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Descriptive Finding

Health expectancies among older adults in China: Results from the 2010 and 2020 population censuses

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Contents

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Abstract

BACKGROUND
Despite the rapid increase in the aging population in China, the health expectancies of older adults remain underexamined.

OBJECTIVE
Our aim is to investigate the health expectancies of older adults in China and examine changes between 2010 and 2020.

METHODS
Using data from the 2010 and 2020 Chinese population censuses, health expectancies were calculated for good, fair, poor, and disabled health states by period, sex, and residence. The Sullivan method was applied, and differences in health expectancies were decomposed into changes in mortality rates (mortality effects) and rates of different health states (health effects).

RESULTS
Between 2010 and 2020, the good health life expectancy at age 60 increased from 9.63 to 11.66 years, while disabled life expectancy rose from 0.76 to 0.97 years. Females experienced a notable rise in good health life expectancy, reaching 11.71 years at age 60 and surpassing males (11.61 years). However, females' disabled life expectancy remained higher than that of males (1.18 vs. 0.76 years). Urban–rural disparities widened, with urban residents enjoying 3.12 years longer good health life expectancy compared to rural residents and experiencing more rapid improvements.

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CONCLUSIONS
China experienced a significant rise in healthy life expectancy between 2010 and 2020, characterized by narrowing sex disparities but widening urban–rural gaps. Both health and mortality effects contributed to these changes and disparities, albeit to varying degrees.

CONTRIBUTION
This study provides updated estimates of health expectancy in China for 2010 and 2020, highlighting sex and rural–urban differences. It finds that both declining mortality rates and improving health contributed to the changes during the past decade.

1. Introduction

China has made significant progress in improving public health over the last few decades, as reflected in a notable increase in health expectancy. According to the Global Burden of Disease (GBD) project, healthy life expectancy in China rose from 60.4 years in 1990 to 63.4 years in 2010, and reached 68.4 years in 2019 (Wang et al. 2020). Despite these advancements, the country faces persistent challenges associated with its aging population, now exceeding 264 million individuals aged 60 and above. Among them, more than 40 million older adults experience difficulties with self-care, and the number of years spent living with illness or disability continues to grow as people live longer (Chinese State Council 2016; Zhang et al. 2022). To address these issues, in 2016 the Chinese government announced the Healthy China 2030 plan, which aims to substantially increase healthy life expectancy by 2030. Achieving this goal requires a detailed analysis of health expectancy trends in order to develop effective, long-term strategies for improving population health.

China also faces substantial health inequalities based on sex and residence. The global male–female health–survival paradox shows that while females generally live longer than males, they also experience poorer health and more years living with disability (Santosa et al. 2016; Stephan et al. 2021). This disparity may be particularly evident in patriarchal societies such as China (Gu et al. 2009; Zhang, d'Uva, and van Doorslaer 2015). Contributing factors, such as unequal access to formal education and health insurance, further affect females' health, leading to greater sex disparities in health expectancy in China (Jiao, Liu, and Xu 2021; Williams, Norstrom, and Ng 2017). Health inequalities are also evident between urban and rural populations, where differences in socioeconomic development, access to healthcare, and educational opportunities result in urban residents enjoying lower mortality rates and better health outcomes than their rural counterparts (Yu and Zhang 2020).

In general, most previous studies on China's health expectancy are primarily based on sample surveys. These surveys suggest that females and rural residents tend to live more years in poor health and fewer years in an impairment-free or disease-free state compared to males and urban residents (Hou et al. 2018, 2019; Luo et al. 2016). Furthermore, some international organizations estimate China's health expectancy, particularly emphasizing disease-free health expectancy by calculating the overall mortality rates from sample surveys (Hay et al. 2017; Wang et al. 2016).

Recently, health data for older adults has been collected through China's 2010 and 2020 population censuses. These censuses provide accurate demographic information and an opportunity to study health expectancy with greater precision. Furthermore, vital data are provided for China's heterogeneous population, aiding in estimating the health disparities based on sex and urban–rural divisions. Thus, this study aims to (1) provide updated health expectancy estimates for the population aged 60 and older, and (2) decompose the observed differences by period, sex, and residence, separating the impacts of mortality and health status.

2. Data and methods

2.1 Mortality and health data

This study utilizes data from China's 2010 and 2020 population censuses (Population Census Office under the State Council 2012; Office of the Leading Group of the State Council for the Seventh National Population Census 2022). The 2020 census is regarded as the most comprehensive and high-quality population census in China's history, employing advanced information technology methods to ensure real-time data reporting to the central government and minimize transmission errors. For the first time, Chinese national ID numbers were incorporated into the census, enabling cross-validation of the census data with administrative records from agencies such as the Public Security Department and the National Health Commission (Zhai and Liu 2021). This integration resolved issues from the 2010 census, where overlapping data from urban–rural migrants – registered in both urban and rural areas – obscured genuine urban–rural disparities. Furthermore, the 2020 census was conducted during the COVID-19 pandemic and the strict population health screening policies and mobility restrictions in place at the time helped overcome data collection challenges, improving coverage and accuracy. Consequently, recording, transmission, and summary errors were significantly reduced. The post-enumeration surveys for the 2010 and 2020 censuses reported underreporting rates of 0.12% and 0.05% respectively, further enhancing the reliability of health expectancy estimates.

Age-specific mortality rates were calculated using data from the Death Form, which surveyed the entire mainland population for deaths occurring in the years prior to the census. Abridged life tables for the 5-year age groups were constructed using these mortality rates, beginning at age 60 and ending at ≥95 years.

Age-specific rates for varying health states was determined using data collected through the Long Form survey, which was distributed to 10% of households, amounting to 25.52 million adults aged 60 years and older. Health outcomes were assessed based on a self-reported item in which older adults categorized their health and functional condition as: (1) good health, (2) fair health, (3) poor health, but able to live independently, or (4) disabled (unable to live independently, such as requiring assistance with eating, dressing, and mobility).

2.2 Methods

Health expectancies were calculated using the Sullivan method (1971) and differences in health expectancies between periods, sexes, and residences were decomposed into mortality and health effects using the method developed by Andreev, Shkolnikov, and Begun (2002).

Health expectancy (h_x) in the Sullivan method is defined by

$$h_x = \frac{1}{l_x}\sum_{i=x}^{\omega} \pi_i L_i, \tag{1}$$

where l_x represents the number of survivors at exact age x in a cohort, L_x denotes the total person-years lived between ages [x,x+1), and π is the rate of each health state within a population between ages [x,x+1). ω represents the largest age group in the dataset. According to Equation (1), two primary factors determine health expectancy: age-specific mortality and health rates. Consequently, when decomposing differences between two health expectancies, these differences for each age group are further divided into mortality and health effects.

The mortality effect for a given age interval [x,x+1) represents the change in health expectancy resulting from substituting the mortality rate q_1 for ages [0,x) with the mortality rate q_2[x,x+1). Similarly, health effects indicate changes in health expectancy caused by replacing the health prevalence π_1 with π_2.

The mortality effect at age x is calculated using the Andreev method as:

$$\lambda_x = \frac{1}{4}(l_x^1 + l_x^2)(P_x^2 - P_x^1)(\pi_x^1 + \pi_x^2) + \frac{1}{2}(h_{(x+1)}^1 l_x^2 + h_{(x+1)}^2 l_x^l)(q_x^1 - q_x^2). \tag{2}$$

The health effect at age *x* is calculated as:

$$\gamma_x = \frac{1}{4}(l_x^1 + l_x^2)(P_x^1 + P_x^2)(\pi_x^2 - \pi_x^1), \quad (3)$$

where superscripts 1 and 2 correspond to the two time points or populations being compared. π_x is the health rate at age *x*, P_x is equal to $\frac{L_x}{l_x}$, and q_x is the death rate at age x.

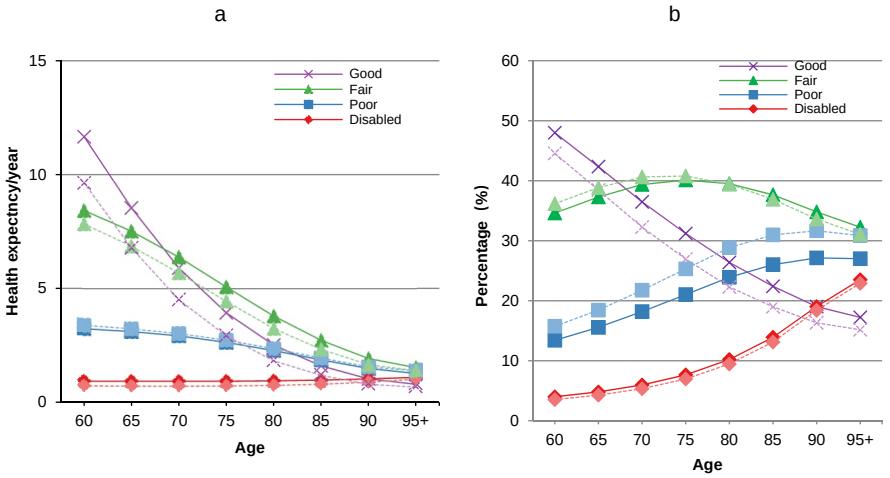
Health expectancy is a flexible concept that can analyze various health dimensions. Depending on the measure used, the terminology varies. For instance, when self-rated health is the measure, it is termed 'healthy life expectancy,' whereas measures based on disability prevalence are referred to as 'disability-adjusted life years' (Saito, Robine, and Crimmins 2014). In this study we categorize life expectancy into four health states: (1) good health life expectancy, (2) fair health life expectancy, (3) poor health life expectancy, and (4) disabled life expectancy.

3. Results

3.1 By period

Figure 1 illustrates the life expectancies for each health state in 2010 and 2020. Compared to 2010, the good and fair health life expectancies showed a significant increase in 2020. For instance, at age 60, life expectancy in good health rose from 9.63 years in 2010 to 11.66 years in 2020, while life expectancy in fair health increased from 7.82 years to 8.41 years. Additionally, the proportion of life expectancy in good health increased across all age groups compared to 2010. Disabled life expectancy also showed an upward trend, rising from 0.76 years to 0.97 years at age 60 in 2020. Additionally, the proportion of disabled life expectancy increases with age across the lifespan.

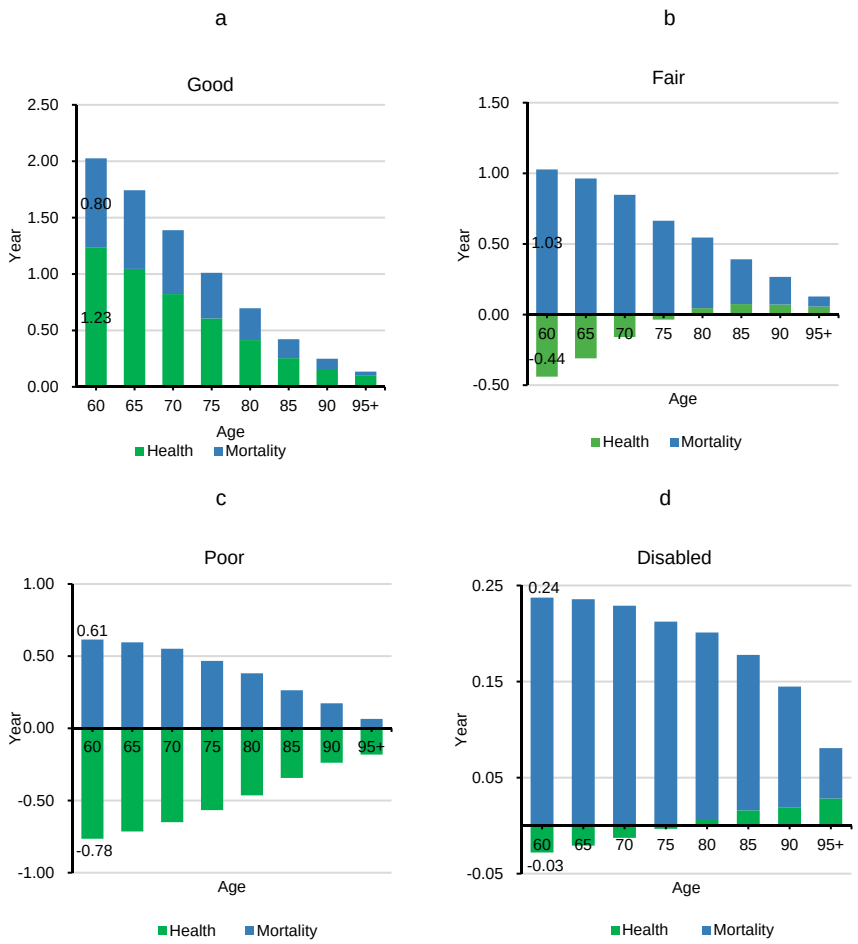
Figure 1: Health life expectancies in 2010 and 2020



Note: Panel a shows the years of each health expectancy, and Panel b shows the proportion of each health expectancy in the total life expectancy. The solid line denotes 2020, and the dotted line denotes 2010.

Figure 2 presents the decomposition results of differences in health expectancies between 2010 and 2020 into mortality and health effects. Across all age groups, the increase in good health life expectancy is mainly attributed to the rise in the age-specific rate of good health (health effects). Conversely, the increase in disabled life expectancy is primarily due to the reduction in age-specific mortality rates (mortality effects). For example, life expectancy in good health at age 60 increased by 2.03 years between 2010 and 2020. Of this increase, health effects contributed 1.23 years and mortality effects contributed 0.80 years. Similarly, disabled life expectancy increased by 0.21 years compared to 2010. This increase was primarily driven by the reduction in mortality rates, which contributed 0.24 years, while a slight decrease in disability rate offset this by –0.03 years.

Figure 2: Decomposition of period differences (2020–2010) in health expectancies into mortality and health effects by age



3.2 By sex

Health expectancies by sex and residence were computed and are presented in Table 1. Between 2010 and 2020, life expectancy in good health increased for both sexes across

all age groups. At age 60, life expectancy in good health rose from 8.06 to 11.71 years for females and from 8.71 to 11.61 years for males. Females experienced greater improvement in healthy life expectancy than males before age 75, leading to a narrowing of the sex gap in life expectancy in good health. Notably, in 2020, females' life expectancy in good health at age 60 (11.71 years) slightly surpassed that of males (11.61 years).

Table 1: Years and proportion of multistate healthy life expectancies by sex and residence in 2010 and 2020

Category		Age group	Life expectancies(years)				Proportion of life expectancies (%)			
			Good	Fair	Poor	Disabled	Good	Fair	Poor	Disabled
Sex: Males	2010: Males	60–64	8.71	7.69	2.99	0.72	43.30	38.25	14.85	3.60
		65–69	5.95	6.71	2.91	0.73	36.51	41.16	17.85	4.47
		70–74	3.83	5.54	2.75	0.73	29.82	43.10	21.37	5.70
		75–79	2.48	4.29	2.45	0.74	24.91	43.02	24.64	7.43
		80–84	1.54	3.14	2.11	0.76	20.38	41.57	27.96	10.09
		85–89	1.04	2.28	1.73	0.79	17.80	39.05	29.59	13.56
		90–94	0.76	1.69	1.40	0.86	16.20	35.84	29.67	18.29
		95+	0.83	1.62	1.30	0.96	17.52	34.46	27.66	20.37
	2020: Males	60–64	11.61	7.43	2.79	0.76	51.42	32.89	12.35	3.34
		65–69	8.53	6.68	2.68	0.75	45.75	35.86	14.36	4.02
		70–74	5.93	5.75	2.52	0.75	39.70	38.45	16.86	4.99
		75–79	3.99	4.65	2.29	0.74	34.17	39.82	19.62	6.39
		80–84	2.58	3.56	2.01	0.76	28.99	39.96	22.58	8.48
		85–89	1.69	2.65	1.70	0.79	24.72	38.83	24.95	11.51
		90–94	1.13	1.98	1.44	0.85	20.98	36.55	26.67	15.79
		95+	0.92	1.65	1.33	0.93	19.06	34.11	27.48	19.35
Sex: Females	2010: Females	60–64	8.06	9.71	4.24	1.20	34.71	41.84	18.29	5.15
		65–69	5.47	8.26	4.07	1.20	28.80	43.48	21.42	6.29
		70–74	3.57	6.59	3.75	1.20	23.64	43.61	24.83	7.92
		75–79	2.34	4.93	3.27	1.20	19.93	41.98	27.84	10.25
		80–84	1.47	3.46	2.71	1.22	16.56	39.05	30.60	13.79
		85–89	0.98	2.41	2.10	1.24	14.57	35.83	31.17	18.44
		90–94	0.67	1.66	1.57	1.27	12.95	32.10	30.36	24.59
		95+	0.58	1.37	1.31	1.29	12.76	30.13	28.74	28.36
	2020: Females	60–64	11.71	9.42	3.73	1.18	44.96	36.16	14.33	4.54
		65–69	8.52	8.33	3.58	1.17	39.43	38.55	16.58	5.44
		70–74	5.88	6.99	3.36	1.17	33.80	40.18	19.30	6.71
		75–79	3.91	5.47	3.00	1.16	28.90	40.40	22.13	8.57
		80–84	2.51	4.01	2.55	1.16	24.52	39.23	24.88	11.37
		85–89	1.60	2.82	2.04	1.17	20.97	36.95	26.71	15.37
		90–94	1.03	1.94	1.57	1.19	17.98	33.87	27.42	20.73
		95+	0.79	1.52	1.30	1.23	16.42	31.43	26.79	25.36

Table 1: (Continued)

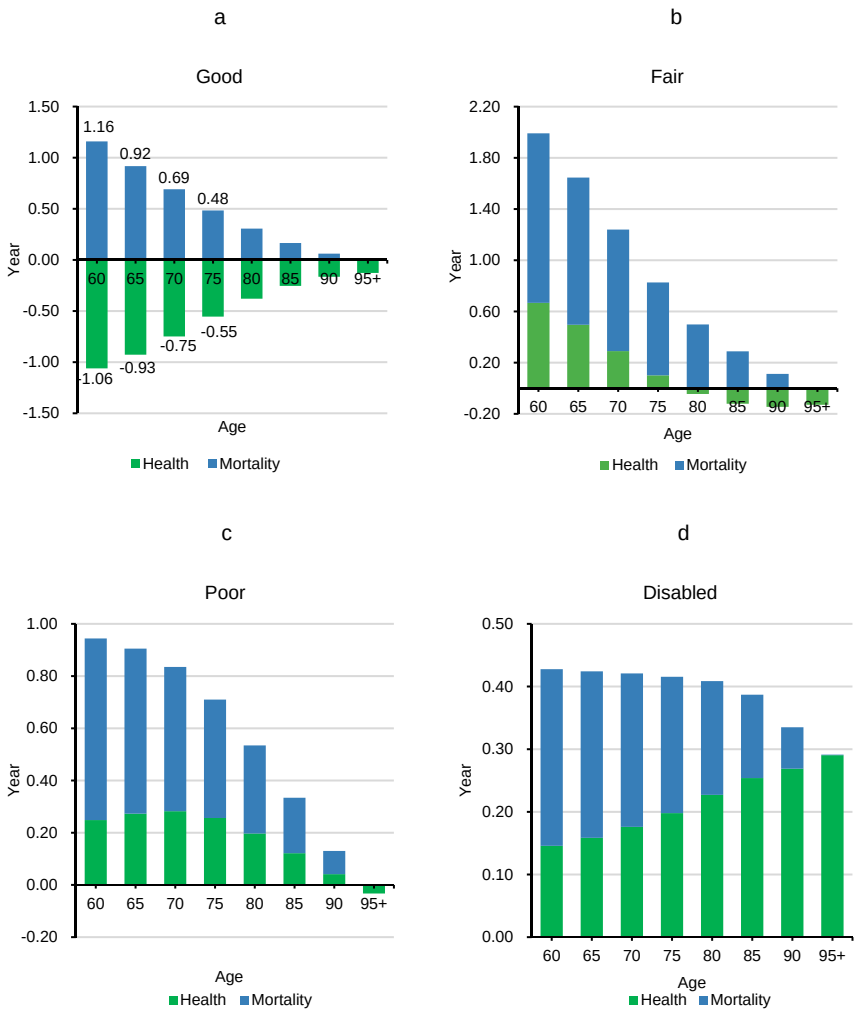
Category		Age group	Life expectancies(years)				Proportion of life expectancies (%)			
			Good	Fair	Poor	Disabled	Good	Fair	Poor	Disabled
Residence: Urban areas	2010: Urban areas	60–64	9.85	9.60	2.98	1.01	42.01	40.93	12.73	4.33
		65–69	6.97	8.40	2.88	1.02	36.17	43.59	14.95	5.29
		70–74	4.70	6.99	2.72	1.03	30.46	45.28	17.60	6.66
		75–79	3.12	5.45	2.46	1.05	25.88	45.11	20.35	8.66
		80–84	1.99	4.01	2.15	1.08	21.54	43.50	23.30	11.66
		85–89	1.33	2.90	1.77	1.12	18.73	40.68	24.87	15.71
		90–94	0.95	2.10	1.44	1.20	16.68	36.97	25.30	21.06
		95+	0.90	1.86	1.29	1.28	16.92	34.89	24.22	23.96
	2020: Urban areas	60–64	13.19	8.42	2.69	1.05	52.03	33.22	10.60	4.15
		65–69	9.85	7.57	2.58	1.05	46.77	35.96	12.27	4.99
		70–74	6.97	6.53	2.45	1.05	41.00	38.42	14.39	6.19
		75–79	4.74	5.31	2.24	1.06	35.51	39.77	16.77	7.95
		80–84	3.07	4.06	1.98	1.08	30.15	39.85	19.40	10.60
		85–89	1.96	2.97	1.66	1.11	25.50	38.50	21.58	14.42
		90–94	1.27	2.13	1.37	1.16	21.46	35.92	23.08	19.54
		95+	0.99	1.72	1.20	1.24	19.17	33.37	23.39	24.07
Residence: Rural areas	2010: Rural areas	60–64	7.41	8.11	3.98	0.92	36.29	39.70	19.48	4.53
		65–69	4.88	6.90	3.86	0.93	29.46	41.64	23.29	5.62
		70–74	3.04	5.49	3.59	0.94	23.27	42.03	27.51	7.18
		75–79	1.95	4.11	3.15	0.95	19.15	40.48	30.99	9.38
		80–84	1.19	2.89	2.62	0.99	15.54	37.55	34.07	12.84
		85–89	0.80	2.04	2.06	1.03	13.57	34.34	34.70	17.39
		90–94	0.55	1.40	1.55	1.09	12.03	30.60	33.68	23.70
		95+	0.50	1.18	1.29	1.13	12.07	28.79	31.55	27.59
	2020: Rural areas	60–64	10.07	8.44	3.81	0.90	43.36	36.36	16.41	3.87
		65–69	7.19	7.46	3.66	0.89	37.44	38.87	19.05	4.64
		70–74	4.85	6.23	3.42	0.89	31.53	40.47	22.25	5.75
		75–79	3.17	4.85	3.07	0.88	26.45	40.55	25.64	7.36
		80–84	2.00	3.55	2.63	0.89	22.03	39.17	28.99	9.82
		85–89	1.30	2.53	2.13	0.92	18.87	36.73	31.00	13.40
		90–94	0.86	1.77	1.67	0.98	16.30	33.57	31.64	18.50
		95+	0.68	1.40	1.39	1.03	15.16	31.06	30.87	22.91

However, the proportion of good health life expectancy remains lower for females across all age groups. In 2020, life expectancy in good health at age 60 accounted for 44.96% of total life expectancy for females compared to 51.42% for males. Additionally, females have consistently longer disabled life expectancy than males at all ages, and at age 60 the disabled life expectancy for females is 1.18 years, compared to 0.76 years for males.

The decomposition results, illustrated in Figure 3, reveal that the narrowing gap between females and males in life expectancy in good health between 2010 and 2020 is

primarily driven by females' longer overall life expectancy, resulting from their lower mortality rates than males. Conversely, females' longer disabled life expectancy is largely attributed to their higher rate of disability, which increases with age.

Figure 3: Decomposition of sex differences (female–male) in health expectancies into mortality and health effects by age in 2020



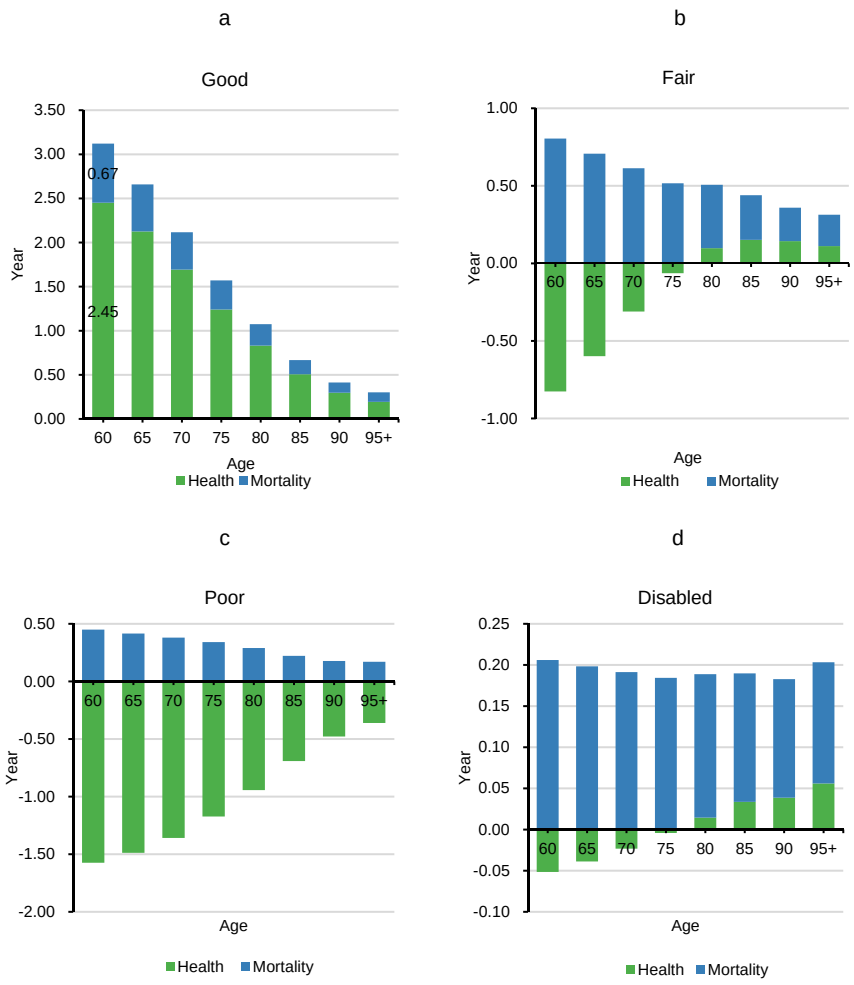
3.3 By residence

The trends in health expectancy from 2010 to 2020 varied significantly between urban and rural areas. Urban residents experienced gains at both ends of the health spectrum. Increases in total life expectancy were entirely due to increases in life expectancy in good health and disabled life expectancy across all ages, while life expectancy in intermediate health states (fair and poor) decreased (Table 1). By contrast, in rural areas the increase in total life expectancy was primarily driven by gains in life expectancy in good and fair health, while there was a concurrent decline in disabled life expectancy.

Despite these improvements, disparities between urban and rural residents in both good health life expectancy and disabled life expectancy persisted and even widened over time. For example, in 2010, at age 60 urban residents lived 2.44 years longer in good health and 0.09 years longer in a disabled state compared to their rural counterparts. By 2020 these gaps had increased to 3.12 years for good health life expectancy and 0.15 years for disabled life expectancy.

Figure 4 highlights the primary factors driving these differences. The gap between urban and rural residents in life expectancy in good health is largely attributable to the higher prevalence of good health across all ages in urban populations. Approximately 80% of the difference (2.45 years) can be explained by health effects. Meanwhile, the higher disabled life expectancy among urban residents is mainly due to their lower mortality rate.

Figure 4: Decomposition of residential differences (urban–rural) in health expectancies into mortality and health effects by age in 2020



4. Discussion

Using data from the 2010 and 2020 censuses, this study provides updated estimates of health expectancies in China. We also analyze changes in health expectancy by period, sex, and residence by decomposing the observed differences into mortality and health effects. The main findings are as follows.

Over the past decade, both life expectancy in good health and its proportion of total life expectancy have increased in China. At age 60, total life expectancy rose from 21.52 years in 2010 to 24.22 years in 2020, with life expectancy in good health rising from 9.64 to 11.66 years. The proportion of life expectancy in good health also rose from 44.56% to 47.99%. However, it is noteworthy that both the years and the proportion of disabled life expectancy increased across all age groups during the same period. At age 60, disabled life expectancy grew from 0.76 to 0.97 years. This study asks whether these changes are due to an overall increase in life expectancy or improvements in population health, and the decomposition results show that approximately 60% of the increase in life expectancy in good health is due to the rise in the rate of good health across all age groups, while nearly the entire increase in disabled life expectancy results from decreased mortality rates. These findings highlight the impact of China's development strategy for healthy aging and advancements in healthcare over the past decade, including effective control of infectious diseases.

We found sex disparities in health expectancy to have narrowed over the past decade, marked by a notable increase in females' life expectancy in good health. By 2020, the gap in life expectancy in good health between the sexes had nearly disappeared. In particular, in 2020, females' life expectancy in good health at age 60 had increased to 11.71 years, surpassing that of males (11.61 years). However, this narrowing gap does not reflect the elimination of health inequalities, but rather results from women having lower mortality rates than men. Females are more likely to experience nonfatal chronic diseases, while males are prone to fatal diseases before reaching the disability stage (WHO 2007). Beyond biological differences, social and economic challenges further disadvantage females, particularly in old age. For instance, older women in China often face unequal access to pensions and healthcare, a disparity that can worsen with widowhood (Zhang, d'Uva, and van Doorslaer 2015).

Urban–rural disparities in total life expectancy have declined, but urban–rural gaps in life expectancy in good health and disabled life expectancy have widened. In urban areas, health expectancy trends show divergence, with increases in both good health and disabled life expectancy, and decreases in intermediate health states (fair and poor health). By 2020, the urban–rural disparity in life expectancy in good health at age 60 has widened to 3.12 years, while the gap in disabled life expectancy has increased to 0.15 years. The decomposition analysis indicates that differences in the rate of good health

account for most of the gap in life expectancy in good health, while lower mortality rates in urban areas explain the disabled life expectancy difference. These findings reflect China's long-standing dual urban–rural system, where urban residents benefit from superior socioeconomic conditions, greater access to health resources, and more effective healthcare services, which preserve health and mitigate mortality risks when disability arises (Liu et al. 2019).

In conclusion, the past decade has witnessed a substantial increase in healthy life expectancy in China, along with a slight rise in disabled life expectancy. These changes underscore the need for the Chinese government to implement strategies that maximize the benefits of extended health expectancy while addressing the rising demand for long-term care resources. The findings from the sex and urban-rural analyses further emphasize the importance of developing targeted health policies and prioritizing long-term care resources for females and older adults in rural areas.

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