Soc Indic Res (2009) 90:257–265
DOI 10.1007/s11205-008-9256-1

A Comparative Study of Handicap-free Life Expectancy of China in 1987 and 2006

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Accepted: 25 March 2008 / Published online: 9 April 2008

Abstract After the first large scale national sampling survey on handicapped persons in 1987, China conducted its second national sampling survey in 2006. Using the data from these two surveys and the national life tables, we computed and compared the expected years of life free of handicapped condition by the Sullivan method. The expected years of life lived with handicap for the Chinese population increased from 4.87 years for males and 5.81 years for females in 1987 to 5.55 years and 6.32 years in 2006, respectively. The same trend was observed for people in working ages (15–64) and old ages (65+). However, the expected years of life lived with handicap decreased for children (0–14). Our results also showed that the effect of skeletal handicap increased notably for both sexes. Healthy life expectancy is an important indicator in measuring quality of life of a population. Our study utilized this measurement to quantify one aspect of quality of life of the Chinese population.

Keywords Disability · Handicap-free life expectancy · Life table · Sullivan method

1 Introduction

Life table techniques have been widely used to quantify the health of a population (Chiang 1984). The life expectancy estimated from constructing of a life table is a standardized statistical indicator and it can be used to compare the mortality across populations and time. Life expectancy is one of the most important indicators utilized not only by health professionals but also by policy makers and general public in measuring population health (Silcocks et al. 2001).

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It is well-known that the life expectancy could be improved rapidly when it is low and cannot be extended much more easily if it is already high. For example, the life expectancy of China was about 35 at the beginning of 1950s, which was very low because of prolonged and large scale wars before the funding of The People's Republic of China in 1949 (Jiang et al. 1984). After the ending of wars and the implementing of new social development programs, the life expectancy of China increased rapidly to near 70 years at the beginning of 1980s (Jiang et al. 1984). During this period of time, the life expectancy and the health care of China was frequently cited as a model to developing countries. The increasing rate of life expectancy in the second three decades was much slower than that in the first three decades after the funding of the new China. This slowness may be derived from the natural course of life expectancy. However, along with the great economic expansion in China since the economic reform in 1979, we also observed that, most people, especially people living in the countryside, lost their limited health insurance that was established during the 1960s and 1970s. The life expectancies for the Chinese males and females were 66.43, 69.35 in 1981, 68.96, 72.77 in 1989 and 69.63, 73.33 in 1999 according to the population censuses of 1982, 1990 and 2000, respectively (Jiang et al. 1984; NBS 1995, 2003 personal communication).

When the life expectancy of a large population is in the advanced level around 1970s, it is not an easy task for further improvement and much of the life gained in the late part of life span may be mostly in sub-healthy status with disability (handicap). To measure the expected years of life lived with handicap, the Sullivan method, in combining with traditional life table techniques, is a popular tool (Sullivan 1971). The Sullivan method was used to estimate the expected years with handicap for the Chinese population based on the first national sampling survey of handicap in 1987 (OFCNSSH 1989; Lai et al. 2000). In present article, we continued our use of the same method to compute the age-gender specific expected years of life lived with the six large categories of handicap according to the second Chinese national sampling survey on handicap in 2006 (OSCNSSD 2007).

Examples of conceptual studies of healthy life expectancies were given by Robine et al. (1992). The quality of Sullivan method is reviewed in Mathers and Robine (1997). Research reports on handicap-free life expectancies of China were also available based on the first survey by Grab et al. (1991) and Qiao (1993). Law and Yip (2003) studied healthy life expectancy of Hong Kong, a relatively small region of China. Hong Kong and other special regions of China are usually not included in the national sampling frame for most of the official statistical activities of China. Robine et al. (2003) provided a comprehensive study on health expectancies.

2 Methods

The first Chinese national sampling survey on handicap was conducted in 1987 and the expected years of life lived with the six large categories of handicap were reported (OFCNSSH 1989; Lai et al. 2000). These six categories of handicap were ocular, aural (including language), intellectual, skeletal, psychological and multiple handicap. After 19 years, the second Chinese national sampling survey on handicap was held in 2006. The summary statistics were published in July 2007 (OSCNSSD 2007). Although the same Chinese word "Canji" was used, the English word "handicap" was used for the first survey and "disability" was used for the second survey (OFCNSSH 1989; OSCNSSD 2007). The sampling design for both surveys were the same. The classifications of handicaps were essentially the same according to *International Classification of Impairments, Disabilities*

and Handicaps for the first survey and *International Classification of Functioning, Disability and Health* for the second survey (WHO 1980, 2001). In this article, we used "handicap" for both surveys as the Chinese word "Canji."

In the second survey, the summary statistics for aural handicap and language handicap were separated into two categories, but we merged the language handicap back to aural handicap as in the first survey for an easy comparison. The sample sizes were 1.58 million for the first survey and 2.53 million for the second survey. Both surveys were conducted by the Offices (first and second) of China National Sampling Survey on Disability under the China Disabled Persons' Federation with the assistance of the National Bureau of Statistics and other related governmental agencies of China. The survey designs were based on multi-stage, stratified, cluster and probability proportion to size sampling (OFCNSSH 1989; OSCNSSD 2007). However, the design structures were not used in preparing the officially published summary statistics of various indicators. Therefore, our study, based on the official publications, was not a design based analysis.

In computing the handicap-free life expectancy based on the first survey, we used the life tables published by the National Bureau of Statistics generated from the 1990 population census of China (NBS 1995). For the second survey, we used the life tables based on the 2000 population census (NBS 2003, personal communication). S-plus was used for the computations for the first survey and Excel was used for the second survey.

As in Lai et al. (2000), let h_x be the age-specific handicap prevalence. The Sullivan method adjusts the life table function L_x (person-years lived in age-group x by multiplying $(1 - h_x)$ (Sullivan 1971). That is, we would get handicap-free person years lived $L'_x = L_x(1 - h_x)$ and the total handicap-free member of person years beyond age x would be $T'_x = \sum_{i=x}^{\infty} L_i(1 - h_i)$. Then, handicap-free life expectancy is $e_x = T'_x/l_x$, where l_x is the total number of survivors at age x. The difference $e_x - e'_x$ is the expected years of life lived with handicap. The expected years of life lived with handicap measure the potential gains of the handicap-free life expectancy of the population that would be realized if there were no handicaps in the society. This measurement is a quality of life indicator for the entire population. Large value of this quality of life indicator shows heavy impact of handicap on the population. This value can be computed by gender and different age groups. For example, to compute the handicap-free life expectancy within working ages (15–64 years old), we have $e_{15,64} = (T'_{65} - T'_{15})/l_{15}$. Similar, we also computed handicap-free life expectancy for childhood (0–14) and for old ages (65+). We compared the results derived from the second survey to what were obtained from the first survey.

3 Results

The prevalence of handicap population of China increased from 4.94% in the first survey (1987) to 6.39% in the second survey (2006) (OFCNSSH 1989; OSCNSSD 2007). The expected years of life lived with handicap for males increased from 4.87 to 5.55 years, of which, 3.44 and 3.97 years were in the age group of 65 years or old for the first and the second survey, respectively, as shown in Table 1. That is, the percentages of expected years lived with handicap for males in 65 years old were 70.64% and 71.53% for 1987 and 2006 respectively. For females, the expected years were 5.81 and 6.32 years for the two surveys respectively. The percentages of expected years of life lived with handicap for females were 76.94% and 84.34% in 1987 and 2006, respectively. The percentages of expected years of life lived with handicap of females were higher than that of males. The handicap-free expectancies were 61.91 and 63.87 years in 1987 and 64.08 and 67.01 years

Table 1 The expected years of life lived with and without handicap for the Chinese population[a]

	Male				Female		
	Age	LE[b] e_x	HFLE[c] e'_x	EYLH[d] $e_x - e'_x$	LE[b] e_x	HFLE[c] e'_x	EYLH[d] $e_x - e'_x$
First	0	66.78	61.91	4.87	69.68	63.87	5.81
	5	64.80	59.79	5.01	68.41	62.35	6.06
	10	60.10	55.21	4.89	63.64	57.70	5.94
	15	55.31	50.59	4.72	58.81	53.01	5.80
	20	50.62	46.01	4.61	54.09	48.36	5.73
	25	45.99	41.47	4.52	49.43	43.77	5.66
	30	41.34	36.92	4.42	44.74	39.15	5.59
	35	36.71	32.41	4.30	40.05	34.55	5.50
	40	32.14	27.95	4.19	35.39	30.02	5.37
	45	27.68	23.66	4.02	30.83	25.60	5.23
	50	23.38	19.50	3.88	26.40	21.29	5.11
	55	19.32	15.57	3.75	22.16	17.20	4.96
	60	15.57	11.97	3.65	18.14	13.67	4.47
	65	12.28	8.84	3.44	14.47	9.92	4.55
	70	9.42	6.18	3.24	11.15	6.92	4.23
	75	7.10	4.10	3.00	8.35	4.53	3.82
	80	5.02	2.49	2.53	5.79	2.70	3.09
	85	3.12	1.31	1.81	3.41	1.39	2.02
Second	0	69.63	64.08	5.55	73.33	67.01	6.32
	5	66.78	61.15	5.63	71.37	64.86	6.51
	10	62.01	56.45	5.56	66.54	60.09	6.45
	15	57.17	51.68	5.49	61.66	55.26	6.40
	20	52.40	46.98	5.42	56.81	50.48	6.33
	25	47.73	42.40	5.33	52.02	45.76	6.26
	30	43.06	37.84	5.22	47.25	41.06	6.19
	35	38.43	33.33	5.10	42.49	36.39	6.10
	40	33.85	28.90	4.95	37.75	31.76	5.99
	45	29.37	24.58	4.79	33.07	27.20	5.87
	50	25.01	20.41	4.60	28.50	22.79	5.71
	55	20.85	16.43	4.42	24.10	18.54	5.56
	60	16.92	12.71	4.21	19.88	14.55	5.33
	65	13.38	9.41	3.97	15.98	10.92	5.06
	70	10.27	6.62	3.65	12.44	7.76	4.68
	75	7.76	4.48	3.28	9.47	5.27	4.20
	80	5.69	2.90	2.79	6.95	3.38	3.57
	85	4.38	2.00	2.38	5.18	2.24	2.94

[a] Life tables of the Chinese population were based on the 1990 and 2000 censuses. The life expectancies from these life tables were used for computing HFLE, EYLH for 1987 and 2006, respectively

[b] LE, Life expectancy

[c] HFLE, Handicap-free life expectancy

[d] EYLH, Expected years of life lived with handicap

in 2006 for males and females respectively. Hence there were about 2- and 3-year increase in handicap-free life expectancy for the Chinese males and females in the 19 years from 1987 to 2006. Table 1 tabulated these results by age-gender groups.

We noticed that the expected years of life lived with handicap were mostly accumulated in old ages (65+). In 1987, the expected life years with handicap for childhood (0–14) and working ages (15–64) were 0.40 and 1.78 years for males and 0.34 and 1.69 years for females, whereas, for 2006, they were 0.25 and 2.47 years for males and 0.20 and 2.12 years for females. Relatively speaking, the expected years of life lived with handicap for children were decreased around 40% for both boys and girls, respectively. For the working aged persons, they increased about 40% for males and 25% for females.

It is worth noting that, from the formula of computing the expected years of life lived with handicap for each age groups, the sum of all age group is not exactly equal to the total. However, we can have an exact partition of the total expected years of life lived with handicap among different categories of handicaps.

From Table 2, we can see that the large relative reduction of the childhood expected life years lived with handicap was mostly due to the decreasing of intellectual handicap. The expected life years with intellectual handicap decreased from 0.26 years in the first survey years to 0.09 years in the second survey for boys and from 0.23 years to 0.08 for girls. The large increase of expected life years with handicap in working ages were mainly resulted from skeletal handicap. The expected life years living with skeletal handicap increased from 0.77 years in 1987 to 1.64 years for males and from 0.60 years to 1.60 years for females. From a relative point of view, there was also a dramatic increase for psychological handicap for people in working ages.

Table 2 The expected years of life lived with handicap for the Chinese population by type of handicap in childhood (0–14), working ages (15–64) and retirement (65+)[a]

	Type of handicap	Male				Female			
		at age 0[b]	0–14	15–64	65+	at age 0[b]	0–14	15–64	65+
First	Total	4.87	0.40	1.78	3.44	5.81	0.34	1.69	4.54
	Ocular	0.67	0.01	0.20	0.59	1.29	0.01	0.29	1.16
	Aural	2.09	0.06	0.59	1.83	2.15	0.04	0.54	1.87
	Intellectual	0.54	0.26	0.27	0.03	0.55	0.23	0.27	0.06
	Skeletal	0.77	0.03	0.43	0.36	0.60	0.02	0.27	0.34
	Psychological	0.13	0.00	0.11	0.03	0.19	0.00	0.15	0.04
	Multiple	0.66	0.04	0.17	0.61	1.02	0.03	0.16	1.06
Second	Total	5.55	0.25	2.47	3.96	6.32	0.20	2.12	5.06
	Ocular	0.68	0.01	0.26	0.58	1.24	0.01	0.31	1.15
	Aural	1.73	0.03	0.46	1.71	1.64	0.02	0.35	1.59
	Intellectual	0.32	0.09	0.21	0.04	0.29	0.08	0.18	0.05
	Skeletal	1.64	0.04	0.96	0.93	1.60	0.03	0.69	1.13
	Psychological	0.29	0.01	0.24	0.06	0.38	0.00	0.29	0.12
	Multiple	0.88	0.07	0.34	0.64	1.17	0.06	0.29	1.02

[a] Life tables of the Chinese population were based on the 1990 and 2000 censuses. The life expectancies from these life tables were used for computing HFLE, EYLH for 1987 and 2006, respectively

[b] The expected years of life lived with handicap at age 0 (EYLH), which is not a simple sum of the expected years of life lived with handicap in the age groups 0–14, 15–64 and 65+

The magnitude of expected years of life lived with ocular, aural and multiple handicap remained similar since the first survey in 1987 as shown in Table 2. We can also virtually observe the dynamics through the plot of the age-gender specific handicap rates in Figs. 1–6. Figure 3 shows the great decrease of handicap rates for children in 2006 as compared to that in 1987, whereas Fig. 4 shows the increase of skeletal handicap rates during and after working ages. Figure 5 reveals the increase of psychological handicap rates. Consisting with the expected years of life lived with handicap, Figs. 1, 2 and 6 indicated that there were no great changes of ocular, aural and multiple handicaps since 1987 for both genders.

4 Conclusions

Although China has its own classifications for various health status, both surveys on Chinese handicapped population were heavily influenced by the international standard. The

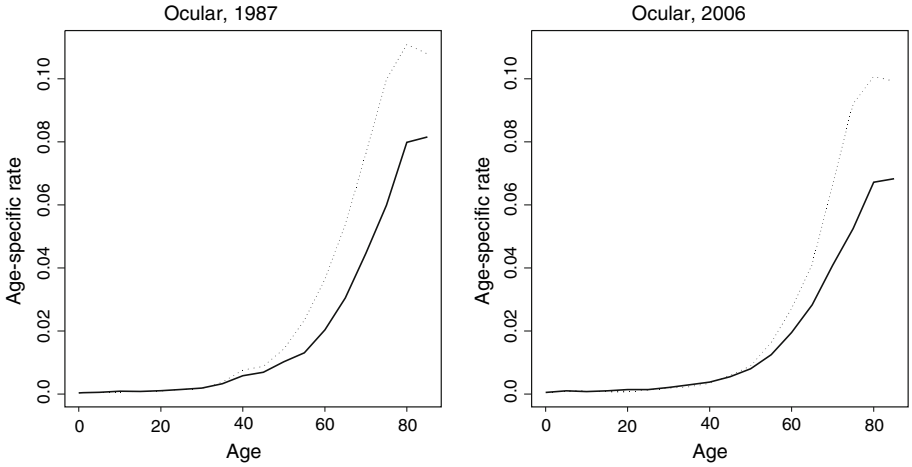

Fig. 1 The age-specific ocular handicap rates of China for males (solid lines) and females (dashed lines)

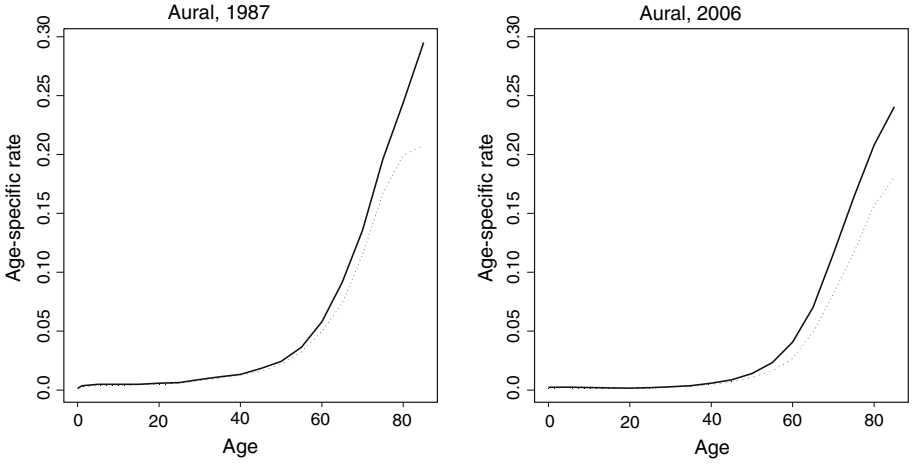

Fig. 2 The age-specific aural handicap rates of China for males (solid lines) and females (dashed lines)

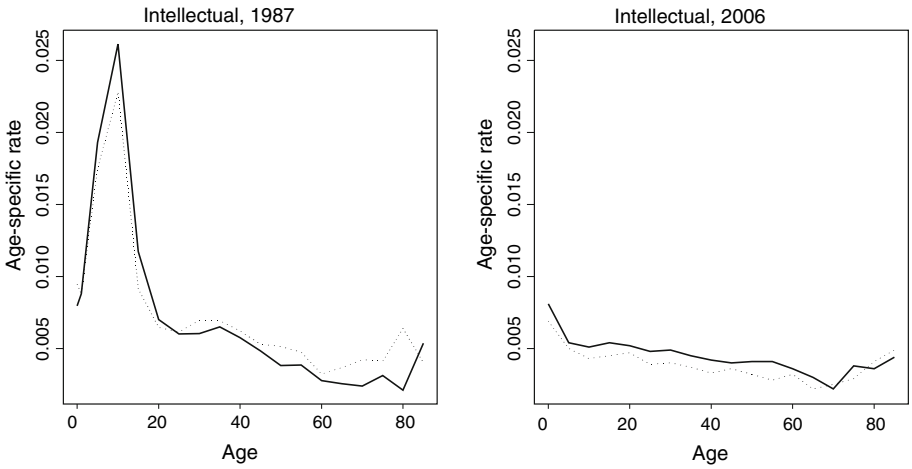

Fig. 3 The age-specific intellectual handicap rates of China for males (solid lines) and females (dashed lines)

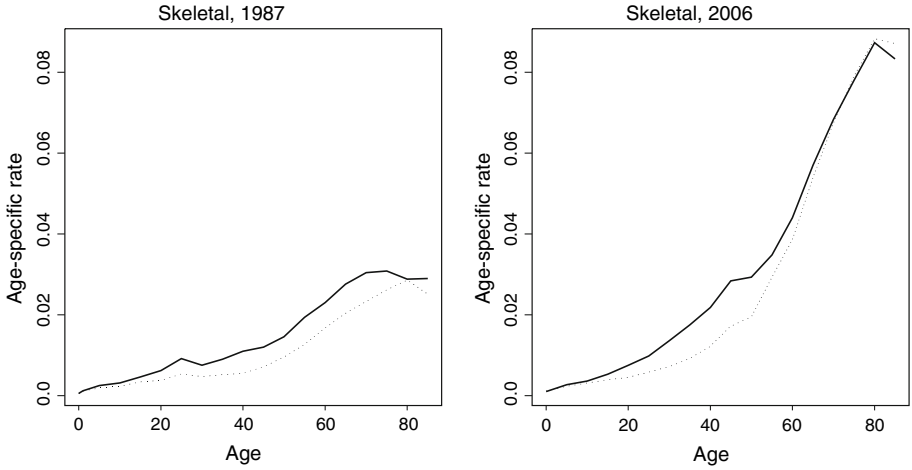

Fig. 4 The age-specific skeletal handicap rates of China for males (solid lines) and females (dashed lines)

first survey in 1987 was mainly based on ICF-1980 (WHO 1980) and the second was based on ICF-2001 (WHO 2001). The classification for both surveys were consistent according to the official publications, especially for the six big categories we studied. Therefore, it is meaningful to conduct the comparisons. Classification of functionality, disability and handicapness may be greatly influenced by the culture and administrative decision of governmental agencies in different countries even if the same terminology was used. Comparisons across different countries may not be easily done.

From our study, we noticed that there were large relative changes for childhood (0–14) intellectual handicap. The fact may be attributed to the economic development and the improvement of living condition of Chinese families. By the same argument, the increased expected years of life lived with skeletal handicap for people in working ages can also be related to the economic activities that may lead to more occupational and traffic injures.

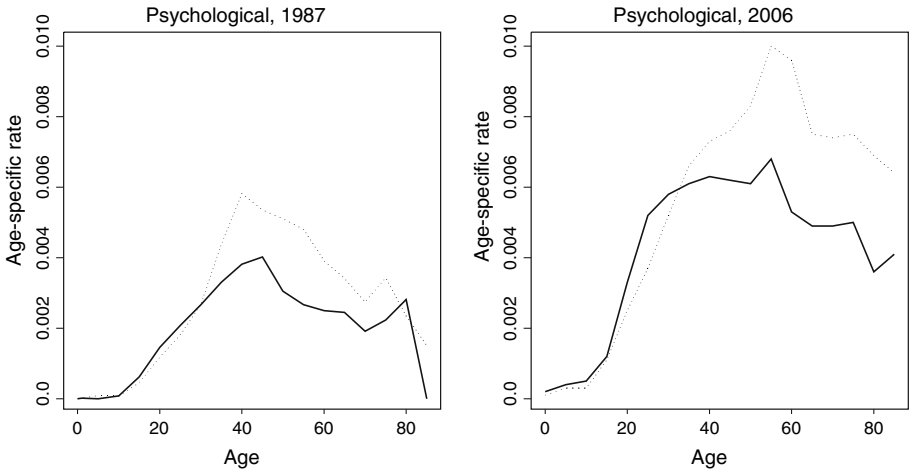

Fig. 5 The age-specific psychological handicap rates of China for males (solid lines) and females (dashed lines)

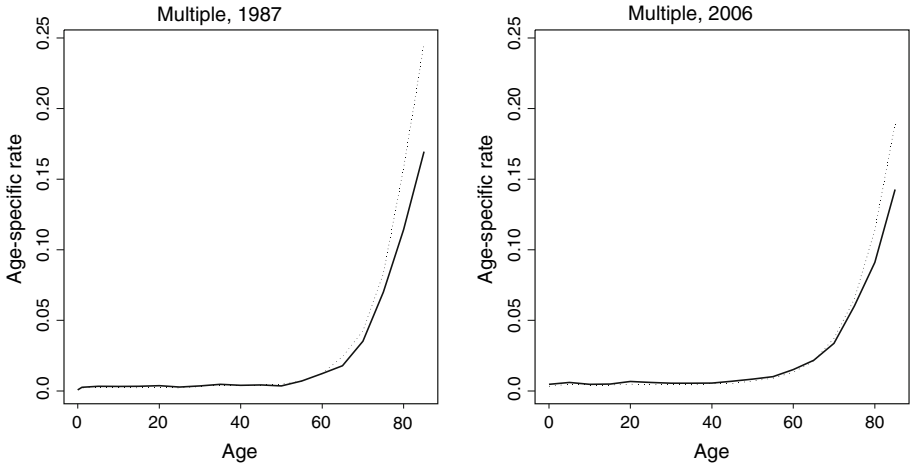

Fig. 6 The age-specific skeletal handicap rates of China for males (solid lines) and females (dashed lines)

The hyper-economic growth in the recent decades in China have increased the expected life years with psychological handicap as the results shown. It is worth noting that mental health is not well recognized in the Chinese society. As it was pointed out by one of the reviewers, there is a lack of qualified clinical and educational psychologists in coping with intellectual disability in children and adolescents in China. Therefore the reliability of the decreasing of childhood intellectual handicaps is in question.

The Chinese population is aging rapidly. More and more people are living in more advanced ages. In general, older people are subject to higher risk of being handicapped since modern medical treatments may be able to prolong one's life, but may have their limitation in maintaining people's functionality fully in many cases. This phenomenon is evidenced with a higher proportion of expected years of life lived with handicap. Having a

handicap lowers the quality of life of the person and also burdens the family and society. As a developing country, China was unable to offer comparable social service to disable persons as its developed counterparts. Much of the burden has to be carried out by the family. It was estimated, based on the second survey, there were about 80 million people living with various forms of handicaps, which translated into 260 millions of their direct family members. Hence, to prevent and reduce handicap would be of great benefits to public health and the quality of life of Chinese population.

In current article, we studied the dynamics of Chinese handicap since 1987. Our quantifications of handicap in terms of life expectancy would provide policy makers additional measures in planning better social programs in improving quality of life for more than one-fifth of the world population. For example, policy makers may use the results to implement proper governmental regulations aim at reducing adverse effects of high speed economic growth on the quality of life of the population. Occupational safety in workplaces would be a priority in reducing the expected years of life lived with handicap for the population. More equity of allocating economic benefits to the general public should be emphasized to avoid too much unnecessary mental stress for people in working ages.

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