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Decomposition analysis of health inequalities between the urban and rural oldest-old populations in China: Evidence from a national survey

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ABSTRACT

The number of Chinese oldest-old (aged 80+) is growing rapidly and some studies have shown that the health status is unequal among older persons in different regions. However, to the best of our knowledge, no study to date has analyzed health inequalities among the oldest-old in urban and rural areas in China. This study therefore aimed to examine the correlation between health inequalities among the oldest-old in urban and rural areas of China. From the 8th wave of the Chinese Longitudinal Health Longevity Survey (CLHLS), we selected 8124 oldest-old participants who met the requirements of the study. Chi-square tests were used to analyze the distribution characteristics of indicators and a logistic model was performed to determine the factors associated with different self-rated health (SRH). The Fairlie model was adopted to decompose the causes and related contributions to health inequality. Our results found that of the Chinese oldest-old, 46.57% were in good health. Urban residents reported significantly better SRH than rural residents (50.17% vs. 45.13%). Variables associated with good and poor SRH had different distribution characteristics. The logistic model suggested that marital status, alcohol consumption, and annual income were important factors underlying the SRH differences. Our decomposition analysis indicated that 76.64% of the SRH differences were caused by observational factors, and validated that the difference in SRH between urban and rural areas was significantly ($P<0.05$) associated with exercise status (45.44%), annual income (37.64%), social activity status (3.75%), age (-5.27%), and alcohol consumption (-2.66%). Therefore, socioeconomic status and individual lifestyle status were the main factors underlying the health inequality between urban and rural Chinese oldest-old.

1. Introduction

The global population is entering an aging phase. Data from the World Population Prospects 2022 report, reflected that in 2018, for the first time, the number of people aged 65 and over exceeded that of children under five. It also indicated that in 2022, the number of people aged 65 and over will reach 771 million, 994 million in 2030, and 1.6 billion in 2050, rising from 10% in 2022 to 16% for the latter (United Nations Department of Economic and Social Affairs Population Division, 2022). Further, the World Population Prospects 2018 report predicted that the number of people aged 80 and over will increase from 143 million in 2019 to 426 million in 2050 (United Nations, 2019). The world is facing the challenge of population aging and understanding the aging process has become one of the most important issues globally, including in China. The seventh national census of China in 2021 showed that the population aged 65 numbered 190 million (13.50%)—among which more than 14% were located in provinces—and that the overall proportion increased by 4.63% compared with the sixth national census in 2010 (National Bureau of Statistics, 2022). By 2035, the number of Chinese people aged 80 or over, is set to double indicating a

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situation that is growing increasingly serious (China Population and Development Research Center, BJD News, 2022).

Many studies have begun to consider the health of the oldest-old (aged 80 and over). Research has investigated activities of daily living, cognition, cardiovascular disease, and all-cause mortality of the oldest-old (Chen et al., 2022; Lisko et al., 2020; Rasmussen et al., 2022; Zeng et al., 2017). Such cohort studies have explored changes in the diseases experienced by the population and physiological causes of death. Most studies have shown that, in addition to physiological indicators, the health of older persons is highly correlated with social factors such as socioeconomic status (Tur-Sinai & Soskolne, 2021), race (Shippee et al., 2020), gender (Muhammad & Maurya, 2021), and region (J. Zhang, 2021), which are important factors underlying health inequalities among older persons. A small number of studies have reported health inequalities among older persons (aged 65 or over) in China (J. Zhang et al., 2021). The oldest-old people are one of the most vulnerable groups in society and often considered to have the strongest health needs. The long-established urban–rural dichotomy in China has led to unequal economic, medical, and educational developments in urban and rural areas, resulting in significant differences between the health status of rural and urban Chinese populations. Many studies (e.g., Tao & Zhang, 2018; Zhang et al., 2022) have reported inconsistency between the health statuses of middle-aged and older people in China in urban and rural areas, and this difference potentially contributes to health inequalities among the elderly at advanced ages. However, no reports to date have focused on health inequalities among the oldest-old (aged 80 or over), especially those in China. Paying attention to the causes of health inequalities among older people could help reduce the imbalance in Chinese social development, which is an important reflection of human care in our social development process.

The health of a population is influenced by several factors, and many studies have shown that socioeconomic status, race, and gender, among others, affect health status. Grossman's health needs model is one of the most classic models in the research and analysis of the factors affecting people's health. Grossman believes that consumers perceive health in two ways: first, they treat health as a consumer good that can provide utility to consumers, while perceiving illness as bringing negative utility to consumers. Second, they view health as a good investment, which will determine the time consumers spend on various wellness activities. Grossman studied health as a function of medical services, income, education, age, gender, race, marital status, and environmental pollution, as well as individual behavior (Tao, 2021). Therefore, based on Grossman's health needs model and referring to other studies, our study classified the influencing factors of health into four categories: demographic characteristics, social support, personal lifestyle, and economic status.

Our research focused on the health status of the Chinese oldest-old and incorporated sociological indicators according to Grossman's health theory (Galama & van Kippersluis, 2013) to evaluate the health status of the Chinese oldest-old and analyze the factors that influence their health status. Fairlie decomposition analysis was used to determine the main reasons underlying differences in health status and the contribution of each factor. This information could be used to inform China's healthcare policy, particularly targeting the oldest-old people.

2. Materials and methods

2.1. Data sources

This study used data from the earliest and longest social science survey in China — the Chinese Longitudinal Health Longevity Survey (CLHLS; Center for Health Aging and Development of Peking University, 2020). We used the data from the 8th round of the survey, which was publicly released in 2020. The data source and design report are available at https://opendata.pku.edu.cn/dataset.xhtml?persistentId=doi:10.18170/DVN/WBO7LK (CLHLS, 2020). The study has generated the world's largest cohort data on the health of older persons, covering 23 provinces in China, with older people aged 80 and above accounting for 67.40% of the total sample (Zeng et al., 2017).

Data of 15,874 people were collected in the eighth round of the survey. After evaluation by our research team, 8124 samples were selected for inclusion in this study, namely 5810 rural oldest-old people and 2314 urban oldest-old people. The data processing is shown in Fig. 1.

2.2. Core health indicator

There are many health status measurement indicators used in academic research, such as disability-adjusted life years (DALYs) (Gianino et al., 2021), disability-adjusted life expectancy (DALE) (Martinez et al., 2021), quality of well-being (QWB) (Clarke et al., 2021), and self-rated health (SRH) (Xu, 1998). However, because of its simplicity and ease of application, the SRH is widely used for large-sample population surveys. SRH was first proposed by Suchman et al. (Xu, 1998). They suggested that SRH can comprehensively reflect the subjective feelings and objective functions of the human body, based on a subjective cognitive process that is not only affected by the individual's objective personal health status, but also by their feelings, cognitive framework, and socio-cultural background. SRH is a subjective measurement index that integrates individual physical, psychological, and social functions, and has been verified by many studies (Ocampo, 2010; Oftedal et al., 2018; Shadbolt et al., 2002; Tao & Zhang, 2018).

The SRH indicator was obtained by answering the question, "What do you think of your current health status?" Possible answers were "very good" (1), "good" (2), "generally good" (3), "bad" (4), and "very bad" (5). Referring to international studies (Li et al., 2020; Tao & Zhang, 2018; J. Zhang et al., 2021), we classified responses of "very good" and "good" as indicating good health, and other responses as indicating poor health.

2.3. Variables

Our study adopted the Grossman model of health demand, which divides the factors that influence health into four categories: demographic characteristics, social support, lifestyle, and economic status. After referring to other studies on the health of older persons (Muhammad & Maurya, 2021; Shippee et al., 2020; Tur-Sinai & Soskolne, 2021; J. Zhang et al., 2021), we selected these four representative

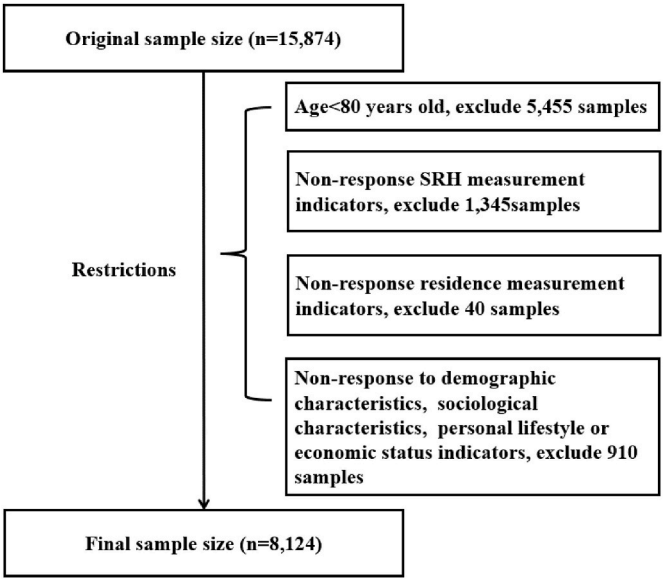

Fig. 1. Flowchart of study participants.

indicators for the current research. The definitions and assignments of the specific variables are shown in Table 1.

2.4. Statistical analysis

General data were summarized by descriptive statistics. The chi-square test was used to analyze the distribution characteristics of indicators related to the Chinese oldest-old in urban and rural areas. Significance was defined as $\alpha = 0.05$. A logistic model was used to explore the main factors associated with a population that has different SRH. An OR>1 indicates a factor promoting SRH, and people with these types of characteristics are more inclined to have good SRH; conversely, an OR<1 indicates a risk factor for SRH, and people with these types of characteristics are more inclined to have bad SRH. SPSS 21.0 software was used for statistical analysis.

2.5. Fairlie Model

The Fairlie model was adopted to decompose the causes and related contributors to the health inequalities of urban and rural oldest-old people. The feasibility of the Fairlie Model in health inequalities decomposition is verified by the application of related studies (Tur-Sinai & Soskolne, 2021). First, the binary Logistic regression models of the urban and rural elderly's SRH status were established respectively: $Y^a = F(X^a\beta^a)$ and $Y^b = F(X^b\beta^b)$; after that, the difference between urban and rural older adults' evaluated self-rated health status was decomposed as:

$$\overline{Y}^a - \overline{Y}^b = \left[\sum_{i-1}^{N^a}\frac{F(X_i^a\beta^a)}{N^a} - \sum_{i-1}^{N^b}\frac{F(X_i^b\beta^a)}{N^b}\right] + \left[\sum_{i-1}^{N^b}\frac{F(X_i^b\beta^a)}{N^b} - \sum_{i-1}^{N^b}\frac{F(X_i^b\beta^b)}{N^b}\right]$$

The first half of the formula is the explained segment and the second half is the unexplained segment. In the formula, $\overline{Y}^a$ and $\overline{Y}^b$ are the average probabilities of binary outcomes of SRH status for urban and rural populations; F is the cumulative distribution function of the logistic distribution; $\overline{Y}^a - \overline{Y}^b$ represents the total variation due to group differences; N^a and N^b are the sample size of the two comparison populations. The first term in parentheses in the above equation represents the fraction of the disparity due to group differences in observed characteristics and the fraction attributable to differences in estimated coefficients, and the second term represents the fraction due to differences in Y levels (Fairlie, 1999, 2017; Fairlie & Robb, 2007; Jann, 2006). The decomposition was implemented using Stata MP 16.0 software. To ensure the stability of the results, we used the software to repeat the calculation of the decomposition model 100 times.

Table 1
Definition and measurement of variables.

Type	Name	Assignment
Dependent variable	SRH	Bad SRH = 0, Good SRH = 1
Grouping variable	Residence	Urban = 0, Rural = 1
Demographic characteristics	Gender	Female = 0, Male = 1
	Age	80–89 = 0, 90–99 = 1, >100 = 2
	Marital status	Married and living with spouse = 0, Widowed = 1, Other[a] = 2
	Living status	Living with family = 0, Alone = 1, Nursing home = 2
	BMI (kg/m^2)	18.5–23.9 = 0, <18.5 = 1, 24.0–27.9 = 2, >28.0 = 3
Sociological and lifestyle characteristics	Smoking	Current = 0, Ever = 1, Never = 2
	Alcohol consumption	Current = 0, Ever = 1, Never = 2
	Exercise	Yes = 1, No = 0
	Social activity	Yes = 1, No = 0
Economic status	Annual income (RMB)	Very low = 0 (income <10,000), low = 1 (10,000 ≤ income <30,000), moderate = 2 (30,000 ≤ income <50,000), high = 3 (income >= 50,000)

[a] Other: includes married but not living with spouse, divorced, and never married.

3. Results

3.1. Participants' characteristics

Table 2 shows the descriptive statistics of the Chinese oldest-old in

Table 2
Descriptive statistics for rural and urban respondents.

Variable	Urban (%)	Rural (%)	χ^2	P
SRH			16.920	<0.001
Bad	1153 (49.83)	3188 (54.87)		
Good	1161 (50.17)	2622 (45.13)		
Gender			32.543	<0.001
Female	1225 (52.94)	3478 (59.86)		
Male	1089 (47.06)	2332 (40.14)		
Age (years)			9.583	0.008
80–89	1000 (43.22)	2443 (42.05)		
90–99	825(35.65)	1955 (33.65)		
>100	489(21.13)	1412 (24.30)		
Marital status			21.771	<0.001
Married and living with spouse	649(28.05)	1367 (23.53)		
Widowed	1603 (69.27)	4320 (74.35)		
Other	62(2.68)	123(2.12)		
Living status			265.658	<0.001
Living with family	1769 (76.45)	4523 (77.85)		
Alone	321(13.87)	1169 (20.12)		
Nursing home	224(9.68)	118(2.03)		
BMI (kg/m^2)			131.478	<0.001
<18.5	458(19.79)	1596 (27.47)		
18.5–23.9	1105 (47.75)	2987 (51.41)		
24.0–27.9	538(23.25)	853(14.68)		
≥28.0	213(9.20)	374(6.44)		
Annual income			1108.063	<0.001
Very low	193(8.34)	1937 (33.34)		
Low	200(8.64)	1213 (20.88)		
Moderate	294(12.71)	806(13.87)		
High	1627 (70.31)	1854 (31.91)		
Smoking			68.416	<0.001
Current	207(8.95)	836(14.39)		
Ever	446(19.27)	811(13.96)		
Never	1661 (71.78)	4163 (71.65)		
Alcohol consumption			7.153	0.028
Current	257(11.11)	765(13.17)		
Ever	261(11.28)	679(11.69)		
Never	1796 (77.61)	4366 (75.15)		
Exercise			254.712	<0.001
No	1427 (61.67)	4583 (78.88)		
Yes	887(38.33)	1227 (21.12)		
Social activity			1.211	0.271
No	914(39.50)	2372 (40.83)		
Yes	1400 (60.50)	3438 (59.17)		

rural and urban areas. We found that 46.57% of the participants had good SRH, 53.43% had bad SRH, and the proportion of good SRH in urban areas (50.17%) was greater than that in rural areas (45.13%; P <0.001). Chi-square tests revealed differences in the distribution of nine factors: gender, age, marital status, living status, BMI, annual income, smoking, alcohol consumption, and exercise. There were no differences in the distribution of social activity status.

3.2. Variable distribution by SRH status

Table 3 shows the variable distribution by SRH status of the Chinese oldest-old in rural and urban areas. The results suggested that the variables had different distribution characteristics according to good and poor SRH. Specifically, differences were found in age, marital status, and alcohol consumption.

3.3. Logistic model results

Fig. 2 shows the logistic model analysis of the SRH reported by the Chinese oldest-old in rural and urban areas. Among the urban oldest-old people, factors protective of SRH were age (90–99, OR = 1.348; >100, OR = 2.043), marital status (widowed, OR = 1.558), exercise (OR = 2.042), and social activity (OR = 1.240). In rural areas, protective factors were age (90–99, OR = 1.211; <100, OR = 1.439), annual income (low, OR = 1.340; moderate, OR = 1.329; high, OR = 1.327), exercise (OR = 1.647), and social activity (OR = 1.472).

Therefore, some of the protective factors of SRH are not consistent between the oldest-old persons in rural and urban areas, mainly manifested in economic factors, marital factors, and alcohol consumption.

3.4. Decomposition analysis

Table 4 shows the decomposition model results for the differences in SRH between the rural and urban oldest-old people. The results suggested that 76.64% of the SRH differences were caused by observed factors, whereas 23.36% of the differences were caused by region (rural and urban) and unobserved factors. Therefore, our decomposition model explained 76.64% of the SRH differences between urban and rural oldest-old people. The model validated that variables that significantly (P < 0.05) explained differences in SRH were exercise status (45.44%), annual income (37.64%), social activity status (3.75%), age (-5.27%), and alcohol consumption (-2.66%).

4. Discussion

To the best of our knowledge, this is the first study to analyze health inequalities between the Chinese oldest-old in urban and rural areas, focusing on the health of those aged 80 and above. This study's results provide new insight into the health of older persons in China's urban and rural areas and will help inform China's policies related to older persons. Further, we analyzed the reasons for the difference in SRH and their contribution to the difference, using the Fairlie model.

Table 3
Descriptive statistics by SRH status.

Variable	Poor SRH				Good SRH			
	Urban (%)	Rural (%)	χ^2	P	Urban (%)	Rural (%)	χ^2	P
Gender			26.883	<0.001			7.142	0.008
Female	612(53.08)	1971(61.83)			613(52.80)	1507(57.48)		
Male	541(46.92)	1217(38.17)			548(47.20)	1115(42.52)		
Age			16.840	<0.001			1.070	0.586
80–89	538(46.66)	1371(43.01)			462(39.79)	1072(40.88)		
90–99	409(35.47)	1061(33.28)			416(35.83)	894(34.10)		
>100	206(17.87)	756(23.71)			283(24.38)	656(25.02)		
Marital status			26.252	<0.001			5.441	0.066
Married and living with spouse	363(31.48)	763(23.93)			286(24.63)	604(23.04)		
Widowed	756(65.57)	2341(73.43)			847(72.95)	1979(75.48)		
Other	34(2.95)	84(2.63)			28(2.41)	39(1.49)		
Living status			169.107	<0.001			99.990	<0.001
Living with family	875(75.89)	2465(77.32)			894(77.00)	2058(78.49)		
Alone	158(13.70)	662(20.77)			163(14.04)	507(19.34)		
Nursing home	120(10.41)	61(1.91)			104(8.96)	57(2.17)		
BMI (kg/m^2)			72.715	<0.001			55.112	<0.001
<18.5	259(22.46)	971(30.46)			199(17.14)	625(23.84)		
18.5–23.9	532(46.14)	1586(49.75)			573(49.35)	1401(53.43)		
24.0–27.9	263(22.81)	437(13.71)			275(23.69)	416(15.87)		
≥28.0	99(8.59)	194(6.09)			114(9.82)	180(6.86)		
Annual income			611.267	<0.001			489.346	<0.001
Very low	103(8.93)	1167(36.61)			90(7.75)	770(29.37)		
Low	100(8.67)	635(19.92)			100(8.61)	578(22.04)		
Moderate	144(12.49)	421(13.21)			150(12.92)	385(14.68)		
High	806(69.90)	965(30.27)			821(70.71)	889(33.91)		
Smoking			47.428	<0.001			28.233	<0.001
Current	87(7.55)	404(12.67)			120(10.34)	432(16.48)		
Ever	246(21.34)	451(14.15)			200(17.23)	360(13.73)		
Never	820(71.12)	2333(73.18)			841(72.44)	1830(69.79)		
Alcohol consumption			0.885	0.643			9.779	0.008
Current	110(9.54)	335(10.51)			147(12.66)	430(16.40)		
Ever	141(12.23)	391(12.26)			120(10.34)	288(10.98)		
Never	902(78.23)	2462(77.23)			894(77.00)	1904(72.62)		
Exercise			106.891	<0.001			133.440	<0.001
No	798(69.21)	2662(83.50)			629(54.18)	1921(73.26)		
Yes	355(30.79)	526(16.50)			532(45.82)	701(26.74)		
Social activity			1.830	0.176			0.200	0.655
No	501(43.45)	1459(45.77)			413(35.57)	913(34.82)		
Yes	652(56.55)	1729(54.23)			748(64.43)	1709(65.18)		

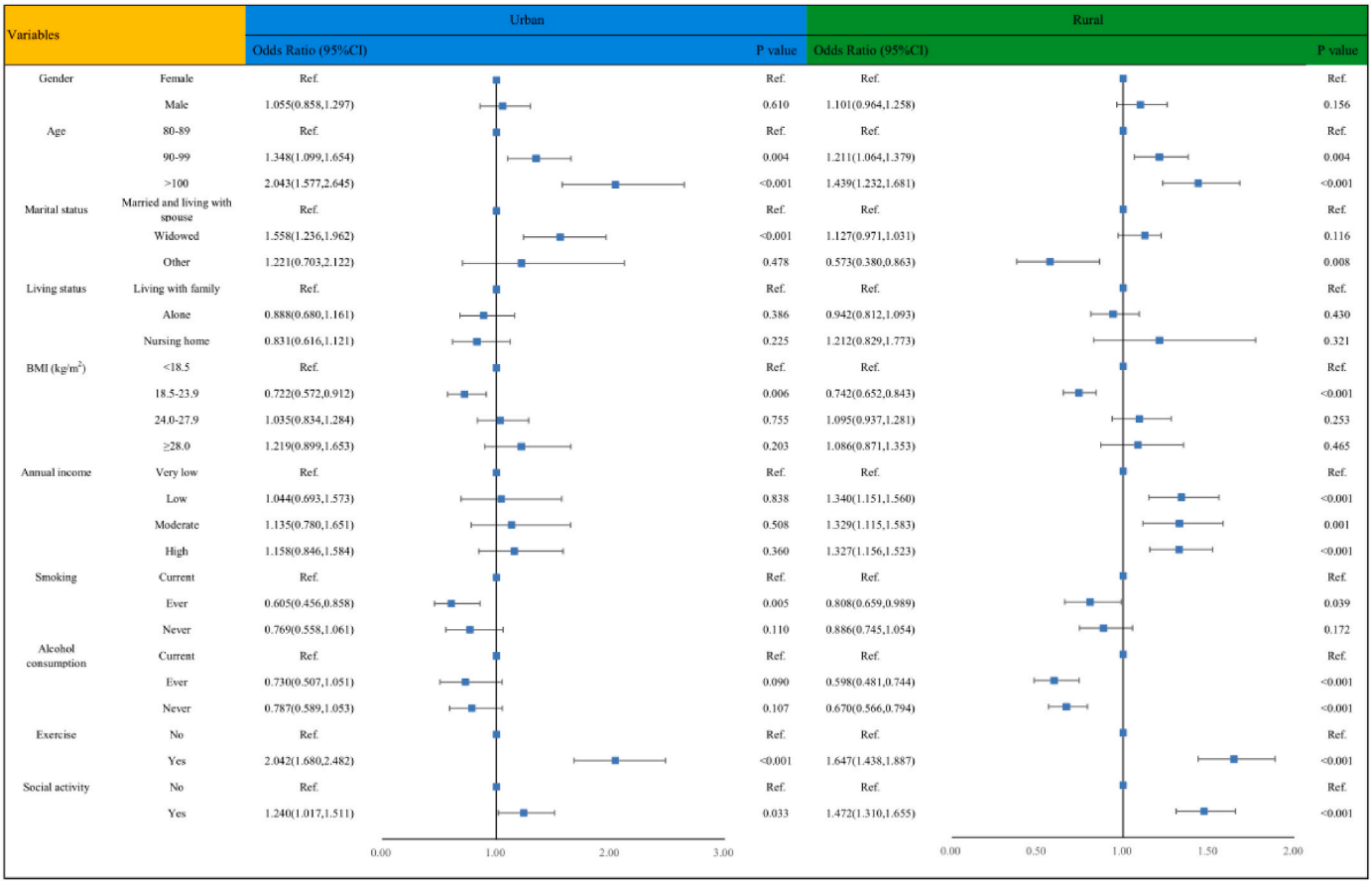

Fig. 2. Logistic results of SRH reported by rural and urban oldest-old people.

Table 4
Fairlie decomposition of SRH disparity between rural and urban oldest-old people.

Terms of decomposition				SRH
Difference				0.0504377
Explained (%)				0.0386530 (76.64)
Unexplained (%)				0.0117847 (23.36)
Explained				
Contribution to difference	P	β	Contribution (%)	(95% CI)
Gender	0.748	0.0002926	0.58	(-0.0014919,0.0020771)
Age	<0.001	-0.0026564	-5.27	(-0.0034039,-0.0019089)
Marital status	0.090	-0.0009405	-1.86	(-0.0020263,0.0001454)
Living status	0.447	-0.0007258	-1.44	(-0.0025966,0.0011449)
BMI	0.569	0.0005635	1.12	(-0.0013771,0.0025042)
Annual income	<0.001	0.0189849	37.64	(0.0104414,0.0275283)
Smoking	0.373	-0.0004524	-0.90	(-0.0014482,0.0005433)
Alcohol consumption	<0.001	-0.0013406	-2.66	(-0.0020451,-0.0006360)
Exercise	<0.001	0.0229168	45.44	(0.0185935,0.0272401)
Social activity	<0.001	0.0018905	3.75	(0.0012873,0.0024937)

4.1. SRH prevalence

Our study found that the good SRH was reported by almost 47% of the Chinese oldest-old (aged 80+). This value is considerably higher than the 20.98% of Chinese older persons (aged 60+) who reported good SRH in a similar study (Zhang et al., 2021), indicating that the health status of the oldest-old people in the current cohort was better than that of older persons in general in China. At the same time, our research also found that the health status of the Chinese oldest-old in urban areas (50.17%) was better than that of the oldest-old in rural areas (45.13%), which is consistent with the findings of other studies on older persons in China (e.g., Shadbolt et al., 2002). These outcomes indicate that there is significant urban-rural health inequality among the Chinese oldest-old, which also exists in the United States, India, Venezuela, and other countries (Anderson et al., 2015; Falk et al., 2017). As a predictor of disease, the high prevalence of poor SRH among rural Chinese oldest-old people suggests that they may face an increased risk of poor health.

4.2. Alcohol consumption and socializing

We found that alcohol consumption was an important factor underlying good, but not poor, SRH. The results of the logistic model suggested that current drinkers (in rural regions) and people with social activities had better health status. Similar results have been reported internationally (e.g., Holdsworth et al., 2016; Riediger et al., 2019). The main reason for this relationship is probably that older persons in poor health are more likely to abstain from drinking and sociality (Li & Li, 2014). In contrast, older persons in good health would probably drink more regularly and have more energy to participate in social activities (Ma et al., 2020). Further, although smoking and alcohol consumption are recognized as health risk factors, the results of our research showed higher health status among older persons who currently drink alcohol and worse health status among those who quit smoking. This may be due to health selectivity in older persons, with those in poor health being more likely to quit drinking and smoking than those in good health, while older persons in good health may have maintained their original drinking and smoking frequency. Hence, the frequency of alcohol consumption and social activity status can be used as measures of the health status of oldest-old people, but it cannot be considered that drinking will result in better SRH.

4.3. Marital and living status

It is worth noting that our study indicates that marriage is an important factor in poor rather than good SRH. Further, the logistic model demonstrated that marital status was a protective factor only in urban areas. Specifically, the results revealed that urban widowed oldest-old people had better health status than older categories of the oldest-old, which differs from other research on Chinese older persons (age $\geq$65 years) (Y. Zhang et al., 2021). The reason for this may be related to the changes in social communication phenomena such as social life characteristics and family conflicts, which we believe are worthy of further study and analysis in sociology. We divided living status into three categories: living with family, alone, and in a nursing home. The results indicated that nearly 78% of the oldest-old people lived with their families, c. 14% in urban areas and 21% in rural areas lived alone, and c. 10% in urban areas and 2% in rural areas lived in nursing homes. This result is similar to that of a survey of 8126 older people's willingness to utilize healthcare in China (Tao & Liu, 2019), which revealed that c. 72% of the older persons sampled believed that they were never receiving care in a nursing home, primarily because of traditional perceptions of healthcare and public opinions, and c. 66% of the older persons had a poor impression of nursing homes (e.g., distrust, discrimination). However, our results demonstrated that the SRH of the oldest-old people living in the three conditions did not differ significantly ($P > 0.05$). Although this is inconsistent with some prior reports from China (e.g., Zheng et al., 2019), our study included a larger sample size and a wider research area compared with prior research; thus, from the perspective of SRH, we believe that different pension models may lead to the same health outcomes. Other studies have also shown that older persons in nursing homes exhibit significantly better mental health, sleep, and diet (Song et al., 2022). Therefore, at a time when China's population is gradually aging, we call on the Chinese government to encourage the development of care institutions for older persons.

4.4. Results of the logistic model

The logistic model also showed that important factors associated with SRH differences between the urban and rural Chinese oldest-old were BMI, alcohol consumption, and annual income. Smoking is traditionally considered a risk factor for the poor health of older persons, but our results indicated that the factor of ever having smoked was significant, whereas the SRH of current smokers and non-smokers was consistent, in line with other research in China (e.g., J. Zhang et al., 2021). Therefore, we do not recommend that oldest-old persons change their smoking behavior.

Our study showed that only a low BMI was a risk factor for SRH, as compared with a BMI in the normal range. As a result, we recommend that all oldest-old people limit their BMI to between 18.5 kg/m^2 and 28.0 kg/m^2, preferably in the range 18.5–24.0, which is based on studies of some chronic diseases (e.g., Kadowaki et al., 2022; Shapkina et al., 2022; Sun et al., 2022).

Exercise is known to be beneficial for improving physical health; this was also suggested in our research. In agreement with other research recommendations, we encourage regular exercise for the oldest-old people (Guan, 2022). However, studies have shown that sports venues in rural areas are much more limited than in urban areas (Guo & Liu, 2022; Xu, 2022). Additionally, those with higher annual income may have better living conditions and medical insurance, and thus have better health outcomes (Tur-Sinai & Soskolne, 2021; J. Zhang et al., 2021; Y. Zhang et al., 2021).

4.5. Causes of health inequalities

There was an obviously inequitable health status distribution between the Chinese oldest-old in urban and rural areas. The results of the Fairlie model validated that the difference was primarily attributed to exercise status (45.44%), annual income (37.64%), social activity status (3.75%), age (-5.27%), and alcohol consumption (-2.66%). All factors except age are amenable to interventions. Annual income is an indicator that clearly reflects socioeconomic status. Alcohol consumption, exercise, and social activity status are indicators of individual lifestyle, confirming that socioeconomic status and individual lifestyle are important reasons for the health status inconsistency between urban and rural oldest-old people.

4.6. Policy recommendations

Our results have substantial policy implications. The first is to increase the number of exercise facilities in rural areas, with a particular focus on areas with poor economic conditions, and increase exercise resources for older persons. The second is to highlight the importance of health education, which is necessary to encourage the oldest-old to adopt a healthy lifestyle, such as controlling BMI, participating in social activities, exercising regularly, and limiting smoking and alcohol consumption. The third is to call on social forces to invest in the field of elderly healthcare and encourage society to develop elderly healthcare institutions. At the same time, it is also necessary to positively guide the publicity of elderly healthcare institutions and establish a good image for them. The fourth implication is the importance of increasing attention toward older persons in need, especially the oldest-old with low economic statuses who should receive preferential policies, such as preferential medical insurance policies, increased public health investments, and free medical examinations.

4.7. Limitations

There are some limitations to our study. First, the population of the Chinese oldest-old is very large, and the CLHLS survey data we used only covered part of this population. Second, SRH is a subjective measurement index, which is not only affected by a person's objective health status, but also by their personal feelings, cognitive framework, and socio-cultural background. As a result, it has a limited reflection on objective health. Third, many factors affect SRH, but we only included some indicators. Finally, the response rate of the CLHLS survey was about 90%, since the CLHLS team did not provide detailed information on the non-responding group, there may be a certain degree of bias, and it is quite possible that the socio-economic status of the group is low. Nevertheless, this dataset is the largest, most extensive, and longest

survey of oldest-old people (aged 80 or over) in the world. Despite these limitations, our study has strong policy implications and we will continue to include additional factors such as insurance coverage, infrastructure, health care scheme, and ethnic differences in further studies to verify the outcomes of the present study.

4.8. Conclusions

This study focused on the SRH of the Chinese oldest-old in urban and rural areas. The SRH of the oldest-old in urban areas was significantly better than in rural areas. Socioeconomic status and individual lifestyle status were the main factors associated with the health inequality between urban and rural oldest-old people.

Credit authorship contribution statement

Lei Yuan: Conceptualization, Methodology, Formal analysis, Supervision, Writing - original draft, Funding acquisition. Boyang Yu: Conceptualization, Supervision, Writing - review & editing. Lei Gao: Methodology, Formal analysis, Supervision, Writing - review & editing. Maolin Du: Conceptualization, Supervision. Yipeng Lv: Methodology, Formal analysis, Funding acquisition. Xu Liu: Writing - review & editing, Funding acquisition. Jinhai Sun: Conceptualization, Supervision, Writing - review & editing.

Ethics statement

This investigation was approved by the Research Ethics Committee of Peking University, China (IRB00001052-13074).

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Declaration of competing interest

None.

Data availability

Data will be made available on request.

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List of Abbreviations

CLHLS	Chinese Longitudinal Health Longevity Survey
SRH	Self-Rated Health
OR	Odds Ratio

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