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Chinese Longitudinal Healthy Longevity Survey (CLHLS), 1998-2012

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Sampling and Design

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Chapter 2
Introduction to the Chinese Longitudinal Healthy Longevity Survey (CLHLS)

Zeng Yi

Abstract To provide readers with information on the data source and research opportunities inherent in the CLHLS data sets, we present in this chapter an introduction to the CLHLS. The chapter includes the general goals, the specific objectives of, the organizational framework, study design, sample distribution and contents of the data collected, and finally a comparison with other survey projects focusing on elderly populations.

Keywords Adult child sample, CLHLS, Data collection, Data source, Determinant, Centenarian, Elderly population, Extent of disability and suffering before dying, Family relation, Healthy longevity, Intergenerational relation, Next-of-kin, Oldest-old, Over-sampling, Refusal rate, Research opportunities, Sample distribution, Study design, Weight

2.1 Background and Significance

The number of oldest-old persons aged 80 and older in China is expected to climb from about 12 million in 2000 to 51, 76, and 114 million in 2030, 2040 and 2050, respectively, under the medium mortality assumption. With the medium fertility and medium mortality assumptions, the proportion of elderly aged 65 and over is expected to increase from 7 percent in 2000 to about 16 percent in 2030, and to more than 23 percent in 2050, while the oldest-old will constitute 14, 22 and 34.4 percent of the elderly population in 2000, 2030 and 2050, respectively (Zeng and George 2002). The main reason why the number of oldest-old will climb so quickly after the year 2030 is that China's "baby boomers," who were born in the 1950s and 1960s, will fall then into the category of the "oldest-old." The average annual increase rate of oldest-old persons between 2000 and 2050 is expected to be

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around 4.4 percent in China, which is about 2.4, 1.9, 2.0, 1.8, and 1.7 times as high, respectively, as that in United Kingdom, USA, France, Germany, and Japan (United Nations 2005). Oldest-old persons are much more likely to need help in daily living as compared to the younger elderly. Data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS), which is the prominent source of data of the analyses contained in this book show that the prevalence of disability in Activities of Daily Living (ADL), such as bathing, dressing and eating, increases dramatically with age from less than 5 percent at ages 65–69 to 20 percent at ages 80–84, and to 40 percent at 90–94 years of age. At ages 100–105, less than 40 percent are able to perform the basic activities of daily living (ADL) without help. The oldest-old consume services, medical care and receive transfers at a higher rate than younger elderly persons. Torrey (1992: 382) estimated that in the US, the cost of Medicare for the oldest-old is 77, 60, and 36 percent higher than that of elders aged 65–69, 70–74, and 75–79, respectively. The total cost of long-term care for the oldest-old is 14.4 times as high as that for younger elders aged 65–74.

The fact that the oldest-old sub-population is growing much faster than any other age group, and that they are also the most likely group to need help, indicates a significant need to investigate the demographic, socioeconomic, psychological and health status of the oldest-old. In the US, Canada, Europe, and some Asian and Latin American countries, efforts have been made to attract the attention of academics and policy makers to the concerns of the oldest-old (Suzman et al. 1992; Baltes and Mayer 1999; Vaupel et al. 1998). Some countries around the world have collected data from large samples of the old, with an over-sampling of the oldest-old. For example, 11 countries in the European Union have developed SHARE Surveys (Survey of Health and Retirement in Europe) and England had collected the ELSA (the English Longitudinal Survey of Aging), which are comparable to the American HRS (Health and Retirement Survey). In Japan the NUJLSOA (Nihon University Japanese Longitudinal Study of Aging) has been developed to be comparable to the US LSOA (Longitudinal Study of Aging). Longitudinal multi-wave studies are also available for the Taiwan area of China (SHLSE, Survey of Health and Living Status of the Elderly); Indonesia (The Indonesia Family Life Survey); and Mexico (MHAS, The Mexican Health and Aging Study). More studies are now being developed particularly in developing countries where less is known about the oldest-old.

Before the Longitudinal Healthy Longevity Survey study was launched in 1998 in China, little attention had been paid to ensure sufficient representation of the oldest-old in national surveys, and most studies on the elderly included few subjects aged 80 and over. Almost all published official statistics were truncated at ages 65 or 80. The surveys on the elderly thus had sub-sample sizes far too small for the proper evaluation of the oldest-old. For example, 20,083 elders aged 60 and above were interviewed under the 1992 Chinese national survey on support systems for the elderly; but among them, only 84 were aged 90+. These small sub-sample sizes made a meaningful analysis of the oldest-old sub-population impossible.

To fill in the data and knowledge gaps for scientific studies and policy analysis, the Chinese Longitudinal Healthy Longevity Survey (CLHLS) has been underway

in China since 1998. Our main objective is to draw societal and governmental attention to scientific studies and practical program interventions for enhancing the well-being and life quality of the oldest-old and all other members of our society (Zeng et al. 2001).

To provide readers with information on the data source and research opportunities inherent in the CLHLS data sets, we present in this chapter an introduction to the CLHLS. The chapter includes the general goals, the specific objectives of, the organizational framework, study design, sample distribution and contents of the data collected, and finally a comparison with other survey projects focusing on elderly populations. Chaps. 3–6 present a systematic and relatively detailed assessment of the age reporting and data quality of the CLHLS.

2.2 Objectives and Organizational Framework

Our general goal is to shed new light on a better understanding of the determinants of healthy longevity of human beings. We are compiling extensive data on a much larger population of oldest-old aged 80–112 than has previously been studied, with a comparative group of younger elders aged 65–79. We propose to use demographic and statistical methods to analyze data culminating from the longitudinal surveys. We want to determine which factors, out of a large set of social, behavioral, biological, and environmental risk factors play an important role in healthy longevity. The large population size, the focus on healthy longevity (rather than on a specific disease or disorder), the simultaneous consideration of various risk factors, and the use of analytical strategies based on demographic concepts make this an innovative demographic data collection and research project.

Our Specific Objectives are as Follows:

- Collect intensive individual interview data including health, disability, demographic, family, socioeconomic, and behavioral risk-factors for mortality and healthy longevity.
- Follow-up the oldest-old and the comparative group of the younger elders, as well as some of the elders' adult children to ascertain changes in their health status, care needs and costs, and associated factors; and ascertain if they die and if so at what age, from what cause, the care that was needed and costs, and their health/disability status before death.
- Analyze the data collected to estimate the social, behavioral, environmental, and biological risk-factors that are the determinants of healthy longevity and mortality in the oldest-old.
- Compare the findings with results from other studies of large populations at advanced ages.

The organizational framework of the CLHLS is summarized in Table 2.1.

Table 2.1 The organizational framework

Sponsoring and supporting organizations	National Institute on Aging; United Nations Fund for Population Activities (UNFPA) and China National Foundation for Social Sciences joined NIA to co-sponsor the expanded survey in 2002; China National Natural Science Foundation and Hong Kong Research Grant Council joined NIA to co-sponsored the expanded survey since 2005; Peking University and Duke University have provided institutional support; Max Planck Institute for Demographic Research has provided support for international training
Principal investigator and steering committee	Zeng Yi, Principal Investigator, Duke University and Peking University. The steering committee of the Chinese research team of this project consists of (alphabetically listed): Guo Zhigang, Li Ling, Liu Yuzhi, Edward Tu, Xiao Zhenyu, Zeng Yi, Zhang Chunyuan
International longevity projects coordinator	James W. Vaupel, Coordinator of the Coordinated International Projects on Healthy Longevity in U.S., Europe, and China, Max Planck Institute for Demographic Research and Duke University
Data collection organizations	Peking University Center for Healthy Aging and Family Studies (CHAFS) and China Mainland Information Group

2.3 Study Design and Sample Distribution

The baseline survey and the follow-up surveys with replacement for deceased elders were conducted in a randomly selected half of the counties and cities in 22 of China's 31 provinces in 1998, 2000, 2002, and 2005. We will conduct the fifth follow-up wave in 2008. Han Chinese people, who generally report age accurately, are the overwhelming majority in the surveyed provinces. The surveyed provinces are Liaoning, Jilin, Heilongjiang, Hebei, Beijing, Tianjing, Shanxi, Shaanxi, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shangdong, Henan, Hubei, Hunan, Guangdong, Guangxi, Sichuan, and Chongqing. The population in the survey areas constitutes about 85 percent of the total population in China.

In our 1998 baseline survey, we tried to interview all centenarians who voluntarily agreed to participate in the study in the sampled counties and cities; for each centenarian interviewee, one nearby octogenarian and one nearby nonagenarian of predefined age and sex were interviewed. In the 2002 and 2005 waves, three nearby elders aged 65–79 of predefined age and sex were interviewed in conjunction with every two centenarians. "Nearby" is loosely defined – it could be in the same village or on the same street, if available, or in the same town or in the same sampled county or city. The predefined age and sex are randomly determined, based on the randomly

assigned code numbers of the centenarians, to have more or less randomly selected comparable numbers of males and females at each age from 65 to 99.[1]

Those interviewees who were still surviving in the follow-up waves were re-interviewed. In our 1998 baseline survey and 2000, 2002, and 2005 follow-up surveys, we tried to interview all centenarians who voluntarily agreed to participate in the study, in order to keep a large sub-sample of centenarians in each of the waves. Those elderly who were interviewed but subsequently died before the next wave were replaced by new interviewees of the same sex and age (or within the same 5-year age group).

We added a sub-sample of 4,478 elderly interviewees' adult children aged 35–65 in 2002. The adult children sub-sample covers the eight provinces of Guangdong, Jiangsu, Fujian, Zhejiang, Shandong, Shanghai, Beijing, and Guangxi. If an elderly interviewee had only one eligible child (i.e., aged 35–65 and living in the sampling areas), that child was interviewed. If an elderly interviewee had two eligible adult children, the elder child was interviewed if the elderly interviewee was born in the first 6 months, and the younger child was interviewed if the elderly interviewee was born in the second 6 months. If an elderly interviewee had three eligible adult children, the eldest, the middle, or the youngest child was interviewed if the elderly interviewee was born in the first 4 months, second 4 months or the third 4 months, and so on. Among the 4,478 adult children interviewed in 2002, 1,722 sons and 338 daughters co-resided with old parents and 1,410 sons and 1,008 daughters did not co-reside with old parents. Such sample distributions reveal a traditional Chinese social practice: most old parents live with a son; non co-residing sons usually live closer to old parents than do the non co-residing daughters.

To avoid the problem of small sub-sample sizes at the more advanced ages, we did not follow the procedure of proportional sampling design, but instead interviewed nearly all centenarians and over-sampled the oldest-old of more advanced ages, especially among males. Consequently, appropriate weights need to be used to compute the averages of the age groups below age 100, but no weights are needed when computing the average of the centenarians. The method for computing the age-sex and rural–urban specific weights, and the associated discussions, are presented in the Appendix to this chapter.

In sum, the Chinese Longitudinal Healthy Longevity Survey (CLHLS) interviewed 8,959 and 11,161 oldest-old aged 80–112 in 1998 and 2000, and 16,057

[1] We obtained the lists of names and addresses of the centenarians through the Chinese local aging committee network or the neighborhood/village residents committees, and randomly assigned a code to each of the centenarians. For those centenarians whose code ended in 0, 1, 2, 3,. . . , 9, we tried to find one nearby octogenarians aged 80, 81, 82, 83,. . . , 89, one nearby nonagenarians aged 90, 91, 92, 93,. . . , 99, one nearby elder aged 70, 71, 72, 73,. . . , 79, respectively. For those centenarians whose code ended in 5, 6, 7, 8, 9, we tried to find one nearby elder aged 65, 66, 67, 68, 69, respectively. The sex of the targeted elderly aged 65–99 is randomly determined, with equal numbers of targeted males and females. If the enumerator could not find (through the urban neighborhood or the village residents committees who have the households' registration records) the target with exactly the predefined age and sex, an alternative subject who is the same sex and in the same 5-year age group was also acceptable.

and 15,638 elderly aged 65–112 in 2002 and 2005, respectively. In the four waves, in total, 10,964, 14,384, 16,526, and 9,941 face-to-face interviews were conducted with centenarians, nonagenarians, octogenarians, and younger elders aged 65–79, respectively (see Table 2.2 for more detailed information). At each wave, the longitudinal survivors were re-interviewed, and the deceased interviewees were replaced by additional participants. Data on mortality and health status before dying for the 12,007 oldest-old (aged 80–112) who died between the waves of 1998, 2000, 2002, and 2005 and the 499 younger elders (aged 65–79) who died between 2002 and 2005 were collected in interviews with a close family member of the deceased. In our 2002 and 2005 surveys, we also interviewed (with follow-up) 4,478 elderly interviewees' adult children (aged 35–65) in the eight provinces.

2.4 Data Collected

An interview with some basic physical capacity tests was performed at the interviewee's home. The questionnaire design was based on international standards and was adapted to the Chinese cultural/social context and carefully tested by pilot studies and interviews. We emphasized questions that might shed light on risk factors for mortality and healthy longevity, and we sought to minimize questions that could not be reliably answered by the oldest-old, some of whom may lack education and may have poor hearing and vision. The data collected included family structure, living arrangements and proximity to children, self-rated health, self-evaluation on life satisfaction, chronic disease, medical care, social activities, diet, smoking and alcohol drinking, psychological characteristics, economic resources, caregiver and family support, nutrition and some health-related conditions in early life (childhood, adulthood, and around age 60). Activities of Daily Living (ADL) and cognitive function measured by the Mini-Mental State Examination (MMSE) were evaluated in all waves in 1998, 2000, 2002, and 2005. The capacity of physical performance was also evaluated in all waves by means of tests of standing up from a chair without using hands, picking up a book from the floor, and turning around 360°. As initially planned, Instrumental Activities of Daily Living (IADL) questions were not included in the 1998 baseline and 2000 follow-up surveys because the 1998 and 2000 waves interviewed the oldest-old only and the Chinese oldest-old are generally limited in IADL. We added IADL questions in our 2002 and 2005 surveys when we expanded our survey to cover both the oldest-old and the younger elderly aged 65–79.

The interview refusal rate among the Chinese oldest-old was very low: about 2 percent among those who were not too sick to participate with proxy assistance. This high rate likely is due to the fact that the Chinese oldest-old in general like to talk to outside people, plus they stay at home without a job or other duties. Many of them and their family members may also feel honored to participate in survey interviews concerning healthy longevity, as they may be proud of being a member of a long-lived group. Many of the disabled oldest-old agreed to participate in our

Table 2.2 Age and sex compositions of the samples of the 1998 baseline, and the 2000, 2002, and 2005 follow-up surveys

Age	Surviving interviewees									Deceased interviewees		
	Follow-up			Newly added			Total					
	M	F	T	M	F	T	M	F	T	M	F	T
1998 baseline survey												
80–89	–	–	–	1,787	1,741	3,528	1,787	1,741	3,528	–	–	–
90–99	–	–	–	1,299	1,714	3,013	1,299	1,714	3,013	–	–	–
100+	–	–	–	481	1,937	2,418	481	1,937	2,418	–	–	–
Total	–	–	–	3,567	5,392	8,959	3,567	5,392	8,959	–	–	–
2000 follow-up survey												
80–89	996	1,048	2,044	1,471	1,403	2,874	2,467	2,451	4,918	339	262	601
90–99	720	907	1,627	925	1,260	2,185	1,645	2,167	3,812	574	612	1,186
100+	262	891	1,153	256	1,022	1,278	518	1,913	2,431	348	1,213	1,561
Total	1,978	2,846	4,824	2,652	3,685	6,337	4,630	6,531	11,161	1,261	2,087	3,348
2002 follow-up survey												
35–65	–	–	–	3,132	1,346	4,478	3,132	1,346	4,478	–	–	–
65–79	–	–	–	2,456	2,438	4,894	2,456	2,438	4,894	–	–	–
80–89	1,454	1,411	2,865	673	672	1,345	2,127	2,083	4,210	481	367	848
90–99	948	1,236	2,184	590	858	1,448	1,538	2,094	3,632	543	677	1,220
100+	277	917	,194	442	1,685	2,127	719	2,602	3,321	292	930	1,222
Total	2,679	3,564	6,243	7,293	6,999	14,292	9,972	10,563	20,535	1,316	1,974	3,290
2005 follow-up survey												
35-65	2,183	820	3,003	–	–	–	2,183	820	3,003	30	5	35
65–79	1,849	1,805	3,654	959	935	1,894	2,808	2,740	5,548	271	228	499
80–89	1,147	1,231	2,378	741	748	1,489	1,888	1,979	3,867	721	627	1,348
90–99	522	824	1,346	943	1292	2,235	1,465	2,116	3,581	55	1,085	,940
100+	158	600	758	360	1462	1,822	518	2,062	2,580	50	1,636	2,086
Total	5,859	5,280	11,139	3,003	4,437	7,440	8,862	9,717	18,579	2,327	3,581	5,908

Table 2.2 (Continued)

Age	Surviving interviewees									Deceased interviewees		
	Follow-up			Newly added			Total					
	M	F	T	M	F	T	M	F	T	M	F	T
Total Sample size of the four waves (1998–2005)												
35–65	2, 183	820	3, 003	3, 132	1, 346	4, 478	5, 315	2, 166	7, 481	30	5	35
65–79	1, 849	1, 805	3, 654	3, 415	3, 373	6, 788	5, 264	5, 178	10, 442	271	228	499
80–89	3, 597	3, 690	7, 287	4, 672	4, 564	9, 236	8, 269	8, 254	16, 523	1, 541	1, 256	2, 797
90–99	2, 190	2, 967	5, 157	3, 757	5, 124	8, 881	5, 947	8, 091	14, 038	1, 972	2, 374	4, 346
100+	697	2, 408	3, 105	1, 539	6, 106	7, 645	2, 236	8, 514	10, 750	1, 090	3, 779	4, 869
Total	10, 516	11, 690	22, 206	16, 515	20, 513	37, 028	27, 031	32, 203	59, 234	4, 904	7, 642	12, 546

*M, Male; F, Female; T, Total (i.e. two-sexes combined); "–", not relevant.

healthy longevity study through proxy assistance by a close family member. Those who were too sick to participate with proxy assistance were not interviewed. Instead the interviewers answered the question "Why was the interview not conducted or not completed?" The answers to this question are used in data analysis to correct for selection bias. Refusal rates increase substantially among younger interviewees aged 65–79 (5.1 percent) and among adult children aged 35–65 (14.3 percent) because some of them did not want to devote their time to the interview.

One unique feature of the CLHLS study is that relatively comprehensive information on the extent of disability and suffering before dying was obtained for those interviewees who had died before the next wave by interviewing one of their close family members. Collected information before dying includes date/cause of death, chronic diseases, ADL, number of hospitalizations or incidents of being bedridden from the last interview to death, and whether the subject had been able to obtain adequate medical treatment when suffering from disease. If any of the ADL activities were disabled or partially disabled, then a question on the duration of the disability (or partial disability) would follow. The number of days spent bedridden before dying was also ascertained. Data on how many days before death the elder did not go outside and how many days before death the elder spent more time in bed than out of bed were collected. Information on socioeconomic and demographic characteristics, such as marital status, family structure, caregivers, financial situation, and living arrangement before death, were also collected.

2.5 Research Opportunities

2.5.1 Healthy Survival and Disability of the Elderly

Population aging accompanied with the fastest growth of the oldest-old is unavoidable. Hence the fundamental question is the following: how can the global community adequately face the challenges of aging and achieve the goals of healthy survival and declining disability, and not only survive, but also remain healthy up to advanced ages? Despite the significance of this question, little is known about why some people live into their 1980s, others into their 1990s, and a select few to age 100 or more; and why some people survive to advanced ages with good health while others suffer severe disability and diseases (Jeune 1995; Vaupel et al. 1998). We believe that research based on CLHLS data may contribute important new knowledge with which these basic questions may be addressed.

Improved knowledge on the determinants of healthy survival will help society to reduce the costs of taking care of the disabled elderly. Leon et al. (1998) have estimated that on average a one-month delay in nursing home placement could save as much as $1 billion annually in health services costs in the US Lessons learned from studying the oldest-old in Chinese society, where family and community-based care (rather than nursing home care) is the main institution for taking care of disabled elderly, may be a useful reference point for offsetting a devastating burden to the

health care systems in the US and other Western countries. Improved knowledge about healthy longevity will also stimulate consumption and investment concerning healthy survival, and strengthen the human capital of the healthy elderly; all of this will certainly be useful in stimulating economic growth (Cutler and Richardson 1997; Morand 2002; Murray and Lopez 1996; Nordhaus 2002; WHO 2002). The information will not only be beneficial to Chinese societies but also to international businesses dealing with the huge markets of rapidly increasing elderly populations in Western countries and China.

2.5.2 Extent of Disability and Suffering Before Dying

Based on Medicare data, Lubitz and Prihoda (1983) showed that 28 percent of all Medicare costs were incurred by the 6 percent of enrollees who died within the next 12 months. If an individual experiences severe suffering for an extended period before dying, much pain and burden are brought on the individual, family, and society. Hence, it is important to study factors associated with both healthy survival and deceased elders' extent of disability and suffering before dying. In the CLHLS study, comprehensive data on health status, disability, and degree/length of suffering before dying were obtained about the deceased oldest-old interviewees by interviewing one of their close family members. As reviewed by George (2002), the use of surrogate or proxy responses from family members is appropriate in quality of dying research. However, George (2002) also found that in most previous quality of dying research, investigators appear to have selected a place for subject recruitment (e.g., hospice settings, palliative care units) and then simply enrolled the available patients, thereby introducing selection bias. Up to 2005, we collected relatively comprehensive data before dying from a sample of nearly 12,506 elders in the randomly selected half of the counties and cities forming the study area; as noted previously, this is an area constituting about 85 percent of the total population of China. This study has clear merit in this regard since it does not rely on a small sample from a single health care setting, as was done in most previous quality of dying research.

2.5.3 Intergenerational Family Relations and Healthy Longevity

Many studies consistently claim a strong association of family support with better health and lower elderly mortality (Anderson et al. 1999; Rogers 1996; Zunzunegui et al. 2001). Of all kin ties, the parent-child relationship remains the most important "stem" in the family support network (Wellman and Wortley 1990). A dyadic approach that collects and analyzes data from members of two generations has been proposed to study family relationships (Lye 1996; Thompson and Walker 1982). Examples of large-scale surveys that interview both parents and children are the US Longitudinal Study of Generations and the National Survey of Families and Households (NSFH). Using funds entirely from Chinese sources, we added a sub-sample

of 4,478 elderly interviewees' adult children aged 35–65 in our 2002 survey. Follow-up surveys on these adult children and their elderly parents in 2005 provided unique data for studying intergenerational family relationships/transfers and their impacts on healthy longevity. This is particularly relevant in the Chinese cultural and social context, which tends to have a more valued family support system. As compared to other studies following the dyadic approach, our study has unique strengths: the mean age of old parents is 83.6 (SD=11.0) and the mean age of adult children is 50.3 (SD=8.6). About 60 percent of our paired-sample consists of oldest-old parent(s) aged 80–110 with a child who is also elderly or nearly elderly, and about 40 percent of the paired sample consists of old parents younger than age 80 with their relatively younger adult child. Our paired-sample is particularly useful for studying the association of healthy longevity with the family relationship between the oldest-old and their elderly children. To our knowledge, no study of this kind, with a large number of pairs of oldest-old parent(s) and their elderly children, has ever been conducted.

2.5.4 The Unique Features

Our continuing CLHLS project offers an unparalleled opportunity for studies of the determinants of healthy longevity. *First, research leverage will be gained by focusing on an extremely selected (and large) group of Chinese oldest-old.* The Chinese population is so huge that despite very high mortality in the past, the numbers of oldest-old persons are very large and continue to rapidly increase. The proportion of centenarians, nonagenarians, and octogenarians in China, however, is much lower than in developed countries. For example, there were about 5 centenarians per million in China in 1990s, compared with 25 per million in Japan and 50 per million in Western Europe (Jeune 1995). The Chinese oldest-old aged 80+ are an extremely select sub-population; they are the survivors of brutal mortality regimes of the past operating on birth cohorts of many millions. A focus on extreme cases is often a good way to gain research leverage at a reasonable expense. Research on the large but extraordinarily selected Chinese oldest-old should provide important leverage for better understanding healthy longevity in general.

Second, the age reporting of the Chinese oldest-old is reasonably good. Accurate age reporting is crucial in studies dealing with elderly people, especially the oldest-old. Often, older persons in developing countries cannot report their age accurately (Coale and Kisker 1986; Elo and Preston 1992; Mosley and Gray 1993). The age reporting of the Chinese oldest-old is reasonably reliable, based on the analysis by a wide variety of international and Chinese demographers such as Coale and Li (1991), Wang et al. (1998), and Zeng et al. (2001; 2002, using the CLHLS data), and as analyzed and discussed in Chaps. 4 and 5 of this book.

Third, this is the largest longitudinal study of the oldest-old and has a comprehensive approach. It includes oldest-old aged 80–110 with the largest sample size ever conducted, with younger elders aged 65–79 as a comparative group; moreover, data have been collected on the extent of disability and suffering before dying, oldest-old siblings-pairs, elderly interviewees' adult children, and

information concerning the communities where the interviewees live. The CLHLS has the largest sample size of centenarians and nonagenarians compared to any other study in the world. It also has a larger sub-sample size of octogenarians than any other survey except the NLTCS and AHEAD in the US and is one of only ten studies that collected data on the extent of disability and suffering before dying; it is one of five studies that collected sibling-pairs data; and it is one of three studies that interviewed elderly subjects' adult children. The CLHLS and NECS are the only two studies that include all three of the above data collection components (extent of disability and suffering before dying, sibling pairs, and adult children) in one study. Further, the main sample of the NECS covers centenarians only, while the CLHLS covers persons in ages 80–110 in 1998 and 2000 and ages 65–110 in 2002 and 2005.

2.6 Data Availability and Contacts

2.6.1 Data Availability

The 1998 baseline, 2000, 2002, and 2005 follow-up healthy longevity survey data sets are being distributed by Peking University and Duke University. Researchers interested in using the data are expected to sign a Data Use Agreement. Raw data will then be provided freely.

2.6.2 Contacts

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Appendix: The Weights for Producing Correct Estimates of the Average of Entire Population of Old Persons, Based on the Healthy Longevity Sample Survey Data

The age (x), sex (s), and rural–urban residence (r) specific weight $w(x, s, r, t)$ in the survey year t is computed as

$$w(x,s,r,t) = \frac{N(x,s,r,t)/\sum_{x}\sum_{s}\sum_{r} N(x,s,r,t)}{n(x,s,r,t)/\sum_{x}\sum_{s}\sum_{r} n(x,s,r,t)}$$

$$= [N(x,s,r,t)/n(x,s,r,t)]\left[\sum_{x}\sum_{s}\sum_{r} n(x,s,r,t)/\sum_{x}\sum_{s}\sum_{r} N(x,s,r,t)\right]$$

Where $N(x, s, r, t)$ is number of persons of age x, sex s, and residence r in year t, derived from the projected elderly population based on the last census 100 percent data tabulations for the 22 provinces where the CLHLS survey was conducted, and the estimated age–sex-specific survival probabilities between the census year and the survey year t. The $n(x, s, r, t)$ is number of persons of age x, sex s, and residence r, derived from the healthy longevity survey conducted in the year t. The weight is actually the multiplication of the ratio of $[N(x, s, r, t)/n(x, s, r, t)]$ and the overall sampling ratio in the survey year t. No weights are needed when we compute the average of the centenarians, since the survey attempted to interview all centenarians in the sampled areas.

The weight $w(x, s, r, t)$ is actually the ratio of age distribution of the entire elderly population in the survey year t to the age distribution of the sample in the year t. The weights for the over-sampled extremely old persons (e.g. 90+) are less than 1.0, and weights for under-sampled elders (e.g. age 65–69 to 80–85) are greater than 1.0.

The values of the weights vary (usually greater than 1.0 under age 88 and less than 1.0 above age 90), and it produces correct average proportions of certain attributes within age groups by using the weights. However, SPSS (or other software) would not produce correct p-values for testing the statistical significance of the differences of the proportions among different age groups, since the sub-sample size of the age groups are altered after weighting the individual cases. Therefore, the weights need to be adjusted to make sure that the sub-sample size within each age group after weighting is exactly the same as the true sub-sample size. Denote $C_j(s, r, t)$ as the adjusting factor for age group j (e.g. age group 90–95) with sex s and residence r; $T_j(s, r, t)$ as the total number of interviewed persons of the age group j with sex s and residence r. The following equations must be fulfilled: $C_j(s,r,t)\sum_{x} w(x,s,r,t)n(x,s,r,t) = T_j(s,r,t)$. Solving this equation, we obtain the adjusting factor, $C_j(s,r,t) = T_j(s,r,t)/\sum_{x} w(x,s,r,t)n(x,s,r,t)$.

The adjusted weights are $w'(x,s,r,t) = w(x,s,r,t)C_j(s,r,t)$. We should use the adjusted weights that produce both correct proportions, and correct sub-sample sizes and thus correct p-values for testing the statistical significance of the differences of the proportions among various age groups.

If one computes proportions of certain attributes of age groups with rural and urban combined, the adjusting factor is not rural–urban specific, but age group and sex specific: $C_j(s) = T_j(s)/\sum_{x}\sum_{r} w(x,s,r,t)n(x,s,r,t)$.

If one computes proportions of certain attributes of age groups with rural and urban combined and both sexes combined, the adjusting factor is neither rural–urban specific, nor sex-specific, but only age group specific: $C_j = T_j / \sum_x \sum_r \sum_s w(x,s,r,t)\, n(x,s,r,t)$.

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