in this chapter are quite similar to those of Zeng and colleagues (2004).

[3] Respondents who report being older than age 106 at baseline were excluded because of insufficient information to validate their age. Respondents younger than age 80 at baseline were excluded in this study for the 1998 and 2000 waves, while those younger than age 65 were excluded for the 2002 wave. The respondents are excluded because they are out of the targeted age range for the CLHLS sample.

[4] We summed the age-sex-specific number of deaths recorded for the period from November 1999 through October 2000 and the age-sex-specific number of persons counted in the 2000 census (i.e., October 31st, 2000) for 22 provinces and applied the formula $d_x = \frac{D_x}{0.5 * (P_x^{t-1} + P_x^t)}$ to calculate the age-sex-specific central death rate. Note that the National Bureau of Statistics of China (NBSC) and each provincial statistic bureau used $d_x = \frac{D_x}{0.5 * (P_x^t + P_{x+1}^t)}$ to calculate the central death rate for age x at time t-1 to time t (i.e., November 1999 thru October 2000). This NBSC formula imposes negligible bias when the size of each birth cohort is similar and mortality is low. However, when mortality is high, especially at old ages, the formula suffers bias even though the size of each cohort is similar. In order to get P_x^{t-1}, the approach proposed by Valin (1973) was employed to split all

census, mortality in the CLHLS was underestimated by around 10 to 15 percent in the first year immediately after the interview for both the 1998 and 2000 waves (not shown), as has already been found by Goodkind (2004). This may be because the next-of-kin of deceased respondents misreported the timing of death to a later date (Goodkind 2004). If the first- and second-year deaths were not distinguished, as in most longitudinal studies, we would find no underestimation in mortality in the CLHLS in the period of 2000 and 2002; however, there would still be a 15 to 20 percent underestimation of mortality before age 90 for both males and females between 1998 and 2000 in the CLHLS (Figure 2). Therefore, we conclude that the mortality rates from the first three waves of the CLHLS are relatively reliable, with the exception of some recall errors by proxies in the respondents' date of death.

---- Figure 1 and Figure 2 about here---

2.2 Estimated All-cause Mortality

Thatcher et al. (1998) examined the force of mortality (i.e., central death rate) at the oldest-old ages in thirteen developed countries across several recent decades. They used the observed population size and number of deaths for ages 80 to 98 and extrapolated for ages beyond 98. They found that the mortality patterns were modeled better with Logistic, Kannisto, and

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possible age-year death aggregates by cohort (i.e., the older cohort shares 2% more deaths for a given amount of death events at age x and year t). The Kannisto and Thatcher database on old-age mortality (80-120) used half versus half to split the death, although they admit their approach may also suffer minor biases. After splitting, we can easily estimate P_x^{t-1} and the central death rate. We also applied the same approach to estimate the central death rate in the 22 provinces from the 2000 census as we did for the CLHLS. We assume that each of person in P_x^t survives 0.5 person-year in age x, each of the deceased persons at age x survives 0.5 person-year in age x, and each person in P_{x+1}^t survives 0.5 person-year in age x before they reach the exact age $x+1$. The central death rate is slightly higher for the person-year-based approach than for $d_x = \frac{D_x}{0.5*(P_x^{t-1}+P_x^t)}$. In this chapter, we present only the person-year-based approach. Both the person-year-based approach and $d_x = \frac{D_x}{0.5*(P_x^{t-1}+P_x^t)}$ are slightly smaller as compared to the NBSC published data for persons ages 90 and over.

quadratic methods than with Gompertz, Weibulll, and Heligman and Pollar models for all the countries and across all three decades. Zeng and Vaupel (2003) used the same methods to investigate mortality patterns for the oldest-old Han Chinese people in the 1990 census and found similar results. Zeng and Vaupel's findings also suggest that the mortality data for the oldest old Han Chinese are quite good in the 1990 census, although the observed rates of male mortality beyond age 94 are slightly underestimated.

We apply the same method to estimate mortality rates from ages 80 to 98 and extrapolate for ages 99 to 105 for the CLHLS 22 provinces in the 2000 census.[5] We present only the findings from the Kannisto model in this chapter. A comparison of mortality rates fitted from the Kannisto model with mortality rates obtained from the 2000 census indicates an underestimation for males after age 94 in the census data (not shown) and no difference for females. Therefore, we conclude that mortality rates for the oldest-old females in the 22 provinces in the 2000 Chinese census are reliable.

Because the CLHLS (or any survey in China) cannot produce reliable mortality rates for each age comparable to the census, we use regression models to estimate age patterns according to the survey data and then compare them with the established criterion (i.e., the Kannisto model, see Zeng and Vaupel 2003). Thus, mortality rates for two periods of the CLHLS (i.e., between the 1998 wave and the 2000 wave, and between the 2000 wave and the 2002 wave) are estimated using both semi-parametric Cox proportion hazard models and parametric exponential and Weibull hazard models.[6] We use an average of the estimates of these three approaches to

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[5] In order to do this, the method described in Endnote 3 is used to estimate the risk population and death for each age. We then follow Thatcher et al.'s (1998) method to estimate and extrapolate the age-specific mortality rates for ages 80 to 105. Zeng and Vaupel (2003) show that the Kannisto model is one of the best models in fitting the oldest-old mortality for Han Chinese.

[6] Weibull and exponential models produce similar results, but they produce higher rates than the Cox model. The mortality rates based on the Weibull or exponential models for the period of 2000-2002 are higher than those based

represent the model-based approach for the force of mortality in the CLHLS. Hazard models are conducted separately for males and females and sample weights are applied.

Figure 3 compares the central death rates for the two periods in the CLHLS using hazard models with those from the 22 provinces in the 2000 census using the Kannsito model. The relative bias of the model-based approach in the CLHLS is also compared with the census results based on the Kannisto model and is reported in Figure 4. The results suggest that the age-sex-specific mortality rates are somewhat underestimated for the period of 1998 to 2000. There is an approximately 5 to 20 percent underestimation of mortality for both males and females before age 90 in the 1998 to 2000 interval. The average underestimations before age 90 are 12 percent for males and 15 percent for females. However, there is no evidence of underestimation in the interval from the 2000 wave to the 2002 wave. Comparisons between the first three waves of pooled data (i.e., 1998, 2000, and 2002) and the results from the Kannisto model further show that there is an underestimation of mortality of roughly 8 percent before age 90 (results not shown).

---- Figure 3 and Figure 4 about here----

2.3 The Effects of Potential Age Exaggeration on Mortality Rates

Approximately 7 percent of the CLHLS sample is categorized as being in a non-Han minority group. Because ethnicity is a major sociodemographic factor in the study of aging, the accuracy of non-Han mortality data will likely influence health and mortality-related patterns and their associations with other sociodemographic variables. If age reporting among the non-Han sample

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on the Kannisto model. This suggests that different analytical models will yield inconsistent findings. Other parametric models were also tested and the results were analogous to those produced by the Weibull and exponential models. According to Cleves, Gould, and Gutierrez (2004:197-200), parametric hazard models are superior to Cox hazard models in utilizing event data over the time intervals being studied. The gap in mortality rates (before age 90) between the estimated average rates from parametric models will be closer to those fitted by the Kannisto model.

is not accurate and thus mortality estimates are not reliable, it may be necessary to drop these persons from the analysis; alternatively, researchers should retain the minority sample in the analyses if the data prove to be reliable. This section assesses the accuracy of mortality data among the non-Han minorities as they relate to age exaggeration and its impact on mortality estimates when age reports are not accurate.

As noted in Chapter 4 of this volume, the accuracy of age reporting for Han Chinese in the CLHLS is relatively reliable and roughly comparable to that of Canada and Australia. Chapter 4 also shows that age reporting among non-Han Chinese is less accurate than among Han Chinese, but that the possible age exaggeration will not bias the association between health/survival and late childbearing in multivariate regression models. Gu and Lu (2004) have demonstrated that age exaggeration among the oldest-old non-Han respondents in the CLHLS does not significantly affect estimates of disability, cognitive functioning, self-reported health, or their predictors either cross-sectionally or longitudinally. In this chapter, four simulations are performed using parametric (exponential) hazard models to further examine the effect of possible age exaggeration among ethnic minorities on mortality rates in the CLHLS. The simulations include: (1) each minority aged 85 and older over-reports their age by 2 years; (2) each minority aged 85 to 89 over-reports their age by 2 years, while each minority aged 90 and older over-reports their age by 5 years; (3) each minority aged 85 to 89 over-reports their age by 2 years, while each minority aged 90 and older over-reports their age by 8 years; and (4) each minority aged 85 to 89 over-reports their age by 2 years, each minority aged 90-94 over-reports their age by 8 years, and each minority aged 95 and older over-reports their age by 10 years.

Figure 5 demonstrates that even though we assume serious age exaggeration among ethnic minorities, its impact on the estimation of overall mortality in the CLHLS is negligible.[7] Zhang and Li (2004) find that there is no underestimation of mortality among minorities from 1998 to 2002 compared with Han Chinese using nonparametric Kaplan and Meier (KM) analyses.

--Figure 5 about here--

2.4 Cause-specific Mortality

Information on cause-specific death rates is important in determining the allocation of health investments and resources in public health policy and for identifying the priorities of national health services. The CLHLS includes information on the primary cause of death for the sampled decedent who died between survey waves (collected from his/her next-of-kin). Table 1 compares the cause-specific death rates in the CLHLS with those obtained from the China National Disease Surveillance Point System (DSP). Data from the DSP covers 145 sites in both urban and rural areas from 31 provinces, and they may be considered a proxy for the 22 CLHLS provinces. Although the DSP accounts for only one percent of the national population and undercounts the number of deaths, the DSP data provide sufficient confidence for the primary causes of death (Yang et al. 2005). Table 1 indicates that the CLHLS highly underestimated the cause-specific death rates of cancer, cerebrovascular disease, heart disease, and respiration and digestive diseases. Nearly half of the results in Table 1 underestimate mortality by more than 50 percent, particularly in rural areas, suggesting that the cause-specific data in the CLHLS are not reliable.[8]

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[7] The results in Figure 5 are slightly different from Figure 3 and Figure A-1 because Figure 5 is based on the exponential hazard model while the other two figures are based on the averages from the exponential, Weibull, and Cox models. The simulation patterns based on the Weibull and Cox models are the same as those in Figure 5. For illustrative purposes, we simply use the exponential model.

[8] Because we are unable to access the SDP data, we have no knowledge of the accuracy of the other cause-specific mortality rates in the CLHLS. We suspect it also would be underestimated.

We suspect the primary reasons for this to be threefold. First, many next-of-kin did not know the cause of death because the majority of subjects died at home (over 90 percent), and many probably lacked medical tests and/or treatment prior to death. Second, many urban respondents – whose next-of-kin are more likely to provide the cause of death – were lost to follow up. Third, information on the cause of death was not collected from official government agencies in the CLHLS.

--- Table 1 about here---

Over 30 percent of the next-of-kin reported the deceased respondents' cause of death as "old age/senility" or "natural death." There is a debate as to the acceptability of categorizing "old age" as the primary cause of death; however, the number of cases so reporting is increasing each year. In England and Wales in 2000, 2.3 percent of deaths were reported as "old age" (United Kingdom General Registry Office 2001). However, Hawley (2003) analyzed 4,300 cremations in the U.K. and found a significant underestimation of medical conditions among 300 deceased persons whose cause of death was recoded as "old age", which is likely due to undiagnosed conditions (Horner and Horner 1998).[9] Therefore, we speculate that the high proportion of "old age" deaths in the CLHLS is also likely resulted from undiagnosed conditions and should be used and interpreted with caution.

In summary, overall mortality rates in the CLHLS during the period of 2000 to 2002 are reliable. However, observed mortality rates from the 1998 to 2000 CLHLS data were underestimated by 15 to 20 percent and by 5 to 20 percent for the regression-based rates before age 90 – a potential consequence of nonrandom missing data. Such underestimation of all-cause

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[9] Seventy percent of deaths in the U.K. result in cremation (see Hawley 2003).

mortality likely induces some bias in calculations of life expectancy.[10] However, the impact of underestimating mortality is minor on the effects of predictors in statistical models.[11] Given the accuracy in age reporting among the oldest old in the CLHLS, and regardless of recall error in the date of event, one would expect little to no mortality underestimation in the CLHLS. The primary reason for such an underestimation of mortality is possibly because the sample lost to follow-up is not completely random. Chapter 3 shows that octogenarians interviewed in 1998 were two times and 50 percent more likely to be lost to follow-up by the 2000 wave compared to nonagenarians and centenarians, respectively. Most persons lost to follow-up were likely dead prior to the 2000 interview. From the period of 2000 to 2002, there is no age pattern associated with the sample lost to follow-up. We suggest that users of the CLHLS data utilize data from the interviews in 2000 and later or use pooled data when conducting survival analyses to produce more robust estimates. If the distinction of first- and second-year mortality is needed for specific research designs, the results should be interpreted with caution because the first-year mortality rates suffer from underestimation due to recall bias by next-of kin.

The underestimation of mortality is also found in some national longitudinal surveys in the United States, despite the linkage of datasets to the National Death Index. For example, Adams et al. (2005) observed an underestimation of mortality for elderly females ages 76 to 82 and ages 88 and older from two waves of the Assets and Health Dynamics among the Oldest Old

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[10] The parametric hazard models produce slightly higher mortality rates than the Kannisto method, as indicated in the above note. Therefore, it is more appropriate to use parametric models when calculating life expectancy.

[11] We examined the impacts of mortality underestimation on the predictors in various hazard models. We divided the data between the 1998 and 2000 interviews into two intervals: the first year and the second year (after the 1998 initial interview). We found differences in the coefficients of the predictors between the first year and the second year data, as well as for the data between the 2000 and 2002 waves. However, when the data were not divided, as is the case for many studies, we found that the coefficients of the predictors were comparable to those based on the second year data. Furthermore, the results from the 1998-2000 dataset were similar to those of the 2000-2002 dataset.

Study (AHEAD).[12] Laditka and Wolf (2004) found differences in mortality between the 1982 interview of the National Long-Term Care Survey (NLTCS) and the data provided by the National Center on Health Statistics. Manton and Lamb (2005) also reported mortality differentials between the NLTCS data and other data sources. Because both the Health and Retirement Study (HRS/AHEAD) and the NLTCS have not released detailed information on the date of death, we are currently unable to examine the full extent of mortality underestimation in these two American surveys. The underestimation of mortality in these two surveys in the U.S. might be due to sample selection (i.e., sampled persons are healthier than the general population) or due to age exaggeration at the oldest-old ages, especially for African-Americans (Coale and Kisker 1990).

Given that there is little to no discussion in the literature on how to adjust for the underestimation of mortality in longitudinal data, we refrain from suggesting new or valid methods of handling this issue. In addition, we do not know whether the first-year underestimation of mortality is unique to the CLHLS or is a widespread phenomenon. Research on addressing the accuracy of mortality in longitudinal surveys should be explored further. Likewise, cause-specific mortality rates in the CLHLS suffer from substantial underestimation possibly because of inadequately informed next-of-kin and/or insufficient efforts in seeking official cause-of-death information. Therefore, we suggest that researchers avoid using cause-specific mortality from the CLHLS or interpret their results with caution when necessary.

3. MORBIDITY RELIABILITY

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[12] Authors did not provide data for males, therefore we do not know the degree of underestimation of mortality among males in the AHEAD study. To date, the mortality data from the Health and Retirement Study (HRS) and AHEAD have not been compared with other sources.

Self-reported questionnaires offer an easy and less expensive alternative for collecting data on respondents' chronic conditions compared to data obtained through direct medical examinations. However, the accuracy and comprehensiveness of data obtained from self-report questionnaire depends to a significant degree on the respondents' health knowledge, ability to recall, and willingness to report (see Klabunde et al. 2005). The accuracy of self-reported chronic conditions compared to medical records, disease registries, or clinical and laboratory reports is inconclusive. For example, some studies suggest that self-reports of diabetes and heart diseases tend to be less accurate than medical records, while reports of arthritis are deemed reliable (Beckett et al. 2000). In contrast, others demonstrate that the accuracy of self-reported chronic conditions is high for diabetes (Midthjell et al. 1992) and moderately good for hypertension (Tormo 2000), whereas the accuracy of reporting other diseases such as arthritis is low (e.g., Kehoe et al. 1994). According to previous studies comparing self-reported conditions with medical records, disease registries, and clinical and laboratory experiments, underreporting of chronic diseases is common in developed nations (e.g., Gross et al. 1996; Hughes et al. 1993; Kehoe et al. 1994; Schrijvers et al. 1994). The underreporting of diseases in developing counties is largely the result of underdeveloped medical technologies and infrastructure, and the shortage of resources and skilled professional personnel in public health. Some studies also find that the accuracy of self-reported chronic conditions is associated with individual characteristics such as age or gender (e.g., Kehoe et al. 1994; Kriegsman et al. 1996). Others find that the accuracy of self-reported morbidity is related to the individual's knowledge, perceptions, awareness, and recognition of chronic disease symptoms (Apolone et al. 2002; Vergara et al. 2004; Satish et al. 1997). Still others indicate that morbidity rates are influenced by public health programs targeting specific populations (e.g., Zaslavsky and Buntin 2002).

To our knowledge, no existing studies have assessed and compared the accuracy of self-reported chronic conditions obtained from surveys and medical/clinical records in China. Therefore, we are unable to fully evaluate the reliability of self-reported conditions among the oldest old in the CLHLS. Fortunately, we can compare indirectly the prevalence rates of chronic disease in the CLHLS with other national sources in an attempt to begin to assess the accuracy of the self reports.[13]

Table 2 compares the self-reported prevalence rates for selected chronic diseases in the CLHLS in 2002 and the Second National Health Service Survey (SNHSS) in 1998. The findings strongly indicate that prevalence rates are much higher in the CLHLS than in the SNHSS, suggesting that the quality of self-reported morbidity in the CLHLS is high. Table 3 compares the CLHLS data with a second national survey on the elderly conducted by the China National Research Center on Aging (CNRCA) in 2000. The proportion of adults with one of more chronic diseases is quite similar across the two national surveys and, again, indicates relatively good data quality in the CLHLS.

--- Table 2 and Table 3 about here--

The first two waves of the CLHLS (1998 and 2000) did not collect data for the younger elderly (ages 65 to 79). Hence we present comparisons of disease prevalence only among the oldest old from the first three waves of the CLHLS. The results in Table 4 indicate that the rates of disease are generally consistent across the waves, with some fluctuations (e.g., diabetes, Parkinson’s disease). Despite the minor fluctuations, which are primarily associated with the

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[13] The prevalence rates of chronic conditions in two other national surveys used in this report are both based on self reports. There is a possibility that these two surveys and the CLHLS underreport the actual number of chronic conditions. The purpose of our comparisons is to examine the consistency between the CLHLS and other national sources, not to determine the true rates of chronic conditions in the population.

small sample size and low prevalence, the validity of the prevalence rates appears to be strong in the CLHLS.

-- Table 4 about here--

Prevalence rates for selected chronic diseases (reported by the respondent or proxy) for living adults were also compared to prevalence rates reported by the next-of-kin when the respondent died (see Table 5). The results suggest some underestimation of disease prevalence for certain conditions reported by the next-of-kin. Therefore, researchers should be cautious when using these kinds of data that were collected for deceased persons. Prior research suggests more robust estimates are obtained by combining data from the last interview of the sampled person with data collected by the decedents' next-of-kin reported between waves (Marshall and Graham 1984).

---Table 5 about here---

In sum, the self-reported prevalence of chronic conditions is quite reliable in the CLHLS, compared to other national sources, whereas the morbidity of deceased subjects reported by the next-of-kin is not as reliable. According to previous research, however, the ADL disability information for deceased persons (reported by the next-of-kin) is shown to be reliable (Gu and Zeng 2004; Zeng, Gu, and Land 2004). This discrepancy is understandable given that most of the kin resided and/or provided care for the respondent before his/her death. In addition, the underreporting of morbidity among the subsequently deceased is likely because many families did not (or could not) seek medical treatment for the respondent while the subject was alive, and consequently, family members may have been unaware of an existing disease.

4. CONCLUDING REMARKS

This chapter examined the reliability of mortality and morbidity data in the first three waves of the CLHLS. Compared with other data sources, the results demonstrate that mortality rates are reliably estimated from 2000 to 2002. However, before age 90 (from 1998 to 2000), we find some underestimation of mortality possibly due to a higher proportion of octogenarians lost to follow-up compared to nonagenarians and centenarians. The first-year mortality rates after the interview also tend to be underestimated. We suspect that this is related to recall bias in the date of death reported by the decedents' next-of-kin. Our results suggest that self-reported rates of chronic disease are reliable. It is believed that the high quality of the CLHLS data is largely attributable to the systematic operation and collection of survey data and the systematic age-verification procedures used for sampled persons. Because we are unaware of the implementation procedures of other surveys on aging in China, we are reluctant to infer the reliability of their mortality rates and the prevalence of self-reported chronic diseases.

We find that reports of morbidity by the next-of-kin and information on the cause of death reported by the next-of-kin are not quite as reliable. These findings suggest that the next-of-kin are not reliable proxies for gathering disease and cause-specific mortality data for the elderly in China. The appropriateness of using next-of-kin as proxies for information regarding end-of-life care research is still debated. Some studies indicate the appropriateness of such reports (see Tang and McCorkle 2002 for a review), while others do not (see Sprangers and Aaronson 1992 for a review). Further, the agreement between proxy-identified and respondent self-reported chronic conditions varies according to demographic and family characteristics, caregiving burden, and the health conditions of the sampled individuals and their proxies (Tang and McCorkle 2002). Given space limitations, we were unable to further explore the mechanisms associated with the estimation of proxy-rated chronic conditions. Additional research is clearly warranted to address this shortcoming. In addition, given that proxies are rarely used to determine cause of death in most end-of-life care studies, it is unclear whether such inaccuracies occur in the CLHLS. This is an issue requiring further investigation. Overall, our results suggest that greater interviewer training may be necessary to further improve CLHLS data collection by eliciting more accurate information from the respondents' next-of-kin.

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Table 1. Comparisons of death rates (%) by main causes between the CLHLS (1998-2000) and China's national death rates (1998)

	Age group	Cancer	Cerebrovascular diseases (CVD)	Heart Diseases	CVD & Heart Dis.	Respiratory & Digestive Dis.
URBAN						
CLHLS (pooled 1998-2002)						
Male	*80-84*	0.78	1.99	1.20	3.19	1.18
	85+	1.43	2.65	2.04	4.69	2.43
Female	*80-84*	0.89	1.53	1.07	2.60	0.81
	85+	0.61	1.80	1.34	3.14	1.26
China's Disease Surveillance Point System (1998)						
Male	*80-84*	1.93	3.28	2.56	5.84	3.30
	85+	1.90	3.75	4.16	7.91	5.40
Female	*80-84*	0.97	2.44	2.14	4.58	2.24
	85+	0.88	3.37	3.82	7.19	4.55
RURAL						
CLHLS (pooled 1998-2002)						
Male	80-84	0.43	1.70	0.97	2.67	2.12
	85+	0.90	2.27	1.37	3.64	1.89
Female	80-84	0.43	1.36	0.79	2.15	0.95
	85+	0.33	1.61	1.03	2.64	1.73
China's Disease Surveillance Point System (1998)						
Male	80-84	1.16	3.36	2.27	5.63	5.51
	85+	0.91	4.53	3.31	7.84	7.86
Female	80-84	0.66	2.30	1.65	3.95	3.57
	85+	0.41	2.47	1.89	4.36	4.35

Note: (1) Age 85+ is the last age group available in the national death rates. China's Disease Surveillance Point System (DSP) was fully established in 1990 with 145 surveillance sites over the country in 31 provinces, covering approximately 10 million people. The DSP data are provided by Yong Li (2005). (2) The CLHLS data are calculated by dividing the number of deaths in each age group by the number of person-years lived in those ages.

Table 2. Comparisons of prevalence rates (‰) of chronic disease among the Chinese elderly aged 65 and older between the CLHLS in 2002 and the SNHSS in 1998

	SNHSS in 1998			CLHLS in 2002		
Diseases	Males	Females	Both sexes	Males	Females	Both sexes
Hypertension	62.9	57.9	75.2	157.6	193.1	176.4
Diabetes	11.4	10.5	15.0	24.8	38.6	32.1
Heart diseases	61.9	57.1	68.7	86.5	115.1	101.66
Stroke or CVD	34.0	31.3	36.2	67.7	52.2	59.5
Bronchitis, emphysema, pneumonia, asthma	194.2	178.9	84.6	166.1	107.4	126.3
Cataract or glaucoma	15.3	14.1	25.36	62.2	102.8	83.7
Gastric or duodenal diseases (digestive disease)	67.2	61.9	58.9	61.8	65.6	63.8
Dermatosis	8.3	7.7	4.0	19.6	18.8	19.2
Cancer (malignant neoplasm)	5.2	4.8	5.4	5.2	5.7	5.5
Psychosis	2.6	2.4	4.0	3.2	3.9	3.6

Note: The Second National Health Service Survey is obtained from website at: http://www.moh.gov.cn

Table 3. Comparisons of the percentages of elderly with chronic conditions between the CLHLS in 2002 and the CNRCA in 2000

	Urban			Rural			Urban and Rural		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
CNRCA Survey 2000									
Age 65-79	67.07	71.97	69.46	51.93	57.98	54.72	59.26	65.14	62.05
Age 80+	61.72	63.66	62.88	52.80	57.17	55.23	56.50	60.14	58.59
Age 65+	66.60	70.88	68.74	52.03	57.85	54.79	58.98	64.41	61.62
CLHLS 2002*									
Age 65-79	64.71	67.59	66.19	53.83	58.31	56.14	57.69	61.57	59.69
Age 80+	69.19	68.15	68.55	58.64	62.49	61.06	62.24	64.36	63.56
Age 65+	65.19	67.68	66.50	54.37	59.01	56.84	58.19	62.03	60.22

Note: (1) * Institutionalized respondents were excluded in the 2000 CNRCA survey.
Source: CNRCA (2003). *Data Analysis of the Sampling of Survey of the Aged Population in China*. Beijing: China Standard Press.

Table 4. Comparisons of prevalence rates (%) for selected diseases among the Chinese oldest-old across three waves of the CLHLS by gender and urban/rural residence

	1998		2000		2002	
Diseases	Males	Females	Males	Females	Males	Females
Hypertension	15.61	18.46	15.55	19.09	15.55	18.54
Diabetes	0.99	1.13	1.64	1.65	1.68	1.53
Heart diseases	8.46	6.67	7.03	8.22	8.60	10.11
Stroke or CVD	4.04	2.98	4.76	3.35	5.85	5.05
Bronchitis, emphysema, pneumonia, asthma	16.52	12.07	13.99	10.57	16.52	12.33
TB	1.09	0.64	1.07	0.88	1.12	0.41
Cataract	13.76	15.21	8.12	10.41	9.30	12.15
Glaucoma	1.68	2.13	1.31	2.45	1.98	2.60
Prostate	8.30	--	4.47	--	5.27	--
Gastric or duodenal ulcer	4.25	3.84	3.71	3.86	4.75	5.15
Parkinson’s diseases	1.12	0.41	0.63	0.27	0.73	0.27
Bedsore	0.75	0.59	0.78	0.87	0.58	0.49
Cancer (malignant neoplasm)	0.78	0.35	0.36	0.08	0.41	0.17

	1998		2000		2002	
	Urban	Rural	Urban	Rural	Urban	Rural
Hypertension	16.86	17.67	18.17	17.58	22.71	14.77
Diabetes	2.41	0.45	2.72	1.13	3.48	0.66
Heart diseases	13.42	4.43	11.75	5.85	13.96	7.44
Stroke or CVD	5.37	2.42	5.28	3.19	7.49	4.33
Bronchitis, emphysema, pneumonia, asthma	13.68	13.72	13.83	10.87	13.56	14.12
TB	1.00	0.51	1.13	0.86	1.44	0.50
Cataract	22.06	11.16	14.90	6.97	15.56	9.00
Glaucoma	2.54	1.69	2.31	1.89	3.00	2.14
Prostate	6.18	1.73	3.50	0.91	3.57	1.21
Gastric or duodenal ulcer	4.20	3.89	4.75	3.34	5.13	5.18
Parkinson’s diseases	0.77	0.62	0.60	0.30	0.67	0.36
Bedsore	0.86	0.55	0.65	0.93	0.69	0.52
Cancer (malignant neoplasm)	0.87	0.34	0.40	0.07	0.40	0.19

Table 5. Comparisons of prevalence rates (%) for selected diseases reported by decedents' next-of-kin in the first three waves of the CLHLS by gender and urban/rural residence

	1998 wave				Died between 1998 and 2000 waves			
Diseases	M	F	U	R	M	F	U	R
Hypertension	11.38	9.61	10.84	9.68	8.85	5.85	8.24	5.63
Diabetes	0.87	0.67	0.81	0.67	1.19	0.76	1.21	0.61
Heart diseases	8.62	6.18	8.30	5.82	8.54	7.23	8.41	6.98
Stroke or CVD	4.51	3.14	4.32	2.94	10.51	7.37	8.88	8.21
Bronchitis, emphysema, pneumonia, asthma	17.79	11.41	14.87	12.68	12.02	8.89	10.95	9.12
TB	0.71	1.14	1.21	0.73	0.71	0.71	0.58	0.86
Cataract or glaucoma	17.87	23.59	23.63	19.11	4.03	6.18	6.17	4.53
Prostate	7.83	--	3.80	2.27	3.24	--	1.61	0.92
Gastric or duodenal ulcer	3.00	2.43	3.11	2.14	2.53	1.95	2.07	2.27
Parkinson's diseases	0.79	1.09	0.81	1.16	0.47	0.24	0.35	0.31
Bedsore	1.19	1.33	1.27	1.29	1.66	1.24	1.38	1.41
	2000 wave				Died between 2000 and 2002 waves			
	M	F	U	R	M	F	U	R
Hypertension	12.83	11.09	12.00	11.42	9.60	8.41	10.07	7.70
Diabetes	1.50	1.00	1.27	1.12	2.55	1.84	2.47	1.74
Heart diseases	8.03	6.77	9.59	4.59	11.93	9.70	14.17	7.26
Stroke or CVD	5.78	4.18	5.91	3.66	11.55	9.25	11.16	9.31
Bronchitis, emphysema, pneumonia, asthma	13.05	10.35	12.12	10.55	15.68	12.44	13.81	13.84
TB	0.98	0.65	0.97	0.62	1.35	1.09	1.09	1.30
Cataract or glaucoma	11.55	16.27	16.77	11.67	5.63	8.76	8.20	6.89
Prostate	5.93	--	3.80	1.24	4.20	--	3.08	0.74
Gastric or duodenal ulcer	3.15	3.33	3.50	2.92	4.95	3.48	3.74	4.47
Parkinson's diseases	0.53	0.20	0.42	0.25	1.28	2.19	0.84	0.56
Bedsore	0.75	1.04	0.66	1.18	1.28	2.19	2.29	1.37
Arthritis	11.18	11.99	11.70	11.67	7.73	6.97	7.18	7.20
Dementia	3.90	5.62	5.31	4.35	2.93	3.88	3.38	3.54

Figure 1. Comparison of observed period-specific mortality rates in the CLHLS and the 2000 census (22 provinces)

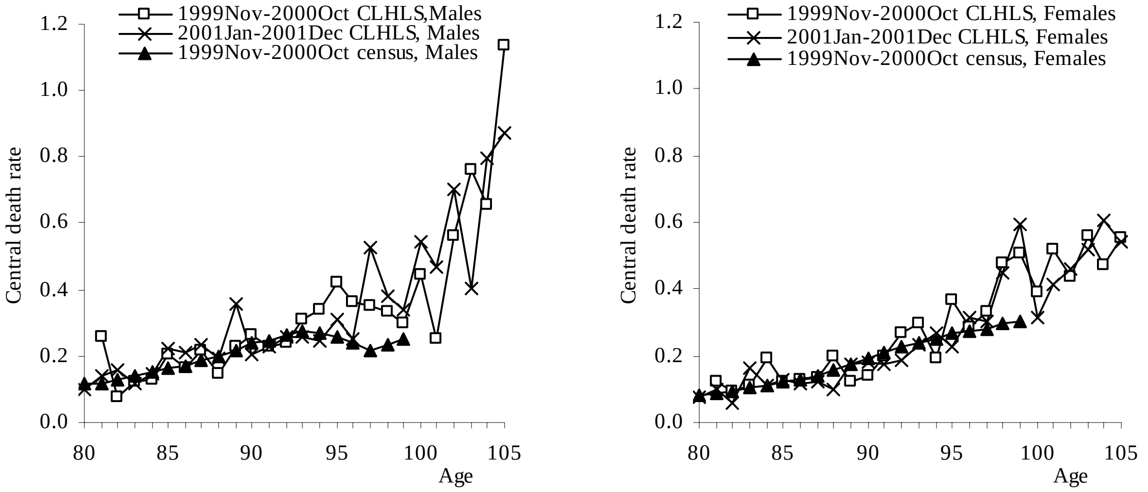

Figure 2. Comparison of mortality rates between the CLHLS and 2000 census (22 Provinces) without distinguishing the first and second year mortality after the interview

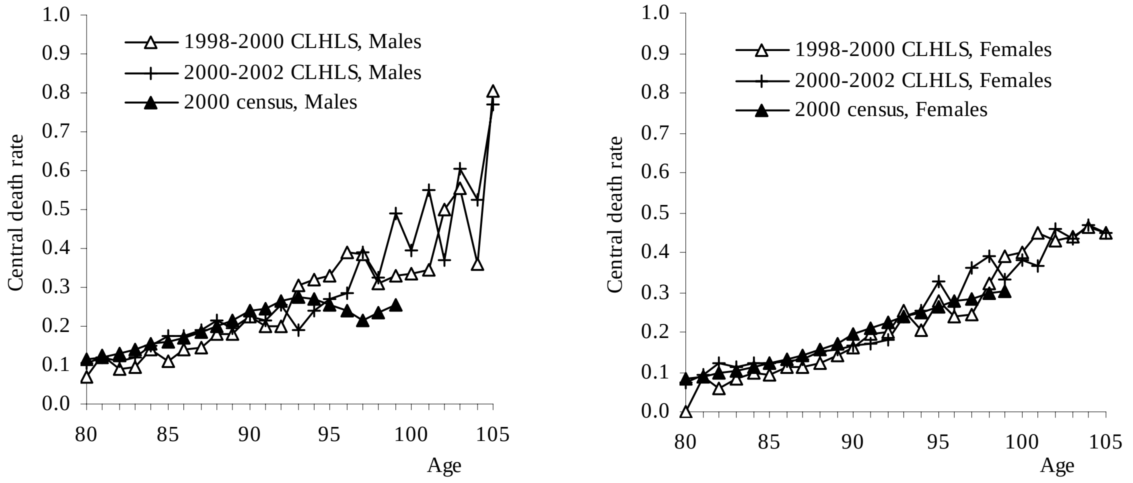

Figure 3. Comparison of age-sex-specific mortality rates between the CLHLS based on hazard models and the 2000 census based on Kannisto models (22 provinces)

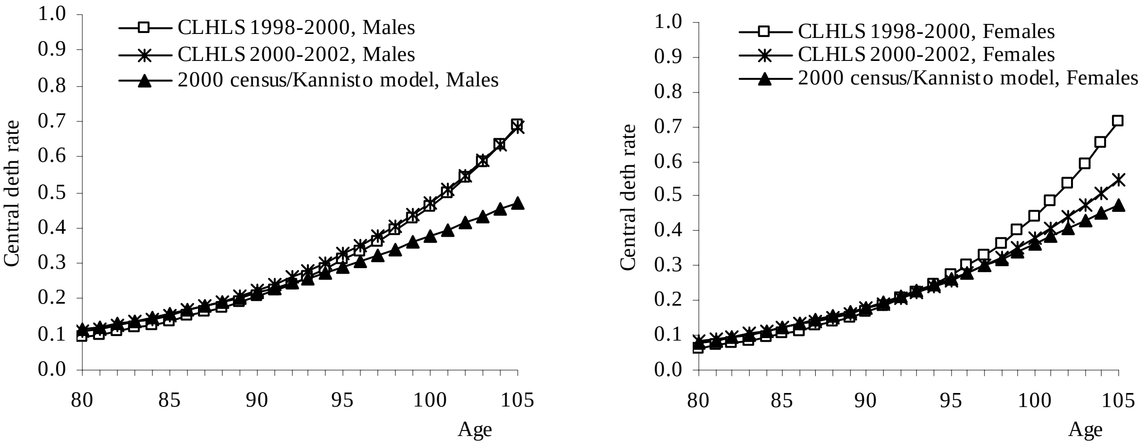

Figure 4. Relative mortality bias between the CLHLS based on hazard models compared to census mortality fitted by Kannisto models (22 provinces)

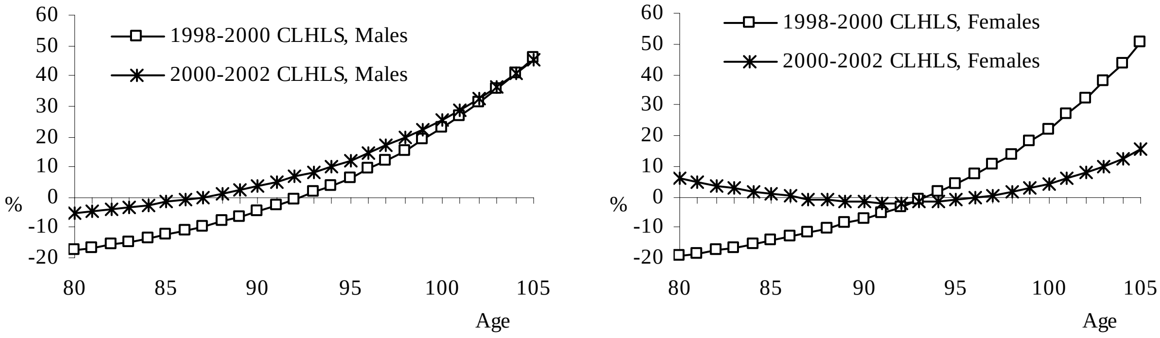

Figure 5. Estimated impact of potential age exaggeration by ethnic minorities on overall mortality in the CLHLS, 1998-2002