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The average life expectancy of persons with disabilities in China

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ABSTRACT

The average life expectancy (ALE) of persons with disabilities (PWDs) is much shorter than that of the total population in many countries. However, there have been relatively few empirical studies on the ALE of PWDs in China. This study estimates the ALE and compiles the life tables of PWDs in China using data on 1,359,812 PWDs registered in the Special Surveys of Basic Services and Needs of the Disabled (SSBSND) in K Province in China from 2015 to 2017. The ALE of PWDs at age 20 is 45.2 years (95% CI: 44.7–45.8) for men and 48.1 years (95% CI: 47.6–48.6) for women, which is 15.0 years (men) and 16.5 years (women) lower than that of the entire population. The ALE of those with the most severe disability is only 33.7 years (95% CI: 32.2–45.1) for men and 37.1 years (95% CI: 35.3–38.8) for women. The ALE is relatively short for persons with intellectual and physical disabilities; moderate for those with hearing, speech, and mental disabilities; and relatively long for those with visual and multiple disabilities. Of the PWDs participating in basic old-age insurance (BOI), more than 30% do not live long enough to receive their pensions. As such, because a large proportion of PWDs die before 60 years old, social policies for PWDs should be specially designed.

1. Introduction

As noted in *The World Report on Disability* produced jointly by the World Health Organization (WHO) and the World Bank, persons with disabilities (PWDs) generally have poorer health, lower educational attainment, fewer economic opportunities, and higher rates of poverty than people without disabilities (WHO, 2011). Thus, PWDs, especially those with poor economic and social conditions, need to be prioritized by social policies to ameliorate these inequalities and maintain their basic living standards. Nevertheless, social protection coverage often excludes those who need it the most. For instance, only 28% of persons with significant disabilities have access to disability benefits globally, and this number is only 1% in low-income countries (United Nations, 2023).

Approximately one billion people, constituting 15% of the global population, grapple with various forms of disability. In addition, the prevalence of disability is notably higher in developing nations (WHO, 2011). The Disability and Development Report demonstrates that PWDs are at a disadvantage regarding most Sustainable Development Goals (SDGs) (United Nations, 2018). Following the ratification of the United Nations Convention on the Rights of Persons with Disabilities (CRPD), there has been increasing acknowledgment of disability as an imperative human rights concern (United Nations, 2007). Moreover, PWDs bear significance as a developmental issue, bolstered by a burgeoning body of evidence underscoring that PWDs confront notably intricate socioeconomic circumstances, often entailing elevated poverty rates compared to their non-disabled counterparts.

China has a large number of PWDs. According to *the Second National Sample Survey of Disabled Persons Main Data Bulletin No. 1* issued by the Chinese National Bureau of Statistics (CNBS) the number of PWDs by April 1, 2006 in China was 82.96 million, or 6.34% of the total population (CNBS, 2006). Moreover, households with PWDs accounted for 19.98% of the total population (CNBS, 2007). According to China's seventh national census, the country's population in 2020 was 1411.78 million (CNBS, 2021). Thus, we estimate that the number of PWDs in China reached over 89.51 million in 2020.

Average life expectancy (ALE), as a measure of a population's overall health status and quality of life, is considered the best measure of health outcomes (Department of Health, 2001). The UK Office for National Statistics has employed ALE at age 0 as a measure of regional health

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inequalities in recent years (Toson & Baker, 2003). To craft policies that effectively uphold the rights and address the needs of PWDs, having precise data regarding their ALE is of paramount importance, as it helps track progress towards global health goals, such as those outlined in the SDGs, and elevates PWDs' holistic well-being and quality of life.

Most studies on the ALE for PWDs have focused on specific diseases or categories of disabilities, such as Down syndrome (Baird & Sadovnick, 1987; Eyman & Call, 1991), mental disabilities (Munro, 1986), learning disabilities (Hollins et al., 1998), eye diseases and vision impairment (Clemons et al., 2004; Cugati et al., 2007; Freeman et al., 2005; Klein et al., 1995; Knudtson et al., 2006; McCarty et al., 2001; Wang et al., 2001), and deafness and hearing impairment (Schcin & Delk, 1974; Lam et al., 2006). Research focusing on intellectual disabilities is the most abundant (Balakrishnan & Wolf, 1976; Carter & Jancar, 1983; Harris & Barraclough, 1998; Heslop & Glover, 2015; Janicki et al., 1999; Merrick, 2002; Patja et al., 2000; Tyrer et al., 2022). A common finding among these studies is that the ALE of PWDs is much shorter than that of the total population.

These studies have included South Korea (Bahk et al., 2019), Canada (Balakrishnan & Wolf, 1976), the United States (Schcin & Delk, 1974), etc., but there are relatively few empirical studies on the ALE of PWDs in China. Zheng and Chen used survey data of PWDs in China from 2007 to 2010 to estimate the ALE of persons with physical disabilities (Zheng & Chen, 2011). Using the same data, Chen (2012) compiled a life table of the disabled population and estimated that the ALE of Chinese PWDs at birth was 56.9 years (standard error 1.2). However, the sample consisted of only 23,837 persons. Liu and Chen (2018) used monitoring data of PWDs in Beijing from 2012 to 2015 to calculate the ALE and healthy working life expectancy of PWDs aged over 40 by gender and disability type. However, the sample size in that study was 19,090, which is too small to accurately estimate the ALE, especially for disabled persons of a specific type or subgroup.

The short ALE of PWDs may result in a negative income redistribution effect for PWDs participating in basic old-age insurance (BOI), specifically in terms of their short benefit periods. In recent years, local governments in China have followed a contribution subsidy policy to help PWDs participate in BOI. However, these contribution subsidies will not be fully enjoyed by PWDs, because many of them may have no chance to live long enough to receive their benefits. Thus, the ALE of PWDs is an important consideration for both relevant scientific research and social policy formulation.

The best method to estimate the ALE of PWDs is to compile a life table based on high-quality data. However, owing to data limitation, previous studies have used death registration data to simply calculate the mean age at death (Lavin et al., 2006), used binary logistic regression analysis (Doyle et al., 2021), used years of life lost (Kim et al., 2019), or estimated a model life table from imperfect data (Chen, 2012; Liu & Chen, 2018; Zheng & Chen, 2011). Few have used life tables to study ALE of PWDs. To our knowledge, Bahk et al. (2019) is the most recent literature that is similar to our study, where they used officially registered disabilities in Korea with a total of 33,221,916 individuals to construct the life tables, which is also a very large sample size. In summary, while there is consensus in the academic community on the shorter ALE of PWDs, there have been few empirical studies in China or other developing countries, and even fewer using large samples. Therefore, the ALE of Chinese PWDs requires further empirical study.

Moreover, exploring the disparities in ALE between individuals with and without disabilities can raise public consciousness of the health challenges confronted by the disabled community and help the government formulate differentiated policies. However, limited studies have compared the ALE of PWDs with that of non-disabled people (Egüez-Guevara & Andrade, 2015). Utilizing the census data of 1,359,812 registered PWDs in K Province from 2015 to 2017, this paper compiles a life table for PWDs in K Province for the first time. This research was undertaken to estimate and contrast the ALE of individuals with and without disabilities in China in 2015 and provide data that can be used as a basis for policy implementation.

2. Methods

Life tables can be divided into current life tables (also known as period life tables) and cohort life tables according to the different data used for their compilation. A period life table is a statistical table constructed by assuming that a generation of people was born at the same time during a specific period and then calculating the sequence of mortality rates at different ages during that period until the entire generation has passed away. This type of life table reflects the complete life course of individuals in a specific population during a specific period and provides insights into their health status. Using data on PWDs in Province K from 2015 to 2017, this paper constructs a period life table for PWDs in Province K for the year 2015.

In the summarized and compiled census data, the surviving population at each age is represented by end-of-period values, while the number of deaths at each age corresponds to the deaths occurring during the survey period. For the Chinese population census, the survey period covers November 1 of the previous year to October 31 of the current year. Considering this data format, a standardized method for calculating current life tables has been proposed in demographic literature (Preston et al., 2001).

The life table is a statistical table that reflects the whole life process of a group of persons (usually 100,000 persons) from birth to death, assuming accordance with the age-specific mortality rate. The life table can be compiled using certain factors, such as gender or area (i.e., urban or rural). The age group distance n can take the value of 1, 5, or 10 years. The age-specific mortality rate and the age-specific average population are needed to calculate the age-specific mortality rate (m_x). The death probability (q_x), number of deaths in the table (d_x), number of survivors (l_x), average years of survival (L_x), average cumulative years of survival (T_x), and ALE (e_x) can then be calculated accordingly.

The age-specific mortality rate m_x is given by

$$m_x = \frac{D_x}{0.5n(N_x + N_{x+n})}, x = 0, 1, 2, \ldots, w-1 \quad (1)$$

where N_x *and* N_{x+n} refer to the population of specific age groups at the beginning and end of the period, respectively, and D_x is the actual number of deaths during the period.

The death probability q_x is given by

$$q_x = n * m_x / (1 + (n - a_x)m_x) \quad (2)$$

where a_x is a parameter indicating the average number of years of survival between the ages of x and $x + n$. The empirical parameter values of a_x in this study correspond to those in Coale et al. (1983).

By convention, the population base l_0 is set as 100,000 persons.

$$\text{Number of deaths } d_x : d_x = l_x * q_x \quad (3)$$

$$\text{Number of survivors } l_{x+1} : l_{x+1} = l_x - d_x, x = 0, 1, 2, \ldots, w-1 \quad (4)$$

$$\text{Average years of survival } L_x : L_x = n * L_{x+n} + a_x(l_x - l_{x+1}) \quad (5)$$

Average cumulative years of survival T_x:

$$T_x = L_x + T_{x+1}, x = 0, 1, \ldots, w-1 \quad (6)$$

$$\text{ALE } e_x : e_x = \frac{T_x}{l_x}, x = 0, 1, 2, \ldots, w-1 \quad (7)$$

It should be noted that the methods described above are specific to the already tabulated end-of-period population figures and deaths for each age (or age group). Because of variations in birth months and birth dates among individuals of the same age, individuals who died during the survey period may have been categorized at the beginning of the period as either age x or age $x-1$.

Various estimation formulas for specific-age mortality probabilities have been provided under different assumptions (Preston et al., 2001). Equation (2) in this study is among the most commonly used formulas. When ${}_na_x = n/2$, the assumption is made that deaths are uniformly distributed within the survey period, which is also a frequently employed setting. The impact of different estimation methods on the results is reportedly minimal (WHO, 1977). Hence, employing the most common model to estimate the life table for the entire population of Province K is reasonable.

However, as we possess micro-level data on disabled individuals, there is no need to deduce mortality probabilities using theoretical methods. We have census data for certified disabled individuals for the years 2015, 2016, and 2017. Therefore, by focusing on the disabled population of 2015, we can separately analyze whether each individual died in 2016. Then, we can directly calculate the mortality probabilities for each age without requiring Equation (2) or its parameters. In estimating mortality probabilities for disabled individuals, the calculation steps outlined earlier are replaced with the statistical outcomes obtained, and subsequent steps are conducted following the other formulas as outlined above.

When direct estimation from the data of the mortality ratios or probabilities at each age is not feasible, mathematical models need to be employed to estimate the mortality probabilities for each age on the basis of certain assumptions. Various related methods have been proposed in the literature, such as the Coale–Demeny model life table (Coale et al., 1983). However, our data sources consist of recent census data collected in China, with relatively high data quality, making the direct use of statistically derived mortality information from the data likely to better reflect the actual situation. Furthermore, existing mathematical models for mortality probabilities are based on data from the entire population, and we have not found theoretical models specifically focused on disabled individuals. This highlights the need to directly estimate the life table using empirical data.

3. Data

3.1. Data source

In this study, the *Special Surveys of Basic Services and Needs of the Disabled* (SSBSND) in K Province of China from 2015 to 2017 were used to compile the life table of the disabled population. The SSBSND is an annual follow-up census conducted by the Disabled Persons' Federation of K Province. The data sizes for 2015, 2016, and 2017 were 1,360,233, 1,500,400, and 1,546,784, respectively, accounting for the number of registered PWDs at the end of 2014, 2015, and 2016 in K Province, that is, 91.85%, 96.42%, and 104.13% of the total registered PWDs, respectively. There are 421 PWDs for whom gender information was not provided in the 2015 survey. Therefore, the final data size of this paper is 1,359,812 PWDs in 2015 in K Province.

In the SSBSND, the types and the grades of disabilities were identified by professional doctors according to the *Classification and Grading Criteria of Disability in China* (GB/T 26341–2010). The GB/T 26341–2010 criteria were drafted by the China Disabled Persons' Federation, Peking Union Medical College Hospital, China Rehabilitation Research Center for Deaf Children, China Rehabilitation Research Center, Third Hospital of Beijing Armed Police Corps, Capital Normal University, Peking University Institute of Mental Health, Peking University First Hospital, China Assistive Devices and Technology Center for Persons with Disabled, etc., within the framework of the *International Classification of Functioning, Disability and Health* (ICF) principles and in reference to the *WHO Disability Assessment Schedule II*. According to the criteria, registered PDWs refer to those who have lost all or part of their ability to engage in certain activities, including visual, hearing, speech, physical, intellectual, mental, and multiple disabilities, but not including irreversible chronic diseases (General Administration of Quality Supervision, PRC, 2011).

3.2. Estimation of death status and probability

The SSBSND involves no questions concerning life span; as such, we had to determine whether a PWD died within one year following the 2015 SSBSND. The original definition of death status is 1 (death) for the registered PWDs surveyed in 2015 who were absent in the 2016 survey and 0 for others. However, there may be some PWDs who were lost to follow-up in the 2016 survey due to migration or other reasons. Fig. 1 shows the possible status of the registered PWDs of the 2015 survey, with A + B + C being the total registered PWDs in the 2015 survey. A is the correct amount of the death PWDs and cannot be observed directly.

Using three-wave survey data, we can directly observe the alive and tracked PWDs in the 2016 survey (C in Figs. 1 and 1302177 individuals) and the tracked ones in the 2017 survey (F in Figs. 1 and 5992 individuals). If we can estimate D + E in Fig. 1, then we can obtain the value of A. We assume that F/(D + E + F)=C/(A + B + C) or that (D + E)/F = (A + B)/C. Then, D + E = F × (A + B)/C. Then, we can obtain a death rate that is closer to the reality,

$$\frac{A}{A+B+C}=\frac{(A+B)-(D+E+F)}{A+B+C}=\frac{(A+B)}{A+B+C}-\frac{F}{C} \tag{8}$$

Assume that l_i is the status of individual *i* who was absent in the 2016 survey (1 for absent status in the 2016 survey, 0 otherwise). Next, y_i is the status of individual *i* who was absent in the 2016 survey but was surveyed in 2017. Then, the corrected average death rate is:

$$m=\frac{\sum_{i=1}^{n} l_i}{n}-\frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n}(1-l_i)} \tag{9}$$

where *n* is the amount of registered PWDs in the 2015 survey. Table 1 shows the descriptive statistics of the data.

Furthermore, the number of individuals in some subgroups is not large enough. Consequently, the calculated death probability by age is not smooth and does not seem to fit the theoretical pattern of death risk. The main reason is that too small of a sample size within a single age group leads to a larger estimation error. This problem arose in the estimation of speech-disabled persons, where there was data for only 3381 women and 5544 men.

The main work is to fit a theoretical model for such subtypes of PWDs. We tested many models and compared the fitted values with the observed values. Finally, we chose the following method to fit the death probability. In the younger ages (20–70 years), the logistic model introduced by Perks (1932) was used, and the equation is $m_x = c + \frac{ae^{bx}}{1+de^{bx}}$. In the senior ages (over 70 years), the Coale and Kisker (1990) model was used, and the equation is $m_x = exp^{a+bx+cx^2}$.

4. Results

4.1. Life expectancy of different types of PWDs

4.1.1. The ALE gap between PDWs and the entire population

Ultimately, the PWDs have a much lower ALE than the entire population. Table 2 reports the ALE and the 95% confidence intervals (CIs) of the entire population and the PWDs. At 20 years old, the ALE of PWDs is 45.2 years (95% CI: 44.7–45.8) for men and 48.1 years (95% CI: 47.6–48.6) for women in 2015 in K Province, which is 15.0 years (men) and 16.5 years (women) lower than that of the entire population. With increasing age, the ALE gap between the entire population and PWDs decreases. The ALE of the PWDs at age 60 is 18.1 years (95% CI: 18.0–18.3) for men and 19.3 years (95% CI: 19.1–19.5) for women, which is 4.4 (men) and 6.5 (women) years lower than that of the entire population.

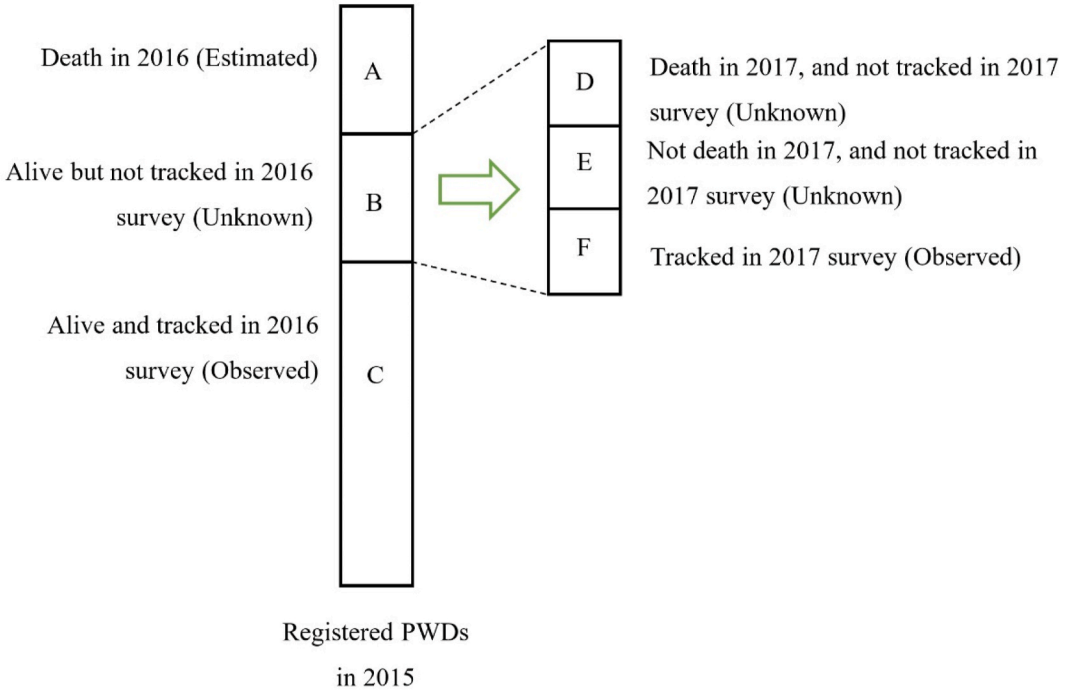

Fig. 1. Estimating the death population in 2016 of the registered PWDs in 2015.

Table 1
Descriptive statistics of PWDs and entire population in K Province in China.

Demographics		Total	Live	Deaths	Death rate (%)
Total of disabled persons		1359812	1309839	49973	3.67
Gender	Men	765121	737571	27550	3.60
	Women	594691	572268	22423	3.77
Hukou Type	Rural	1036522	996358	40164	3.87
	Urban	323290	313481	9809	3.03
Disability Type	Visual	161580	156862	4718	2.92
	Hearing	87950	86288	1662	1.89
	Speech	8925	8801	124	1.39
	Physical	735413	712794	22619	3.08
	Intellectual	172515	169892	2623	1.52
	Mental	130376	128366	2010	1.54
	Multiple	41623	41047	576	1.38
Disability Grade	1 (Severe)	175148	169030	6118	3.49
	2	399523	386815	12708	3.18
	3	346188	337124	9064	2.62
	4 (Mild)	417523	411081	6442	1.54
Total of 1% population survey					
Gender	Men	382735	380363	2372	0.62
	Women	371554	369662	1892	0.51

Source: Author's calculation based on the 1% population survey in 2015 and the 2015–2017 SSBSND data for K Province in China.

4.1.2. The ALE of different disability types

Disability type had a significant influence on ALE. At 20 years old, intellectually and physically disabled persons have the shortest ALE, regardless of gender. The ALE of physically disabled persons is 44.1 years (95% CI: 43.2–44.9) for men and 47.0 years (95% CI: 46.0–47.9) for women. The ALE of intellectually disabled persons is 44.2 (95% CI: 43.3–45.2) years for men and 46.2 years (95% CI: 45.3–47.2) for women.

On the other hand, visually and speech-disabled persons have the highest ALE among the PWDs. The ALE of visually disabled persons is 50.6 years (95% CI: 48.9–52.3) for men and 51.4 years (95% CI: 48.8–54.0) for women at 20 years old. The ALE of speech-disabled persons is 51.8 years (95% CI: 48.4–55.2) for men and 54.2 years (95% CI: 48.9–59.5) for women.

Owing to the different sample sizes of the different disability types, the estimation accuracy also differed for different disability types. The CIs of almost all the results are small, with the exception of speech-disabled persons, whose gap between the 95% upper and lower bounds is 6.8 years (men) and 10.6 years (women). The reason is that the number of speech-disabled persons is only 8925. This reflects the importance of the data size for accurately estimating the ALE, especially for specific subgroups of PWDs. According to the large-scale data covering almost all PWDs in K Province, all sub-groups have more than 80,000 individuals with the exception of the speech (8,925) and multiple disability (41,632) types. Thus, our ALE estimations are accurate and reliable.

At 60 years old, intellectually disabled persons have an extremely lower ALE of 15.7 years (95% CI: 15.2–16.2) for men and 15.5 years (95% CI: 14.9–16.1) for women, indicating a higher death risk for intellectually disabled older adults. People with an intellectual disability may have difficulty communicating pain, symptoms, or needs, causing medical issues to go unnoticed or delayed. They need more care and support, and insufficient social support can also increase the risk of disease. Some intellectually disabled persons may also have accompanying mental health problems such as depression and anxiety. All these factors may contribute to their lower ALE.

A strange result is that the ALE of multiple-disability persons at 20 years old in 2015 is very large at 50.2 years (95% CI: 48.0–52.4) for men and 55.2 years (95% CI: 52.8–57.6) for women. This is because the proportion of those having a mild disability (disability grade equal to 4) among multiple-disability persons was 70.4% in K Province in 2015, which is much higher than the proportion in the other disability type subgroups: 46.1% for speech, 39.0% for visual, 20.1% for hearing, and no more than 10% for the others.

4.1.3. The ALE of different disability grades

There is a stark difference in the ALE of those with severe and mild disabilities. At the age of 20, the difference between grades 1 and 4 reaches 19.5 years for men and 19.2 for women. At 60 years old, that difference is 3.8 years for men and 5.0 years for women. The ALE of those at 20 years old with a severe disability (grade = 1) is only 33.7 years (95% CI: 32.2–35.1) years for men and 37.1 years (95% CI:

Table 2
Average life expectancy (ALE) of entire population and PWDs at ages 20 and 60 years.

		Men (Age 20)			Women (Age 20)			Men (Age 60)			Women (Age 60)		
		L.E	Lower	Upper	L.E	Lower	Upper	L.E	Lower	Upper	L.E	Lower	Upper
Entire population		60.2	/	/	64.6	/	/	22.5	/	/	25.8	/	/
Disability		45.2	44.7	45.8	48.1	47.6	48.6	18.1	18.0	18.3	19.3	19.1	19.5
Disability Type	Visual	50.6	48.9	52.3	51.4	48.8	54.0	21.5	21.1	22.0	22.6	22.2	23.0
	Hearing	45.9	44.1	47.6	48.8	46.3	51.2	21.4	20.7	22.0	24.8	23.8	25.7
	Speech	51.8	48.4	55.2	54.2	48.9	59.5	18.0	15.4	20.6	22.0	18.1	25.8
	Physical	44.1	43.1	45.1	47.0	46.0	47.9	17.2	17.1	17.4	18.1	17.9	18.3
	Intellectual	44.2	43.3	45.2	46.2	45.3	47.2	15.7	15.2	16.2	15.5	14.9	16.1
	Mental	47.3	46.1	48.5	49.6	48.1	51.2	17.3	16.5	18.2	20.1	19.4	20.7
	Multiple	50.2	48.0	52.4	55.2	52.8	57.6	20.4	19.1	21.7	23.8	22.2	25.5
Disability Grade	1 (Severe)	33.7	32.2	35.1	37.1	35.4	38.8	17.3	16.9	17.8	18.9	18.4	19.4
	2	44.7	44.0	45.5	46.9	46.1	47.7	16.3	16.1	16.6	17.7	17.4	18.0
	3	44.0	42.9	45.0	46.8	45.8	47.8	16.8	16.5	17.1	17.7	17.3	18.0
	4 (Mild)	53.4	52.5	54.2	56.6	55.5	57.7	21.4	21.1	21.8	24.2	23.7	24.6
Pension Type	BOIUE	51.3	49.8	52.8	53.6	52.1	55.2	20.9	20.5	21.4	23.3	22.7	24.0
	BOIURR	43.5	42.6	44.3	46.4	45.5	47.2	17.3	17.1	17.4	18.6	18.4	18.8
	None	45.9	45.2	46.7	48.8	48.0	49.6	18.6	18.3	19.0	19.9	19.5	20.3

Note: Lower and Upper are the lower and upper bounds of 95% confidence intervals (CI). The confidence intervals were calculated with the bootstrap method.
Source: Author's calculation based on the 1% population survey in 2015 and the 2015–2017 SSBSND data for K Province in China.

35.4–38.8) years for women, which is 26.6 years (men) and 27.5 years (women) less than that of the entire population.

4.1.4. The ALE of disabled persons covered by different social security policies

PWDs need more support from society. For example, some countries provided subsidies to the disabled to help them participate in pension insurance. Among the 1,359,812 registered PWDs surveyed in K Province in 2015, 286,841 (21.09%) and 692,606 (50.93%) participated in the Basic Old-age Insurance for Urban Employees (BOIUE) and the Basic Old-age Insurance for Urban and Rural Residents (BOIURR), respectively, while 380,365 (27.97%) did not participate in any BOI programs. Across all age groups, the number of PWDs participating in the BOIUE is the highest, followed by those not participating in any BOI and those participating in the BOIURR. At 20 years old, the ALE of PWDs who participated in the BOIUE is 51.3 years (95% CI: 49.8–52.8) for men and 53.6 years (95% CI: 52.1–55.2) for women. Both of these ALEs are very close to those of mildly disabled persons (disability grade = 4). BOIUE is linked with formal employment, and mildly disabled people presumably have a higher labor force participation rate and thus have more opportunities to obtain employee pensions.

The disabled persons who participated in the BOIURR have the poorest health status. Most of them lack the ability to work and thus lack the opportunity to participate in BOIUE. In terms of geographical distribution, most disabled persons participating in BOIURR live in rural areas with relatively poor development conditions. They need more income or security to face health risks, although their income security from society is lesser.

4.2. Survival curve of PWDs

4.2.1. Comparing PWDs with the entire population

Fig. 2 shows the survival curve for 1% of the total population and PWDs of different age groups in K Province. Evidently, the survival number of PWDs in each age group is much less than that of the total population, and the survival number of male PWDs in each age group is less than that of female PWDs. The survival curve for female PWDs is higher than that for male PWDs, indicating a relatively lower mortality rate for women. However, the gender difference in the survival curve of the disabled population is much smaller than that of the entire population. That is, the gender difference in the life table of the disabled population is smaller than that of the entire population.

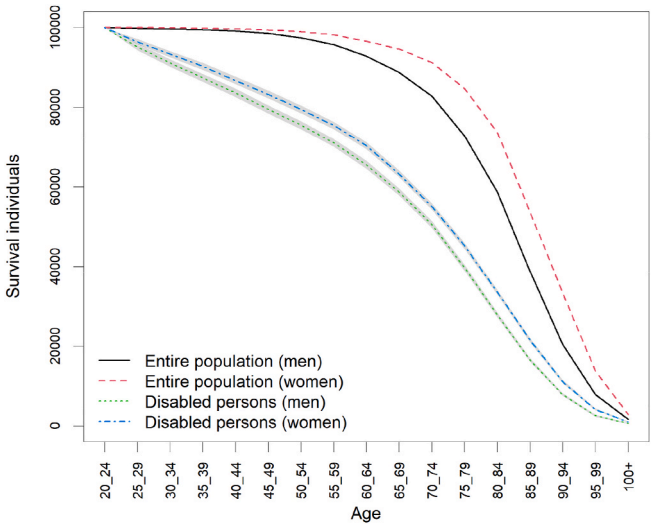

Fig. 2. Survival curves of 1% of the total population and PWDs in 2015 for K Province.
Source: Author's calculation based on the 1% population survey in 2015 and the 2015–2017 SSBSND data for K Province in China.

4.2.2. Different PWD types

Fig. 3 shows the number of persons with different disability types by age group in K Province. The survival curves vary widely for different disability types, and the relationship between the number of survivors and the disability type is significantly different at the ages of 40, 60, 80, etc. For example, at the age of 40, the survival rates of male PWDs by disability type rank as follows, in descending order: speech, mental, visual, multiple, intellectual, physical, and hearing. However, at the age of 80, the survival rate changes, with a descending order of visual, multiple, hearing, speech, mental, physical, and intellectual.

The death probability of those with hearing disabilities is higher at a young age, while those with mental disabilities have a relatively low death probability at a young age but a relatively high probability in old age. For female PWDs, at the age of 40, the survival rate by disability type (in descending order) is multiple, physical, intellectual, mental, visual, speech, and hearing. Further, at the age of 80, the survival rate by disability type (in descending order) is multiple, speech, hearing, visual, mental, physical, and intellectual.

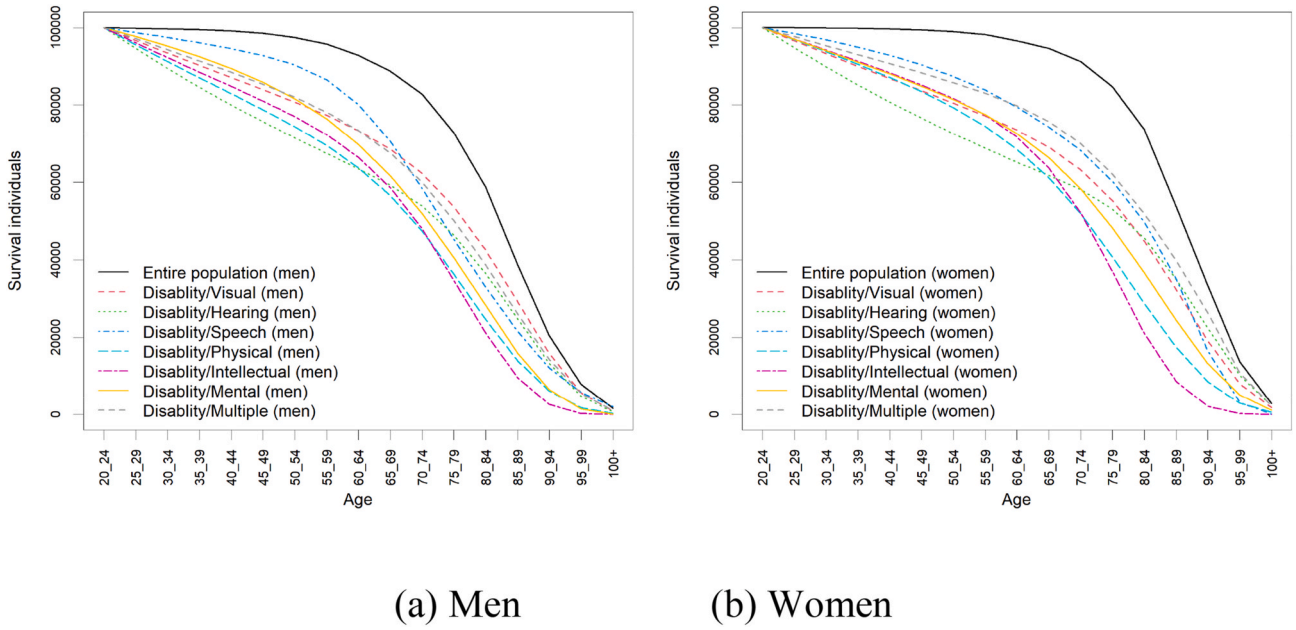

Fig. 3. Survival curves of persons with different disability types in K Province (persons).
Source: Author's calculation based on the 2015–2017 SSBSND data for K Province in China.

4.2.3. Different disability grades of PWDs

People with severe disabilities have a very high death probability at a young age. Approximately 35.4% (men) and 30.9% (women) die by the age of 40, and 59.7% (men) and 53.4% (women) die by the age of 60. At the same time, those rates for the entire population are 0.09% (men), 0.04% (women), and 7.2% (men), 3.4% (women) by the ages of 40 and 60, respectively. The survival curves of mildly disabled people are close to those of able-bodied people.

The survival curves for those with disability grades 2 or 3 are very similar and show no significant difference, as is shown in Fig. 4. The survival curves for people with disability grades 2 and 3, although higher than those for people with severe disabilities, are still significantly lower than those for people with mild disabilities. Especially at an advanced age, the death probability of those with disabilities of grades 2 and 3 increases rapidly, and the survival curve after the age of 85 even overlaps with that for those with severe disabilities. This may reflect that the actual disability status of PWDs of grades 2 or 3 may become increasingly close to that of people with severe disabilities as they age In some cases, their survivability may even be worse than that of people identified as severely disabled.

4.2.4. PWDs with different pension insurance

Individuals receive pension benefits only after they have survived to retirement age. For the disabled who participate in the BOI, what proportion can have the opportunity to receive the benefit? Fig. 5 shows the number of survivors among the PWDs with different BOI types. At age

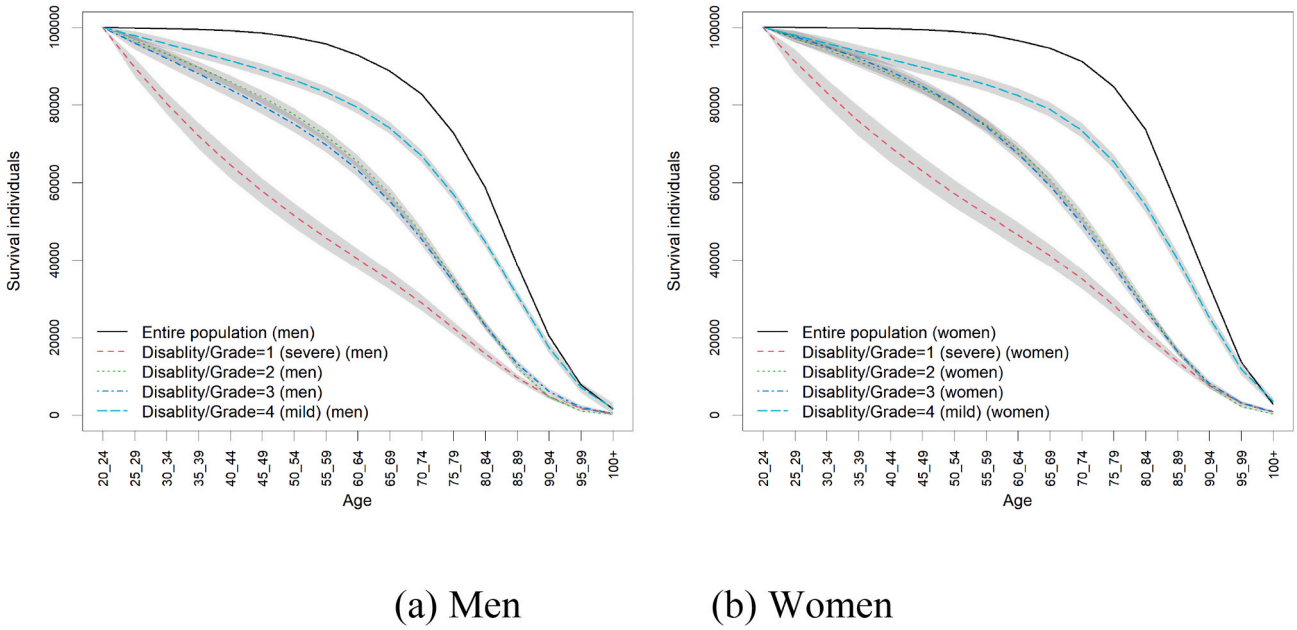

Fig. 4. Survival curves of persons with different disability grades in K Province (persons).
Source: Author's calculation based on the 2015–2017 SSBSND data for K Province in China.

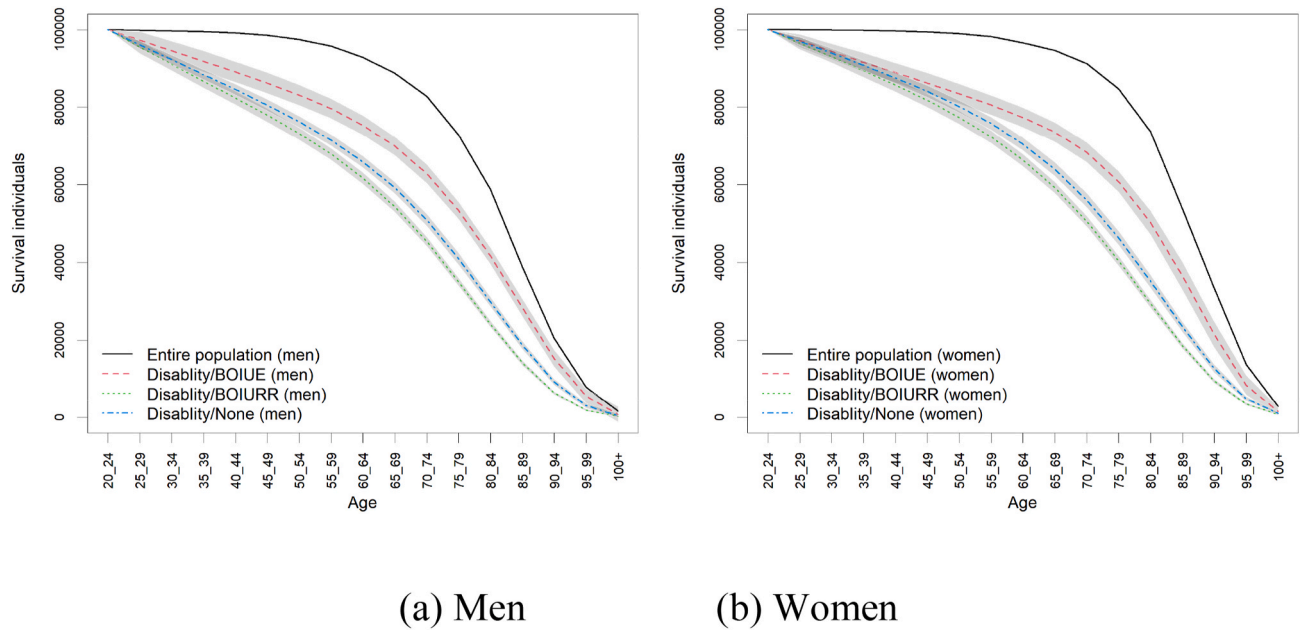

Fig. 5. Survival curves of persons who participated in different pension insurances in K Province (persons).
Source: Author's calculation based on the 2015–2017 SSBSND data for K Province in China.

60, the survival rate of the PWDs with BOIURR is only 61.67% for men and 66.35% for women. Female disabled BOIUE participants at age 55 have a survival rate of 80.56%, and male disabled BOIUE participants at age 60 have a rate of 75.34%. At age 60, the proportion of the deceased population for female disabled BOIURR and BOIUE participants is 9.81 and 6.60 times that of the total population in K Province, while that for men is 5.34 and 3.44 times that of the total population, respectively.

5. Discussion

Our results demonstrate that the ALE of PWDs was significantly lower than that of the total population of K Province in 2015. Clearly, disability has a great impact on health and ALE. The presence of a disability could elevate the susceptibility to chronic illnesses (Jeon et al., 2015). Moreover, disparities in healthcare might hinder accessibility to medical and societal support. Social isolation and psychological health issues could compound the physical strain, exacerbating the situation.

Globally, the ALE has increased by more than 6 years between 2000 and 2019—from 66.8 years in 2000 to 73.4 years in 2019—which increase was due to declining mortality rather than reduced years lived with disability (WHO, 2020). According to *The Detailed Summary Data of the Sixth National Census* in 2010, the ALE of the Chinese population reached 74.83 years, an increase of 3.43 years from 71.40 years in 2000. In 2020, the ALE continued to rise to 77.93 years (Bai, 2022). This is consistent with the changing pattern of ALE in other countries in the world (CNBS, 2012).

The ALE of the population in K Province in 2010 was 76.63 years, 74.6 years for men and 78.81 years for women (CNBS, 2022). This study estimates that the ALE of the population in K Province in 2015 was 79.9 years for men and 84.2 years for women. Although the Bureau of Statistics did not release the population ALE calculated from the 1% of the population sample survey data in 2015 and the seventh census data in 2020, the results calculated in this study are credible given the increasing trend of the population ALE.

According to our calculation results, the ALE of PWDs at the age of 20 in K Province in 2015 was 45.2 years for men and 48.1 years for women, while that of PWDs at the age of 20 in the whole of China in 2007–2010 was 43.35 years, as calculated by Chen (2012). K Province is a developed province along the eastern coast, and it should have a higher ALE compared to that of China as a whole. The present study estimates that the ALE of the disabled population at the age of 40 in K Province is 32.2 years for men and 34.0 years for women, which is very close to the estimated values in Beijing of 31 years for men and 35 years for women (Liu & Chen, 2018).

Similarly, the ALE of K Province is very close to that of some developed countries. For instance, among the respondents aged 65 with a disability in the United States in 2012, the projected ALE amounted to 17.1 years (Jia & Lubetkin, 2020). In K Province, at the age of 65, the ALE is calculated to be 14.93 years for men and 16.19 years for women, both slightly lower. Lavin et al. (2006) selected 1120 death samples from the *Irish National Intellectual Disability Database* from 1996 to 2001 and found that the average age of death among disabled people in Ireland was 45.68 years. Notably, the ALE at 0 years old for registered disabled individuals in South Korea witnessed a progression from 59 years in 2004 to 68 years in 2017 (Bahk et al., 2019). The ALE at the age of 20 in K Province was about 45–48 years in 2015, similar to the level in South Korea in 2017. Bahk et al. (2019) also found that the average ALE gap between the non-disabled population and PWDs decreased from 20.4 years in 2004 to 16.4 years in 2017. Our results for K Province in China in 2015 are 15.0 years (men) and 16.5 years (women), which are similar to those of South Korea.

There are currently two main types of BOI in China: BOIUE and BOIURR (Giles et al., 2023). According to Fig. 2, although the ALE of PWDs participating in the BOIUE is significantly longer than that of PWDs and of PWDs participating in BOIURR, it is still much shorter than that of the non-disabled population. According to the survival curve in Fig. 2, the death rates at 60 years old for PWDs participating in the BOIUE and BOIURR in K Province are about 4.3 and 6.6 times that of the total population of K Province, respectively. Of the PWDs participating in the BOIURR, 36.64% do not live long enough to receive their pensions. This finding further reminds us that the rationality of old-age insurance is worth reconsidering for the disabled group. Specifically, we should establish a special income security system for PWDs.

6. Conclusion

What is the ALE of PWDs in China? To answer this question, we compiled a life table of the disabled population based on the SSBSND

data of the registered PWDs in K Province from 2015 to 2017.

Ultimately, this study found that the ALE of PWDs at age 20 in K Province is 45.2 years for men and 48.1 years for women, both much lower than the ALE of the entire population in 2015. Among the seven types of PWDs, the ALE is relatively short for persons with intellectual and physical disabilities; moderate for those with hearing, speech, and mental disabilities; and relatively high for those with visual and multiple disabilities. The ALE of PWDs participating in the BOIUE is the longest, followed by that of PWDs not participating in any BOI and that of PWDs participating in the BOIURR.

According to the estimation results, disabilities significantly impact health and ALE in China. Accordingly, the government needs to strengthen the protection and rehabilitation of disabled people. Moreover, considering the special life course of disabled individuals, social policies related to their ALE should be developed differently from those relating to able-bodied individuals. Two typical examples are old-age security and labor employment policies.

For example, in recent years, China has adopted a contributory subsidy strategy aimed at providing support to PWDs. However, considering their comparatively reduced ALE, questions arise as to whether PWDs can fully avail themselves of the subsidy allotment. Thus, it may be judicious to contemplate implementing a non-contributory pension policy tailored specifically to the needs of PWDs. In the future, further in-depth study is needed on the effectiveness of policies for PWDs due to the differences in their ALE.

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Language improvement

The text was improved by English language editors.

Author statement

Peng Zhan: Conceptualization, Methodology, Software, Formal analysis, Writing - Review & Editing, Funding acquisition.

Dongwen Li: Methodology, Validation, Formal analysis, Data curation, Writing- Original draft preparation, Writing - Review & Editing, Visualization.

Xiang Zhang: Conceptualization, Writing - Review & Editing, Funding acquisition.

Xianchun Bai: Resources.

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data availability

The authors do not have permission to share data.

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List of abbreviations

ALE	average life expectancy
PWDs	persons with disabilities
SSBSND	Special Surveys of Basic Services and Needs of the Disabled
BOI	basic old-age insurance
WHO	World Health Organization
SDG	Sustainable Development Goal
CRPD	Convention on the Rights of Persons with Disabilities
CNBS	Chinese National Bureau of Statistics
CI	confidence interval
BOIURR	basic old-age insurance for urban and rural residents
BOIUE	basic old-age insurance for urban employees

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