

## Article

# Research on Mortality Risk of Chinese Older Adults from the Perspective of Social Health

Guoliang Xu <sup>1</sup>, Longchao Xu <sup>2</sup> and Li Jia <sup>1,\*</sup><sup>1</sup> School of Humanities and Management, Guangdong Medical University, Zhanjiang 524023, China<sup>2</sup> Department of Social Policy and Social Work, National Chi Nan University, Nantou County 54561, Taiwan\* Correspondence: [jiali@gdmu.edu.cn](mailto:jiali@gdmu.edu.cn); Tel.: +86-137-9490-4443

**Abstract:** In response to the increasing aging problem that China is facing, this study aimed to investigate the impact of social health on the mortality risk of the Chinese older adult population. In this paper, we used the data from “The Chinese Longitudinal Health Longevity Survey (CLHLS)-Longitudinal Data (2008–2018)” and applied the Cox proportional hazard model to investigate the effects of three dimensions of social health on the risk of death among older adults in China. The study found that: (1) The three dimensions of social health have a positive effect on the mortality risk of older adults. (2) Among those three dimensions, social activities had the most significant effect on older adults. The effect of social support and social network on the mortality risk of older adults are basically similar. Moreover, social activity, social support, and the social network had no significant effect on the young-old’s mortality risk. (3) In order to address the problem of data censoring, the Cox proportional hazard model can be used, whereas demographic characteristics, health status, and health behavior components are selective to society. This study enriches social health research in China and promotes the development of social health research from theory to practice. Moreover, it has obvious advantages in terms of economics and feasibility for achieving mortality risk reduction through improving the social health of older adults and building a healthy aging society.

**Keywords:** older adults; social health; mortality risk; Cox proportional hazard model; CLHLS



**Citation:** Xu, G.; Xu, L.; Jia, L. Research on Mortality Risk of Chinese Older Adults from the Perspective of Social Health. *Sustainability* **2022**, *14*, 16355. <https://doi.org/10.3390/su142416355>

Academic Editors: Gregor Wolbring, Shiro Horiuchi and Takeshi Matsuda

Received: 4 November 2022

Accepted: 5 December 2022

Published: 7 December 2022

**Publisher’s Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

According to the “Statistical Bulletin of National Economic and Social Development in 2021” from the National Bureau of Statistics, Chinese older adults, defined as those 60 and over, made up 18.90% of the country’s total population in 2021; those 65 and older made up 14.20% of the population [1]. China is facing an increasingly serious aging problem, and the older adult population is expected to grow substantially in both its proportion and size in the next fifty years [2].

As China’s population enters an aging society, the study of mortality risk in older adults has become an important and realistic issue. In late 2006, the Chinese government released its first white paper on the development of aging, reflecting the importance that China attached to the cause of aging and demonstrating the government’s positive attitude to dealing with population aging [3]. Since the 1990s, some research institutions have conducted large-scale surveys on the aging population, including the “China Health and Retirement Longitudinal Survey, CHARLS”, hosted by the China Center for Economic Research of Peking University in 1998, which has conducted eight nationwide follow-up surveys on older adults, providing rich data for research on population aging [4].

There are few research findings on the social health of older adults, and the meanings of social health are incredibly complicated. Because of the richness of social health, the mechanisms by which social health affects the mortality risk in older adults are yet to be understood entirely [5]. Social health, also known as social adaptability, refers to the ability of individuals to interact with others and the social environment, have good interpersonal

relationships, and fulfill social roles [6,7]. With the improvement of the basic medical system and the popularization of endowment insurance, the level of physical health of older adults has been improving, and the role of physical health in influencing mortality risk has been reduced. Therefore, the study of social health as an aspect of understanding social functioning and social support has direct relevance to protecting and reducing the mortality risk in older adults [8].

Therefore, it is vital to study the social health of older adults in a localized way, which is necessary for building a healthy aging society. This study used data from CHARLS (2008–2018) to examine the mortality risk among older adults through three dimensions of social health: social activity, social support, and social network. The empirical analysis was used to explore the relationship between social health and mortality risk in older adults. The purposes of this research are listed as follows:

- (1) The use of tracking data to study the social health of older adults provides a longitudinal and cross-sectional study to understand how demographic characteristics, health status, health behaviors, and social health affect the mortality risk in older adults, which is beneficial to apply in practice.
- (2) The processing of censored data using the Cox proportional hazard model enhances the scientific validity of our findings. Moreover, we explain the mechanism of social health on the mortality risk in older adults and provide policy guidance for the aging society.

The research is organized as follows. The second section of this study describes the factors influencing the mortality risk in older adults. The third section describes the data sources and research methods, including variable design and measurement. The next section presents the study results and concludes with a discussion of the findings.

## 2. Literature Review

Since the World Health Organization introduced its revised definition of health, research findings on one of its components, social health, have gained attention in academia [9]. Currently, studies on the mortality risk in older adults have focused on three aspects: sociodemographic characteristics, socioeconomic factors, and social support factors to explore their effects on the mortality risk in older adults [10,11].

In terms of sociodemographic characteristics, age, gender, urban/rural, occupation, marriage, and mode of residence may influence the mortality risk in older adults. In terms of demographic characteristics of older adults, women are at a greater mortality risk than men; rural residents are at a greater mortality risk than urban residents; unmarried older adults are at a greater mortality risk than married older adults. When it comes to the living situation, older adults who live alone, live only with their spouse, and live in a nursing home are at a greater mortality risk than those who live with their offspring. Older adults without community services have a greater mortality risk than those with community services [12,13].

In the aspect of socioeconomic factors, the mortality risk at age 60 was consistently higher among those without medical insurance than among those with medical insurance. Medical insurance had a significant effect on the mortality risk among older adults in the older age group but not in the younger age group. In addition, among older Chinese adults, inferior family background in childhood has a long-term effect on the mortality risk in old age [14].

Social support refers to the access to financial support, life care, and spiritual comfort of older adults and the extent to which they are satisfied, including care service needs, financial needs, choice needs, and management needs [15]. In terms of social support factors, the mortality risk is lower in older adults with better social activity participation, such as the ability to perform daily activities, the ability to perform daily instrumental activities, and functional limitations, than in those with poorer functional limitations. Religious involvement, an integral part of daily life for most older adults, is thought to have a role in their mental health and physical well-being. Many studies have shown that religious involvement is associated with the human body [16], subjective health [17], happiness, and life satisfaction [18]. Religious involvement can reduce the mortality risk to

some extent. However, the effect of religious involvement on mortality risk can be replaced by the health of the body of older adults themselves. In contrast to social support in the form of life care and spiritual support, which are more effective in reducing the mortality risk among older adults, financial support is less effective in improving the survival status of older adults in China. However, this does not imply that financial support is unrelated to the mortality risk among older adults, as even those without pensions can receive financial and medical support from their families to make up for their lack of income, indirectly demonstrating the importance of social support from family in enhancing the health status of older adults [19].

However, more research needs to be conducted on the three dimensions of social health in terms of mortality risk in older adults. Previous research has shown that socioeconomic, social support, social activities, social networks, and other social factors have significant positive effects on quality of life, satisfaction with life, and ADL (activities of daily living) in older adults. Additionally, less social support increases the mortality risk and causes mental health problems [20,21]. Active participation in social activities can enhance the life satisfaction of older adults, and the integrity of social networks can reduce the mortality risk in older adults. However, it is vital to conduct the study because it is unclear whether social health, which includes the integrated aspects of social support, social activities, and social networks, has a positive impact on the health risk and mortality risk of the aged.

In sum, we proposed three hypotheses:

**H1:** *Social activities have a positive effect on mortality risk.*

**H2:** *Social support has a positive effect on mortality risk.*

**H3:** *Social networks have a positive effect on mortality risk.*

### 3. Data Source and Research Method

#### 3.1. Data Source and Processing

Data for this study were obtained from the “Chinese Longevity Healthy Longevity Survey (CLHLS)”, tracked from 2008–2018 [22]. CLHLS is a tracking survey of older adults organized by the Center for Healthy Aging and Development of Peking University and the China Development Research Institute. The survey covers 23 provinces across China, targeting older adults aged 65 and above and their adult children aged 35–64. The questionnaires are divided into two types: questionnaires for surviving respondents and questionnaires for family members of deceased older adults. The survey content of the questionnaire for the surviving respondents includes a wealth of individual microdata on the fundamental circumstances of older adults and their families, such as socioeconomic background, family structure, financial resources, economic status, self-assessment of health, quality of life, cognitive function, personality and psychological traits, physical and psychological health of the older adults, ability to perform daily activities, and intergenerational relationships. The questionnaire for family members of the deceased older adults includes the time of death and the cause. Since 1998, the survey has conducted eight follow-up surveys on the health of older adults, with a total of 113,000 household visits, of which the older adults aged 80 and above, who are most in need of care, account for 67.40% of the total sample, with the rest being lower-aged older adults and middle-aged control groups. The survey also interviewed 28,900 direct family members of deceased seniors over the age of 65, collecting detailed data on health status, quality of life, and cost of medical and care needs prior to death. The most recent follow-up survey (2017–2018) interviewed a total of 15,874 older adults aged 65 years and older. In order to maintain and increase the sample size in accordance with the principle of “same region, same gender, and same age” in each follow-up survey, the survey replaces the sample of dead and lost visits with a new sample of older adults to address the issue of the high mortality rate and the loss of follow-up of older adults. In this study, we conducted an empirical study based on the follow-up survey data from CLHLS during 2008–2018.

### 3.2. Variables and Measurement

The key concept studied in this paper is social health, which refers to an individual's ability to interact with others or the social environment and have good interpersonal relationships and achieve social roles. McDowell and Newell defined individual social health as a dimension of personal well-being. Specifically, individual social health is how an individual gets along with others and interacts with social institutions and practices and how others respond to him [23]. This paper divides social health into three dimensions: social activities, social support, and social networks.

#### (1) Dependent variable

In exploring the mortality risk of older adults from the social health perspective, this study uses mortality risk as the dependent variable, which is the interval between 2008 (the start of the survey) and death. Moreover, survival status at the time of the survey from 2017–2018 is taken as the mortality risk time.

#### (2) Independent variables

The independent variable in this study is social health, which is specifically divided into three dimensions: social activities, social support, and social networks.

1. Participation in social activities is the social activity indicator (organized social activities). This factor is divided into five categories in the survey, with 1 denoting frequent participation and 5 denoting never participation. These three variables are recoded from 0 to 4, with 0 being never and 4 being frequently participating in facilitating scoring. The theoretical range of the social activity index is 0–4, with higher scores indicating more frequent participation in social activities.
2. Social support includes three aspects: substantive support, emotional support, and accessible support. (A) Substantive support variables include “main source of economic support” and “daily care”. The “main source of financial support” is measured as a dichotomous variable of family members (children and spouse), self or other (social assistance), and assigned with a dummy variable (1, 0). The “daily care” variable is measured as “who mainly takes care of you when you are unwell or sick” and is assigned a dummy variable (1,0). (B) The emotional support variable is measured by “Who do you talk to most” and “If you have something on your mind, who do you talk to first”. If the answer is “relative”, the value is assigned to 2, “nonrelative” is assigned to 1, and “no one can say” is assigned to 0. The values of the first, second, and third options are assigned to weights of 3, 2, and 1, respectively, and then summed to get the score of each case. The theoretical range of these three variables is 0–38. The higher the score is, the better the social support they receive.
3. The social network consists of marital status, the number of children who visit often, and the number of siblings who visit often. In the assignment of each indicator, the weight of the social network index is referred to Berkman & Syme (1979) [24], in which marital status is assigned a value of 2 if it is “remarried” and 0 otherwise. The number of children and siblings in frequent contact between 1 and 3 is assigned a value of 1, and 4 or more is assigned a value of 2. The score of the social network index is obtained by adding the three together. The theoretical range of the social network index is 0–6. The higher the score is, the stronger the social network is.

The mean value of the scores of social health's three dimensions is used as the criterion. A score below the mean value is coded as “0”, representing a poor level of social health in the corresponding dimension. Otherwise, the score above the mean value is noted as “1”, representing a good level of social health in the corresponding dimension. Because of the significant differences in each dimension of social health in young-old and older adults, we analyzed these two groups separately. For the reliability test of social health indicators, Cronbach's  $\alpha = 0.806 > 0.7$ . The KMO value for the validity test was 0.724, and Bartlett's test of sphericity was significant ( $<0.001$ ).

### (3) Control variables

The control variables in this study include three aspects: demographic characteristics, health status, and health behavior. Among them, demographic characteristics include gender, ethnicity, age, type of residence, mode of residence, education level, occupation held before age 60, and economic status. Health status includes the ability to perform daily activities and self-rated health. The ability to perform activities of daily living (ADL) is a valid indicator to measure the health status of older adults. The questionnaire includes six indicators: eating, bathing, dressing, toileting, indoor activities, and control of urination and defecation. Respondents are considered to have poor ADLs if they need help in at least one of the aspects and are considered to have intact ADLs if they do not need any help in any of the six items. Health behaviors include whether or not to smoke, drink alcohol, and exercise. The selectivity of some variables for death can be excluded by controlling for variables. However, if the control variables are also selective for social health, this can be addressed by constructing appropriate interaction models [25].

### 3.3. Model Construction

There is a data truncation issue since while some older persons experienced “death” events between 2008 and 2018, the majority of older adults did not. The exclusion of samples that did not die would lead to statistical distortion. Therefore, this research uses the Cox proportional hazards model (Cox) to perform data analysis [26,27] and separates the senior and young-old for fitting. At present, there is no clear definition for the age division of young- and old-old. However, in the aging policy making in China and in the studies of some scholars, it is found that scholars often classify the elderly into young-old and oldest-old based on the degree of degeneration of their neurological, motor, and immune systems and their physiological and psychological health. It is generally agreed that the age span of young-old is 65–79 years old and the age of oldest-old is 80 years old or above.

Cox is a semiparametric regression model proposed by British statistician D.R. Cox. The specific formula is:

$$h(t, X) = h_0(t) \exp(\beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m) \quad (1)$$

whereas,  $\beta_1, \beta_2, \dots, \beta_m$  is the partial regression coefficient of the independent variable, which is the parameter to be estimated from the sample data.  $h_0(t)$  is the baseline hazard rate of  $h(t, X)$  when the  $X$  vector is 0, which is the estimated quantity to be made from the sample data.

The model is often used in medical and sociological studies to analyze the effect of one or more predetermined variables on the survival time of patients. Unlike Kaplan–Meier curves and logrank tests, which are commonly used for monivariate analysis, Cox can be used for multifactor survival analysis. Moreover, Cox can include categorical variables (e.g., gender) and also numerical variables (e.g., age), whereas Kaplan–Meier curves and logrank tests can only include categorical variables [28,29]. Cox has a wider application since it extends survival analysis to simultaneously evaluate the effect of numerous risk factors on survival time [30]. Thus, we performed Cox based on IBM SPSS Statistics 26.

## 4. Research Result

### 4.1. Descriptive Analysis

The total sample size for the 2008–2018 follow-up survey was 16,954. The number of deaths before the 2011 survey was 5642, and the number of the loss of follow-ups in 2011 was 2894. The number of older adults who survived in the 2011 survey but passed away in the 2014 survey was 2589, and the number of the loss of follow-ups was 591. There were 1547 older adults who were alive in the 2014 survey but passed away in the 2018 survey, and there were 1259 older adults who were lost to follow-up.

Table 1 presents the data's basic demographic characteristics, health status, health behaviors, social support, social activities, social networks, and the composition of survival status from 2008–2018.

**Table 1.** Distribution of Samples (N = 16,954).

Variables	Young-Old		Old Adult		Total		
	Sample Size	Percentage (%)	Sample Size	Percentage (%)	Sample Size	Percentage (%)	
Demographics							
Sex	Female	2027	47.29	7548	61.48	9575	57.81
	Male	2259	52.71	4729	38.52	6988	42.19
Ethnic group	Han	4031	94.05	11,526	93.88	15,557	93.93
	Minority	255	5.95	751	6.12	1006	6.07
Age	65–69	1402	32.71	–	–	1402	8.47
	70–79	2884	67.29	–	–	2884	17.41
	80–89	–	–	4278	34.85	4278	25.83
	90–99	–	–	4621	37.64	4621	29.90
Rural or urban areas	100 and above	–	–	3378	27.51	3378	20.39
	Rural areas	3686	85.94	10,714	87.40	14,400	87.02
Ways of living	Urban areas	603	14.06	1544	12.60	2147	12.98
	Alone or in a nursing home	621	14.49	2233	18.19	2854	17.23
Literacy	With household members	3665	85.51	10,044	81.81	13,709	82.77
	Illiterate	1716	40.04	8754	71.30	10,470	63.21
Occupation	Literate	2570	59.96	3523	28.70	6093	36.79
	Manual	2891	68.75	9839	81.49	12,730	78.20
Economic status	Nonmanual	1313	31.25	2235	18.51	3548	21.80
	Poor	684	15.95	2329	18.88	3013	18.13
Health conditions	Average	3038	70.89	8334	67.57	11,372	68.42
	Good	564	13.16	1671	13.55	2235	13.45
Severe illness	Never	3518	82.08	10,133	82.53	13651	82.42
	Once and above	768	17.91	2144	17.46	2912	17.58
ADL	Good	4121	96.15	8710	70.95	12,831	77.47
	One and above with assistance	165	3.85	3566	29.05	3731	22.53
Self-rated health	Bad	683	16.14	1691	16.38	2374	16.31
	Average	1411	33.33	3649	35.35	5060	34.76
Health behaviors	Good	2139	50.53	4982	48.27	7121	48.93
	Yes	1117	20.06	1700	13.85	2817	17.01
Smoking	No	3169	73.94	10,577	86.15	13,746	82.99
	Yes	948	22.12	1840	17.99	2788	16.83
Alcohol	No	3338	77.88	10,437	85.01	13,775	83.17
	Yes	1748	40.79	2787	22.70	4535	27.38
Exercising	No	2537	59.21	9490	77.30	12,027	72.62
	Poor	2802	65.38	5004	40.76	7806	47.13
Social activities	Good	1484	34.62	7273	59.24	8757	52.87
	Poor	1807	42.16	5435	44.27	7242	43.72
Social Support	Good	2479	57.83	6842	55.73	9321	56.28
	Poor	1003	23.40	9287	75.65	10,290	62.13
Social network	Good	3283	76.60	2990	24.35	6272	37.87
	Alive	3294	89.03	4992	48.85	8286	59.53
Survival state	Deceased	406	10.97	5227	51.15	5633	40.47

Notes: There are missing values in the sample. Table 1 shows the values of each indicator obtained by removing the missing values, so there are differences in the total number of samples.

Considering that different dimensions of social health have different mechanisms of action between seniors and young-old, the older adults were divided into two groups: young-

old (65–79 years old) and older adults (80 years old and above), of which 12,277 senior citizens accounted for 72.40% of the total sample size, 4286 young citizens accounted for 25.30%. There were 391 cases with missing values accounting for 2.30% of the total sample size.

In the survey sample, women accounted for a larger proportion than men, with slightly more men than women in the young group and a significantly higher proportion of women than men in the senior group. The proportion of ethnic minorities was only 6.07%, and the survey respondents were basically Han residents. Rural seniors are 74.04% more likely than urban seniors in terms of the type of residence. The data show that the older adults mainly live with their families. The proportion of senior citizens living alone or in nursing homes was slightly higher than that of young-old. The sample's older adults had a typically low literacy rate, with a lower percentage of illiterates in the younger age groups than in the older age groups. The majority of older people working before the age of 60 had lower-level jobs (Tables 1 and 2).

**Table 2.** Between-group difference tests for independent variables among the young-old and older adults.

		t	df	Sig. (2-tailed)	Mean. S. D.	Std. Error Mean
Social activity	Equal Variances Assumed	23.817	16561	0.000	0.329	0.014
	Equal Variances Not Assumed	18.802	5369.178	0.000	0.329	0.017
Social support	Equal Variances Assumed	5.544	16,561	0.000	0.868	0.157
	Equal Variances Not Assumed	5.788	8117.960	0.000	0.868	0.150
Social network	Equal Variances Assumed	46.174	16,561	0.000	0.739	0.016
	Equal Variances Not Assumed	45.479	7281.666	0.000	0.739	0.016

The socioeconomic status of the older adults was often low. The older adults in the sample generally had good health, and the young group had higher ADLs and self-rated health status than the senior group. The proportion of seniors with low ADL was 25.2% higher than that of seniors with high ADL. In terms of health behaviors, the proportions of seniors who smoked, drank, and exercised were not high, and the proportions of seniors with low ADL were slightly lower than that of seniors with high ADL. The differences in the status of social support and social activities were relatively large. The proportion of poor social networks was larger than that of good social networks, while the proportion of poor social networks was significantly higher than that of good social networks in the older adults. The proportions of poor and good social support and social activity were largely balanced. However, young-olds had poorer social activity and better social support, while the older adults had the opposite.

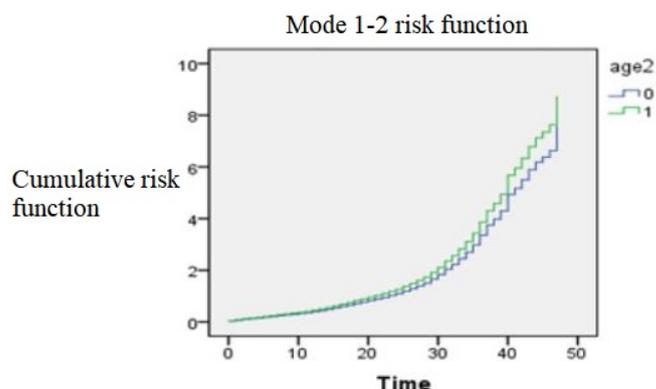
From the underlying medical history of the older adults in the data set (Table 3), the prevalence of hypertension, diabetes, heart disease, bronchitis, emphysema, pneumonia, asthma, and arthritis was much higher in the young-old than in the older adults. The prevalence of dementia and bedsore was higher in the older adults than in the young-old. In addition, it is worth noting that tumors are far more deadly for the young-old than the older adults, with 12.84% of the young-old dying from tumors compared to 2.93% of the older adults.

**Table 3.** Diseases of young-old and older adults in the sample.

Variables	Young-Old		Older Adult		Total	
	Sample Size	Percentage (%)	Sample Size	Percentage (%)	Sample Size	Percentage (%)
Basic medical history of the older adults						
hypertension	1157	31.27	1241	12.14	2398	17.23
diabetes	241	6.51	127	1.24	368	2.64
heart disease	520	14.05	562	5.50	1082	7.77
stroke or cvd	322	8.70	369	3.61	691	4.96
bronchitis, emphysema, pneumonia, asthma	438	11.84	587	5.74	1025	7.36
tuberculosis	45	1.22	48	0.47	93	0.67
cataract	327	8.84	726	7.10	1053	7.57
glaucoma	54	1.46	100	0.98	154	1.11
cancer	35	0.95	38	0.37	73	0.52
prostate tumor	192	5.19	244	2.39	436	3.13
gastric or duodenal ulcer	187	5.05	192	1.88	379	2.72
Parkinson's disease	30	0.81	37	0.36	67	0.48
bedsore	10	0.27	45	0.44	55	0.40
arthritis	574	15.51	617	6.04	1191	8.56
dementia	55	1.49	234	2.29	289	2.08
epilepsy	6	0.16	15	0.15	21	0.15
cholecystitis, cholelith disease	141	3.81	160	1.57	301	2.16
blood disease	193	5.22	91	0.89	284	2.04
rheumatism or rheumatoid disease	317	8.57	380	3.72	697	5.01
chronic nephritis	35	0.95	37	0.36	72	0.52
galactophore disease	17	0.46	16	0.16	33	0.24
uterine tumor	24	0.65	26	0.25	50	0.36
hyperplasia of prostate gland	132	3.57	192	1.88	324	2.33
hepatitis	29	0.78	12	0.12	41	0.29
Main death factor						
Infectious diseases and parasites	2	0.49	5	0.09	7	0.12
Tumors	52	12.84	153	2.93	205	3.64
Blood, hematopoietic organs and immune diseases	10	2.47	74	1.42	84	1.49
Endocrine, nutrition and metabolic disease	10	2.47	59	1.13	69	1.22
Spiritual and behavioral disorder	4	0.99	10	0.19	14	0.25
Nervous system disease	18	4.44	168	3.21	186	3.30
Eye and attachment disease	0	0.00	5	0.09	5	0.09
Ear and mastoid disease	87	21.48	814	15.58	901	16.00
Circulatory disease	50	12.35	543	10.39	593	10.53
Systemic disease	10	2.47	138	2.64	148	2.63
Digestive system disease	0	0.00	20	0.38	20	0.36
Skin and subcutaneous tissue disease	5	1.23	69	1.32	74	1.31
Muscle skeletal system and connective tissue disease	10	2.47	30	0.57	40	0.71
Urinary reproductive system disease	18	4.44	346	6.61	364	6.46
Damage, poisoning, accident or other external causes	60	14.81	1253	23.98	1313	23.31
do not know	69	17.04	1540	29.46	1609	28.56

#### 4.2. Hazard Function for the Older Adults

From the hazard function plots of the young-old and older adults in Figure 1, the mortality risk was higher in the older adults than in the young-old due to the difference between the hazard function plots. Therefore, the mortality risk for the older adults and the young-old were studied separately. In Figure 1, 0 represents the young-old, and 1 represents the older adults. As a whole, the older adults' hazard function shows an exponential distribution, reflecting the increasingly prominent aging problem in China from 2008 to 2018 and the gradual increase in mortality among older adults. While China's economy and society are developing rapidly, it is necessary to improve the self-assessed health status of older adults, continuously enhance the old-age security system, adopt policies and foster a social environment in which senior citizens are respected, cared for, and live happily in their later years, so as to provide the necessary guarantee for achieving high-quality economic development.



**Figure 1.** The Hazard Function of Model 1. Note: 0 represents the young-old and 1 represents the older adults.

4.3. Cox Regression Analysis of Univariable

Table 4 presents the results of univariate regressions of demographic characteristics, health status, health behaviors, and social health variables on the mortality risk among the older adults and young-old. The variables differed in their effects on the mortality risk among the older adults, with most of them not significant for the young-old, but significant for the older adults.

**Table 4.** Uni-variate Cox Regression of the older adults (N = 16,563).

Variables	Reference Groups	Young-Old	Older Adult
		Relative Risk	Relative Risk
Demographic			
Sex	Female	0.962	1.028 *
Ethnic group	Han	0.988	0.906
Age		0.989 *	1.01 ***
Type of residence	Rural areas	0.812	1.027
Way of living	Not with household members	0.969	1.071 *
Literacy	Illiterate	0.982	0.989 *
Occupation	Manual	0.873 *	0.891 ***
Economic status	Poor	0.923	0.940 **
	Average Good	0.851	0.929 **
Health conditions			
Severe illness	Never	0.907 *	1.106 ***
ADL	Good	1.184	1.372 ***
Self-rated health	Bad	0.742	0.823 ***
	Average Good	0.586	0.697 ***
Health behavior			
Smoking	No	0.861	0.905
Alcohol	No	0.805 *	0.907
Exercising	No	0.982	0.861 ***
Social health			
Social activities	Poor	0.853	0.772 ***
Social support	Poor	1.164	1.013
Social network	Poor	0.939	0.914 ***

Notes: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Among the variables for demographic characteristics, the univariate regression for the young-old was significant for only two variables: age and occupation before age 60. The mortality risk was 12.70% lower for the young-old in higher-paying occupations than for the young-old in lower-paying occupations. Only ethnicity and the type of residence were nonsignificant in the univariate regression for the older adults. Among the older adults, the mortality risk was higher for men than women. Additionally, the mortality risk

increased with age, which was 7.10% higher for the older adults living with family than for those not living with family. Generally, older adults who live with their families are those who are in poor health and need family care. Older adults with high education levels, higher-paying occupations before age 60, and good economic status have a lower mortality risk than that with low education levels, lower-paying occupations before age 60, and poor economic status.

The effect of all three health status variables on the mortality risk in the older adults was significant, with a lower mortality risk in those with an intact ADL than in those with an absent one. This difference was more significant in the older adults. Those who rated themselves as having good and fair health had a lower mortality risk than those who had poor health. The mortality risk was 10.60% higher for the seniors who had had a serious illness than for those who had not. Among the health behaviors, the older adults who exercised regularly had a lower mortality risk than those who did not exercise. The role of smoking and drinking was not significant. The older adults with good social activities and social networks had a lower mortality risk than those with poor ones. Moreover, the role of social support was not significant for both the young-old and older adults. Due to the altered disease spectrum, the effect of many variables on the mortality risk in the young-old is not significant. Therefore, this study only examined the mortality risk in the older adults.

#### 4.4. Multivariate Cox Regression of Mortality Risk in the Older Adults

Table 5 presents the multivariate Cox regression results for three dimensions of social health in the older adults (social activity, social support, and social network) and each significant control variable on the mortality risk. Model 1 is a positive effect of social activity, social support, and social networks on the mortality risk among the older adults after controlling for demographic variables. Among them, the mortality risk was 10.60% higher for men than for women, which increased by 1.10% for each year of age. The role of social activity was the most significant, with the mortality risk being 21.60% lower for seniors with good social activity and 5% lower for seniors with good social networks than for seniors with poor social networks.

Model 2 adds the control variables of social factors to Model 1, of which only the three variables of ethnicity, economic status, and occupation engaged before age 60 are the most significant. Older adults of Han nationality have a mortality risk that is 10.20% higher than that of ethnic minorities. Older adults in higher-paying occupations also have a mortality risk that is 6.10% lower than that of older adults in lower-paying occupations. Older adults with good and average economic status also have a mortality risk lower than older adults with poor economic status. The remaining univariate regressions are no longer significant.

Model 3 adds the control variable of health status to Model 1, and the changes in the three dimensions of social health are insignificant. Moreover, the “whether or not you have had a serious illness” variable is no longer significant. The mortality risk for the older adults with perfect ADL status is 37.10% lower than those with one or more missing ADLs. Furthermore, the mortality risk for the older adults with fair and good self-rated health status is lower than those with poor self-rated health status. The significant variable—“whether to exercise regularly”—in univariable regression is added to health behavior, and the mortality risk is 9.9% lower in the older adults who exercised regularly than those who did not exercise.

Model 4 adds the interaction variables of social support and “whether or not they had been seriously ill” based on Model 3, in which good social support and having been seriously ill once or more are assigned a value of 1, otherwise 0. The results show that the *p*-value of the interaction variables is less than 0.05. Model 5 includes all variables, and there was no significant difference compared with Model 4.

**Table 5.** Multivariate Cox Regression of Social Health and Mortality Risks of the Oldest-old.

Variables	Reference Group	Model 1	Model 2	Model 3	Model 4	Model 5
		Relative Risk	Relative Risk	Relative Risk	Relative Risk	Relative Risk
Sex	Female	1.106 ***	1.104 **	1.144 ***	1.151 ***	1.181 ***
Age		1.011 ***	1.010 ***	1.004 **	1.004 **	1.003 *
Social activities	Poor	0.784 ***	0.782 ***	0.791 ***	0.808 ***	0.815 ***
Social support	Poor	0.985 *	0.989	0.972 *	0.916 *	0.985
Social network	Poor	0.950 ***	0.947 ***	0.939 ***	0.939 ***	0.939 ***
Ethnic group	Han		0.898 *			0.883 *
Way of living	With household members		1.039			
Literacy	Illiterate		0.975			
Occupation before age 60	Manual		0.939 *			
Economic status	Poor		0.872 *			
	Average Good		0.853 *			
Rural or urban areas	Urban areas		1.044			
Severe illness	Never			1.053	1.025	
ADL (Good = 0)				1.371 ***	1.363 ***	1.361 ***
Self-rated health	Bad	Average		0.892 ***	0.891 ***	0.891 ***
		Good		0.762 ***	0.765 ***	0.759 ***
Exercising	No			0.901 *	0.901 *	0.901 *
Social support *severe illness			Good social support and once and above severe illness		1.066 *	1.071 *

Notes: (1) \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . (2) Model 1 is a positive effect of social activity, social support, and social networks on the mortality risk among the older adults after controlling for demographic variables. Model 2 adds the control variables (ethnicity, economic status, and occupation engaged before age 60) to Model 1. Model 3 adds the control variable of health status to Model 1. Model 4 adds social support and “whether or not they had been seriously ill” based on Model 3. Model 5 includes all variables.

## 5. Discussion and Conclusions

Population aging has become one of the common problems faced by both developed and developing countries. Especially since the outbreak of COVID-19 in 2020, China’s serious population aging problem has been aggravated [31,32]. The health problems and mortality risk of older adults have posed a great challenge to the promotion of the “Healthy China Strategy” [10,33]. The health of older adults is not only related to the quality of life of the older adults themselves and their families but also directly related to the burden of care for the whole society and the issue of sustainable development. The ability of older adults to maintain health and independence not only helps to overcome the emotions of aging and improve the quality of life but is also of great value in reducing the burden on families and even society [34,35]. Therefore, it is of great practical importance to investigate the health of older adults and their mortality risk. This study was conducted based on the data from the 2008–2018 survey of the China Health and Retirement Longitudinal Study for older adults aged 65 years and above.

First, in the univariate regressions of demographic characteristic variables (health status, health behaviors, and social health variables) on the mortality risk for the young-old and older adults, most of the variables in the univariate regressions for the young-old were insignificant for mortality risk. Moreover, multivariate Cox regressions of the mortality risk for the young-old revealed that most of the variables were still insignificant. The multivariate Cox regression analysis of mortality risk for the young-old was therefore excluded from this study but performed in the older adults. In addition, it was found that this insignificance may be caused by changes in the disease spectrum, increasing life expectancy, and changes in aging patterns [36]. In a survey of residents in Shanghai, China, Zhou et al. (2022) found that changes in the disease spectrum resulting from an aging population have implications for mortality risk in older adults [37]. In particular, the increase in the number of older adults in the region is associated with increased deaths from neurological and psychiatric diseases, including Alzheimer’s disease, Parkinson’s disease, and dementia [38,39]. Due to better self-care ability and self-assessed health status,

the young-old have a lower mortality risk. In contrast, older adults performed worse in these two areas and have a higher mortality risk [40].

Second, the difference between univariate regressions of mortality risk in the older adults and multivariate regressions was relatively large. This difference resulted from the selection of control variables in the three dimensions of demographic characteristics, health status, and health behaviors. Social health has a positive effect on the mortality risk in the older adults. That is to say that the mortality risk is lower for older adults with above-average social health levels than those with below-average social health levels [41,42]. Moreover, similar results have been found in other studies [43,44]. For example, in a study of causes of death among centenarians in England from 2001–2010, Evans (2014) [43] found that centenarians were more likely to die from infections such as pneumonia compared to young-old patients. This reflects the positive role of the social health status of older adults on the mortality risk among older adults in both developed and developing countries.

Third, in the multivariate Cox regression of mortality risk among the older adults, the three dimensions of social health had different effects on mortality risk among the older adults, with social activity having the largest effect and social support going from insignificant to significant after the inclusion of the interaction variable with having a serious illness [45,46]. Therefore, hypothesis one and two is supported. Although a social network had a reduced effect on mortality risk compared to the results of the 2002–2005 data [47,48], it had a significant effect on both young-old and older adults. Therefore, hypothesis three is supported. The older adults, especially those had only one child, need more social networks from the community to improve social health and decrease mortality risk. Therefore, social health has a predictive effect on the mortality risk of older adults. In Asia, research from South Korea also reported similar results. The social network presents a positive effect on older adults (neighborhood environments and self-rated health in Mainland China, Japan, and South Korea). If a reliable and scientific social health measurement index system can be established, the trend of mortality risk changes of the older adult population in the community or society can be detected early through the predictability of social health indicators. Targeted measures can then be taken to shift the health problems of older adults from treatment to prevention, allowing some policies intended to improve the quality of life and health of older adults to be more effective [49]. Meanwhile, because of the family planning policy, China's rapid aging, and the proliferation of "421" families, the role of the family in older adult care has been reduced. New types of older adult care, such as interactive older adult care, home care, housing endowment, and institutional older adult care, have been rapidly developed [31,32], resulting in the diversification of social support for older adults. Therefore, family members provide less support, while social workers and nannies provide more support. Thus, social support is not significant for the mortality risk of older adults.

In summary, this study found that social health has a positive effect on the mortality risk in older adults. The better the social health is, the lower the mortality risk older adults face. On the one hand, as the meaning of social health is constantly updated and deepened, while physical health is no longer the only factor affecting health levels, the importance of social health is gradually highlighted. Due to the rapid population aging in China and the shortage of healthcare resources, it is too expensive to medically improve the health status of older adults and reduce their mortality risk, in addition to the importance of disease prevention due to the changing disease spectrum. By studying the mortality risk of older adults, we can better predict the factors that influence the mortality risk of older adults so that we can develop effective measures to improve the social health of older adults, especially Chinese older adults. On the other hand, this study has guiding implications for older adult policy development. The research results show that the three dimensions of social health: social activities, social support, and social network have different effects on the mortality risk among older adults [50]. According to the severity of the effects, more rational and scientific older adult policies can be considered, as well as creative solutions to ease the burden of family retirement, such as offering a variety of ways to create a peaceful

and healthy aging society and offering a supportive response to the guidance of the aging society [51].

Although this study reveals the specific effects of social health on the mortality risk of older adult people, some work still needs to be followed up with in-depth studies. Firstly, we failed to figure out how aging affects the needs of different older adults. Secondly, we only investigated the impact of social health (social activity, social support, and social network) on mortality risk, failing to analyze diseases, emotions, and changes in family structure. Thirdly, we did not collect information on the participants' religion in this study. In the future, we will continue to strengthen the follow-up survey on the health of older adults, to gain a deeper understanding of the different ways of aging and the needs of different older adults, and to reveal its influence on the mortality risk of older adults from various aspects such as diseases, emotions, changes in family structure, and well-being indices, in order to support the formulation of aging policies and the extension of life expectancy of older adults in China and the world. In future studies, we will continue to explore the impact of participants' religious information.

**Author Contributions:** Conceptualization, G.X.; Methodology, L.J.; Software, L.X.; Investigation, G.X. and L.X.; Data curation, L.X.; Writing—original draft, G.X. and L.J.; Writing—review & editing, L.J.; Project administration, L.J. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by [2022 Zhanjiang Philosophy and Social Science Planning Project] grant number [ZJ22YB33] and [Education and Teaching Planning Project of Guangdong Province 2022 (Higher Education Special)] grant number [2022GXJK206].

**Institutional Review Board Statement:** The study did not require ethical approval.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The study did not report any data.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. National Bureau of Statistics. Statistical Bulletin of National Economic and Social Development in 2021. Available online: [http://www.gov.cn/xinwen/2022-02/28/content\\_5676015.htm](http://www.gov.cn/xinwen/2022-02/28/content_5676015.htm) (accessed on 9 October 2022).
2. Friedsam, H.J.; Harry, W.M. A comparison of self and physicians health ratings in order population. *J. Health Soc. Behav.* **1963**, *4*, 179–183.
3. Li, J. A study on the relationship between quality of life and social support among the elderly population. *Popul. Res.* **2007**, *3*, 50–60.
4. Zhao, Y.; Hu, Y.; Smith, J.P.; Strauss, J.; Yang, G. Cohort Profile: The China Health and Retirement Longitudinal Study (CHARLS). *Int. J. Epidemiol.* **2012**, *43*, 61–68. [[CrossRef](#)]
5. House, J.S.K.R.; Landis, D. Umberson. Social relationships and health. *Science* **1988**, *241*, 540–545. [[CrossRef](#)]
6. Lu, J.; Yu, Z.; Zhang, X.; Wu, M.; Lin, S.; Zhu, Y.; Xu, Z.; You, L.; Wei, F.; Tang, M.; et al. Association between social health status and health-related quality of life among community-dwelling elderly in Zhejiang. *Health Qual. Life Outcomes* **2020**, *18*, 110. [[CrossRef](#)] [[PubMed](#)]
7. Wang, Z.; Li, X.; Chen, M.; Si, L. Social health insurance, healthcare utilization, and costs in middle-aged and elderly community-dwelling adults in China. *Int. J. Equity Health* **2018**, *17*, 17. [[CrossRef](#)] [[PubMed](#)]
8. Yang, Y.; Meng, Y. Is China Moving toward Healthy Aging? A Tracking Study Based on 5 Phases of CLHLS Data. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4343. [[CrossRef](#)]
9. Xu, L.; Tan, X.; Zhou, J.; Cao, G.; Zhao, K.; Wen, Y.; Zhang, D. Analysis of the social support status of healthy older adults in rural communities and its associated factors. *Chongqing Med.* **2013**, *42*, 668–670.
10. Liu, Y.; Wang, D.; Li, Q.; Guo, A. Association between psychological resilience and mortality risk of the elderly in China: An analysis of the CLHLS data 2011–2018. *South China Popul.* **2021**, *36*, 59–69.
11. Pitkänen, K.; Lehtimäki, J.; Puhakka, R. How do Rural Second Homes Affect Human Health and Well-being? Review of Potential Impacts. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6748. [[CrossRef](#)]
12. Yang, F.; Gu, D. Research of the relationship between social vulnerability and mortality in China's Elderly. *Chin. J. Popul. Sci.* **2017**, *5*, 74–85.
13. Mu, H.; Yang, Z. The effect of marital status on the death probability of the elderly: An empirical analysis of CLHLS queue data. *South China Popul.* **2016**, *31*, 38–49.

14. Shen, K. The impact of childhood SES on the mortality risk of China's oldest old. *Chin. J. Popul. Sci.* **2008**, *3*, 56–63.
15. Zhu, H.; Lu, J. The impact of religious attendance on mortality risk of China's oldest old. *Popul. Res.* **2012**, *36*, 83–92.
16. Koenig, H.G.; Hays, J.C.; George, L.K.; Blazer, D.G.; Larson, B.; Landerman, R. Modeling the Cross-Sectional Relationships Between Religion, Physical Health, Social Support, and Depressive Symptoms. *Am. J. Geriatr. Psychiatry* **1997**, *5*, 131–144. [[CrossRef](#)] [[PubMed](#)]
17. Drevenstedt, G.L. Race and ethnic differences in the effects of religious attendance on subjective health. *Rev. Relig. Res.* **1998**, *39*, 245–263. [[CrossRef](#)]
18. Levin, J.S.; Chatters, L.M.; Taylor, R.J. Religious effects on health status and life satisfaction among black Americans. *J. Gerontol. Ser. B Psychol. Sci. Soc. Sci.* **1995**, *50*, S154–S163. [[CrossRef](#)]
19. Luo, Y. The effect of social support on the mortality risk of the Chinese elderly by Cox model analysis. *South China Popul.* **2014**, *29*, 62–70.
20. Seeman, T.; Kaplan, G.; Knudsen, L. Social network ties and mortality among the elderly in the Alameda County study. *Am. J. Epidemiol.* **1987**, *126*, 714–723. [[CrossRef](#)]
21. Choi, E.H.; Kang, M.J.; Lee, H.J.; Yun, M.S. A Latent Class Analysis of Health-Related Quality of Life in Korean Older Adults. *Int. J. Environ. Res. Public Health* **2021**, *18*, 7874. [[CrossRef](#)]
22. PKU Center for Healthy Aging and Development. Available online: <https://opendata.pku.edu.cn/dataset.xhtml?persistentId=doi:10.18170/DVN/WBO7LK> (accessed on 25 October 2022).
23. McDowell, I.; Newel, C. *Measuring Health: A Guide to Rating Scales and Questionnaires*; Oxford University Press: New York, NY, USA, 1987.
24. Berkman, L.F.; Leonard, S. Social networks, host resistance, and mortality: A nine year follow-up study of Alameda County resident. *Am. J. Epidemiol.* **1979**, *109*, 186–204. [[CrossRef](#)]
25. Liang, Y.; Li, X.; Qiu, Y.; Qi, P.; Liu, T. Research on the new type of elderly care model of interactive travel in different places. *China J. Commer.* **2021**, *5*, 106–108.
26. Austin, P.C.; Fang, J.M.; Lee, D.S. Using fractional polynomials and restricted cubic splines to model non-proportional hazards or time-varying covariate effects in the Cox regression model. *Stat. Med.* **2022**, *41*, 612–624. [[CrossRef](#)]
27. Wang, B.; Bu, Y.; Tao, G.; Yan, C.; Zhou, X.; Li, W.; Zhao, P.; Yang, Y.; Gou, R. Quantifying the Effect of Crown Vertical Position on Individual Tree Competition: Total Overlap Index and Its Application in Sustainable Forest Management. *Sustainability* **2020**, *12*, 7498. [[CrossRef](#)]
28. Lee, S.J.; Schneijderberg, C.; Kim, Y.; Steinhardt, I. Have Academics' Citation Patterns Changed in Response to the Rise of World University Rankings? A Test Using First-Citation Speeds. *Sustainability* **2021**, *13*, 9515. [[CrossRef](#)]
29. Bai, S.M.; Ji, X.F.; Dai, B.Y. An Integrated Model for the Geohazard Accident Duration on a Regional Mountain Road Network Using Text Data. *Sustainability* **2022**, *14*, 12429. [[CrossRef](#)]
30. Yin, Z.Y.; Zheng, C.J.; Fang, Q.J.; Gong, X.; Cao, G.; Li, J.; Xiang, Z.; Song, W. Introduction of Two-Dose Mumps-Containing Vaccine into Routine Immunization Schedule in Quzhou, China, Using Cox-Proportional Hazard Model. *J. Immunol. Res.* **2021**, *2021*, 5990417. [[CrossRef](#)] [[PubMed](#)]
31. Zhao, L.; Liao, X.; Wang, P. Research on the allocation of urban primary medical facilities under home care model: Take Beijing sub-center as an example. *Urban Dev. Stud.* **2022**, *29*, 14–19.
32. Liu, Y.; Liu, E. Feasibility study of “four-two-one” families to break through the bottleneck of the “housing for the elderly” policy. *China Market* **2014**, 79–81. Available online: [https://xueshu.baidu.com/usercenter/paper/show?paperid=71be67d9e7f78fde9ae5dfa59312e7bd&site=xueshu\\_se](https://xueshu.baidu.com/usercenter/paper/show?paperid=71be67d9e7f78fde9ae5dfa59312e7bd&site=xueshu_se) (accessed on 3 November 2022).
33. Cui, H.; Hu, Y.; Hong, C.; Hu, G.; Fan, L. A 15 years study of the causes of death among elderly hypertensive patients in a hospital-based sample of China. *Arch. Gerontol. Geriatr.* **2012**, *55*, 709–712. [[CrossRef](#)]
34. Walia, B.; Kmush, B.L.; Ehrlich, J.; Mackowski, M.; Sanders, S. Age at League Entry and Early All-Cause Mortality among National Football League Players. *Int. J. Environ. Res. Public Health* **2022**, *18*, 13356. [[CrossRef](#)]
35. Bellomo, G.; Piscopo, P.; Corbo, M.; Pupillo, E.; Stipa, G.; Beghi, E.; Vanacore, N.; Lacorte, E. A systematic review on the risk of neurodegenerative diseases and neurocognitive disorders in professional and varsity athletes. *Neurol. Sci.* **2022**, *43*, 6667–6691. [[CrossRef](#)] [[PubMed](#)]
36. Zhu, H.; Xie, Y. Socioeconomic differentials in mortality among the oldest old in China. *Res. Aging* **2007**, *29*, 125–143. [[CrossRef](#)]
37. Zhou, Y.H.; Cai, X.; Chen, Y.C.; Chen, H.; Li, X.; Sun, L.; Chen, H.; Qu, X.; Wang, S.; Xiao, S. Trend Analysis of Life Expectancy and Decedent Life Expectancy per Resident in Pudong New Area, Shanghai, 2005–2020. *Dis. Surveill.* **2022**, *37*, 1118–1123.
38. Wu, L.L.; Li, J.; Yu, J.L.; Liu, Y.; Liu, J.; Zhou, M.; Niu, P. Analysis of disease burden of Parkinson's disease in Beijing and Shanghai from 1990–2019. *Dis. Surveill.* **2022**, *37*, 275–279.
39. Bayraktar, Y.; Isik, E.; Isik, I.; Ozyilmaz, A.; Toprak, M.; Guloglu, F.; Aydin, S. Analyzing of Alzheimer's Disease Based on Biomedical and Socio-Economic Approach Using Molecular Communication, Artificial Neural Network, and Random Forest Models. *Sustainability* **2022**, *14*, 7901. [[CrossRef](#)]
40. García-González, J.J.; García-Peña, C.; Franco-Marina, F.; Gutiérrez-Robledo, L.M. A frailty index to predict the mortality risk in a population of senior mexican adults. *BMC Geriatr.* **2009**, *9*, 47. [[CrossRef](#)] [[PubMed](#)]
41. Gander, J.; Lee, D.C.; Sui, X.; Hébert, J.R.; Hooker, S.P.; Blair, S.N. Self-rated health status and cardiorespiratory fitness as predictors of mortality in me. *Br. J. Sports Med.* **2011**, *45*, 1095–1100. [[CrossRef](#)] [[PubMed](#)]

42. Rozzini, R.; Bianchetti, A.; Franzoni, S.; Zanetti, O.; Trabucchi, M. Social, functional and health status influences on mortality: Consideration of a multidimensional inquiry in a large elderly population. *J. Cross Cult. Gerontol.* **1991**, *6*, 83–90.
43. Evans, C.J.; Ho, Y.; Daveson, B.A.; Hall, S.; Higginson, I.J.; Gao, W. Place and cause of death in centenarians: A population-based observational study in England, 2001 to 2010. *PLoS Med.* **2014**, *11*, e1001653. [[CrossRef](#)]
44. Smith, S.G.; Jackson, S.E.; Kobayashi, L.C.; Steptoe, A. Social Isolation, Health Literacy, and Mortality Risk: Findings from the English Longitudinal Study of Ageing. *Health Psychol.* **2017**, *37*, 160–169. [[CrossRef](#)]
45. Cohen, S.; Wills, T.A. Stress, social support, and the buffering hypothesis. *Psychol. Bull.* **1985**, *98*, 310–357. [[CrossRef](#)]
46. Bennett, S.J.; Perkins, S.M.; Lane, K.A.; Deer, M.; Brater, D.; Murray, M. Social support and health-related quality of life in chronic heart failure patients. *Qual. Life Res.* **2001**, *10*, 671–682. [[CrossRef](#)] [[PubMed](#)]
47. Loprinzi, P.D.; Ford, M.A. Effects of Social Support Network Size on Mortality Risk: Considerations by Diabetes Status. *Am. Diabetes Assoc.* **2018**, *31*, 189–192. [[CrossRef](#)] [[PubMed](#)]
48. Cheng, H.L.; Sung, P.; Chan, A.; Ma, S.; Malhotra, R. Transitions between social network profiles and their relation with all-cause mortality among older adults. *Soc. Sci. Med.* **2022**, *292*, 114617. [[CrossRef](#)]
49. Fu, C.H. Impact of social health on the risk of death in the elderly population. *Chin. J. Gerontol.* **2016**, *36*, 1469–1473.
50. Marcus, A.F.; Echeverria, S.E.; Holland, B.K.; Abraido-Lanza, A.F.; Passannante, M.R. The joint contribution of neighborhood poverty and social integration to mortality risk in the United States. *Ann. Epidemiol.* **2016**, *26*, 261–266. [[CrossRef](#)] [[PubMed](#)]
51. Beluzos, C.E.; Silva, E.; Alves, L.C.; Bresan, R.C.; Arruda, N.M.; Sovat, R.; Carvalho, T. Towards neonatal mortality risk classification: A data-driven approach using neonatal, maternal, and social factors. *Inform. Med. Unlocked* **2020**, *20*, 100398. [[CrossRef](#)]