Preplanned Studies

The Relationship Between Physical Activity and All-Cause Mortality Among Older Adults — China, 1998–2018

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Summary

What is already known about this topic?

Previous research indicates that non-occupational physical activity can reduce mortality risk. Nevertheless, the relationship between occupational physical activity and health improvements has not been consistently established.

What is added by this report?

The study found that regular exercise and leisure activities reduced the risk of all-cause mortality. However, the combination of exercise and leisure activities demonstrated more substantial benefits. Additionally, no meaningful association was identified between physical work and mortality risk within the older population.

What are the implications for public health practice?

It may be beneficial to encourage older adults to engage in regular exercise and to partake actively in leisure activities. Combining these two elements might yield greater benefits than regular exercise alone.

Existing research has showcased the inverse correlation between non-occupational physical activity (e.g., exercise, recreation) and mortality risk (*1*), while the health-protective influence of occupational physical activity remains debatable (*2*). Nevertheless, the precise impact of varying forms of physical activities — including exercise, leisure activities, and physical work — on mortality risk remains ambiguous. This study examined these implications utilizing data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) from 1998 to 2018. The study included 34,038 participants (mean age 88.2±11.1 years), with 277,169 person-years of follow-up, during which 25,238 deaths occurred. Cox proportional hazard models assessed relationships between physical activity and the all-cause mortality risk amongst Chinese older adults. Regular exercise and engagement in leisure activities have been associated with lower mortality risk [fully adjusted hazard ratios (HR): 0.897–0.900; 95% confidence interval (*CI*): 0.868–0.931; fully adjusted HR: 0.899–0.903; 95% *CI*: 0.860–0.943] compared to those who did not regularly partake in exercise or leisure activities. However, no significant association was observed between physical work and all-cause mortality risk after full adjustments. Compared to the inactive group, those regularly engaging in exercise and leisure activities had the lowest mortality risk. This study underscores the significance of encouraging older adults to regularly participate in exercise and leisure activities to promote longevity and overall health.

Participants for the present study were sourced from the CLHLS study, a nationally representative investigation into factors contributing to healthy longevity in China across 23 provincial-level administrative divisions (*3*). Initially, 44,621 participants aged 65 or older were enrolled at the baseline. Subsequently, the final analysis incorporated 34,038 participants with a minimum of one follow-up interview, and available data regarding regular exercise, leisure activities, and physical work were included in the final analysis (Supplementary Figure S1, available in https://weekly.chinacdc.cn).

At the baseline interview, participants were asked about their involvement in eight customary leisure activities(i.e., housework, outdoor activities, gardening, rearing domestic animals/pets, reading newspapers/ books, playing cards/mah-jongg, watching TV, listening to radio, and participating in social activities) during the previous six months. Regular exercise was ascertained by asking, "At present, do you regularly exercise for fitness, such as walking, running, playing ball games, qi gong (a deep-breathing exercise system), or other exercises?". The question determined physical work engagement, "Do you engage in physical labor regularly?".

A comprehensive explanation of this dynamic cohort's study design and methodology is available

elsewhere (*3*). The Peking University's Ethics Committee sanctioned the study, and all respondents gave informed consent.

Descriptive data are expressed as either the mean±standard deviation (SD) or frequency (percentage), depending on what is most appropriate. The baseline characteristics were examined using either a *t*-test or an F-test for continuous variables, while a chi-square test was applied for categorical variables. Using the Cox proportional hazard regression models, we evaluated the associations between various types of physical activities and the risk of all-cause mortality. The timescale used was the attained age under the stratification of the calendar year of recruitment (*4*). The Schoenfeld residual test verified the proportional hazards assumption, with no violations detected. Variables considered in the fully adjusted Cox model encompassed sex, ethnicity, residence, marital status, occupation, income level, education level, living arrangement, smoking status, drinking status, dietary diversity type scores, body mass index (BMI), self-reported health status, hypertension, diabetes mellitus, cardiovascular disease (CVD) or stroke, respiratory disease, activities of daily living (ADL), Mini-Mental State Examination (MMSE) score, cancer, and a mutual adjustment for regular exercise, leisure activities, or physical work.

Subgroup analyses were conducted by age (<80 and ≥80 years) and sex using fully adjusted models. A likelihood ratio test was utilized to inspect for interaction effects. All statistical investigations were carried out with R (version 3.4.5; R Development Core Team, Vienna, Austria). A two-sided *P* value of <0.05 was established as the benchmark for statistical significance.

Table 1 provides an overview of the baseline characteristics of the study participants. The average age of these participants was 88.2, with a majority (58.4%) being female. Substantial proportions of the surviving participants were married (51.0%), working as farmers (45.2%), had less than one year of schooling (52.4%), resided in rural areas (54.1%), and lived with their families (85.3%). Most participants also reported never having smoked (66.3%) or consumed alcohol (70.2%).

During the 277,169 person-years tracked, a total of 25,238 deaths were recorded. Table 2 shows the association between different types of physical activities and all-cause mortality. Compared to individuals who did not regularly exercise, those who did exhibited a 10.0% lower risk of mortality (fully adjusted HRs: 0.900, 95% *CI*: 0.870–0.931). Similarly, those engaged in leisure activities demonstrated a 9.7% lower mortality risk (fully adjusted HRs: 0.903, 95% *CI*: 0.864–0.943) than those who did not partake in such activities. Nevertheless, no significant association was found between physical work and all-cause mortality. Figure 1 illustrates the combined effect of regular exercise and leisure activities on all-cause mortality. Those who regularly exercise and participate in leisure activities have the lowest risk of mortality compared with inactive individuals (fully adjusted HRs: 0.811, 95% *CI*: 0.770–0.855). The subgroup analysis results were consistent across all subgroups (Supplementary Table S1, available in https://weekly.chinacdc.cn).

DISCUSSION

This study involving 34,038 older adults discovered a notable association between regular exercise, leisure activities, and a reduced risk of all-cause mortality. The advantageous effects were particularly notable when these activities were combined, surpassing the benefits of either activity independently. However, this study did not reveal a significant relationship between physical work and all-cause mortality. Consequently, we recommend that older adults in China actively engage in habitual exercise and leisure activities.

Our findings align with previous research suggesting a negative association between regular exercise, engagement in leisure activities, and reduced mortality risks (*5*–*7*). One study involving 272,550 older adults identified seven specific leisure activities that diminished a mortality risk in descending order: racquet sports, running, walking for exercise, other aerobic exercise, golf, swimming, and cycling (*6*). Another study, which based its findings on the 1998–2014 CLHLS cohort of 30,070 older adults (mean age: 92.7 years), reported that each leisure activity led to an 11%–18% reduction in mortality risk, with multiple leisure activities contributing even more significantly to decreased mortality risk (*5*). The National Health Interview Surveys (1997–2013), including 89,962 participants aged 65 years or older, found that combining aerobic and muscle-strengthening activity significantly benefits all-cause, CVD, or cancer mortality (*7*). Physical activity, intrinsically characterized by any skeletal muscle-induced movement that notably boosts energy expenditure (*8*), is differentiated from exercise, which is a distinct subset of physical activity marked by its planned, structured, and repetitive nature (e.g., aerobic

TABLE 1. Baseline characteristics of participants, comprising Chinese older adults, from 1998 to 2018.

Characteristics	All participants (*N*=34,038)	No. of alive (*N*=8,800)	No. of deceased (*N*=25,238)	*P*-value
Age, mean±SD, years	88.2±11.1	79.7±11.0	91.2±9.4	<0.001
Sex, *n* (%)				<0.001
Male	14,152 (41.6)	3,985 (45.3)	10,167 (40.3)	
Female	19,886 (58.4)	4,815 (54.7)	15,071 (59.7)	
Ethnicity, *n* (%)				<0.001
Han	2,338 (6.8)	520 (5.8)	1,818 (7.2)	
Other	31,700 (93.2)	8,280 (94.2)	23,420 (92.8)	
Residence, *n* (%)				<0.001
Urban	13,446 (39.5)	4,035 (45.9)	9,411 (37.3)	
Rural	20,592 (60.5)	4,765 (54.1)	15,827 (62.7)	
Marital status, *n* (%)				
Married	24,448 (71.8)	4,489 (51.0)	19,959 (79.1)	<0.001
Unmarried	9,590 (28.2)	4,311 (49.0)	5,279 (20.9)	
Occupation, *n* (%)				
Famer	14,738 (43.3)	3,970 (45.2)	107,68 (42.7)	<0.001
Others	19,271 (56.7)	4,820 (54.8)	14,451 (57.3)	
Income level, *n* (%)				
Independent	7,664 (22.5)	3,547 (40.3)	4,117 (16.3)	<0.001
Dependent	26,374 (77.5)	5,253 (59.7)	21,121 (83.7)	
Educational level, *n* (%)				
<1 year	22,196 (65.5)	4,600 (52.4)	17,596 (70.0)	<0.001
≥1 years	11,704 (34.5)	4,174 (47.6)	7,530 (30.0)	
Living arrangement, *n* (%)				
With family	29,588 (87.0)	7,498 (85.3)	22,090 (87.6)	<0.001
Alone or in an institution	4,427 (13.0)	1,293 (14.7)	3,134 (12.4)	
Smoking status, *n* (%)				<0.001
Never	23,061 (67.8)	5,827 (66.3)	17,234 (68.3)	
Former	4,673 (13.7)	1,122 (12.8)	3,551 (14.1)	
Current	6,282 (18.5)	1,845 (21.0)	4,437 (17.6)	
Drinking status, *n* (%)				<0.001
Never	23,469 (69.0)	6,166 (70.2)	17,303 (68.6)	
Former	3,413 (10.0)	747 (8.5)	2,666 (10.6)	
Current	7,121 (20.9)	1,874 (21.3)	5,247 (20.8)	
Dietary diversity score type, *n* (%)				
Well	16,281 (47.8)	3,394 (38.6)	12,887 (51.1)	<0.001
Poor	17,757 (52.2)	5,406 (61.4)	12,351 (48.9)	
BMI group, *n* (%)				
Underweight (<18.5 kg/m^2)	13,000 (38.2)	2,541 (28.9)	10,459 (41.4)	<0.001
Normal (18.5–23.9 kg/m^2)	17,226 (50.6)	4,607 (52.4)	12,619 (50.0)	
Obese or overweight (≥24.0 kg/m^2)	3,812 (11.2)	1,652 (18.8)	2,160 (8.6)	

TABLE 1. (Continued)

Characteristics	All participants (*N*=34,038)	No. of alive (*N*=8,800)	No. of deceased (*N*=25,238)	*P*-value
History of disease, *n* (%)				
Self-reported bad health status	7,291 (22.6)	1,204 (13.9)	6,087 (25.7)	<0.001
Hypertension	19,937 (59.8)	5,119 (59.2)	14,818 (60.0)	0.205
Diabetes mellitus	539 (1.7)	222 (2.6)	317 (1.3)	<0.001
Cardiovascular diseases	3,702 (11.4)	1,133 (13.4)	2,569 (10.7)	<0.001
Respiratory disease	3,789 (11.6)	896 (10.5)	2,893 (12.0)	<0.001
ADL disability	9,380 (27.6)	1,003 (11.4)	8,377 (33.2)	<0.001
Cancer	119 (0.4)	33 (0.4)	86 (0.4)	0.771
MMSE score, median (IQR)	19.4 (8.4)	22.8 (5.8)	18.2 (8.8)	<0.001
Physical Activity, *n* (%)				
Regular exercise				<0.001
No	9,244 (27.2)	3,206 (36.4)	6,038 (23.9)	
Yes	2,4794 (72.8)	5,594 (63.6)	19,200 (76.1)	
Leisure activities				
No	10,460 (30.7)	1,828 (20.8)	8,632 (34.2)	<0.001
Yes	23,578 (69.3)	6,972 (79.2)	16,606 (65.8)	
Physical work				<0.001
No	27,595 (81.2)	6,943 (78.9)	20,652 (81.9)	
Yes	6,443 (18.8)	1,857 (21.1)	4,586 (18.1)	

Note: Data are *n* (%) or mean±SD unless otherwise stated. Of the 34,038 older adults, the numbers of missing data ranged from 22 to 138 (29 for occupation, 138 for educational level, 23 for living arrangement, 22 for smoking status, and 35 for drinking status).
Abbreviation: BMI=body mass index; ADL=activities of daily living; MMSE=Mini-Mental State Examination; SD=standard deviation; IQR=interquartile range.

TABLE 2. Hazard ratios (95% *CI*s) associated with all-cause mortality risk for various types of physical activity among Chinese older adults from 1998 to 2018.

Physical activity	Deaths/No. of participants	HR (95% *CI*) for all-cause mortality		
		Model 1	Model 2	Model 3
Regular exercise				
No	19,200/24,794	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	6,038/9,244	0.802 (0.778–0.826)†	0.809 (0.785–0.834)†	0.900 (0.870–0.931)†
Leisure activities				
No	8,632/10,460	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	16,606/23,578	0.970 (0.944–0.996)*	0.762 (0.733–0.793)†	0.903 (0.864–0.943)†
Physical work				
No	4,586/6,443	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	20,652/27,595	0.979 (0.948–1.011)	0.943 (0.909–0.977)*	0.979 (0.941–1.018)

Note: Model 1: adjusted sex; Model 2: further adjusted ethnicity, residence, marital status, occupation, income level, educational level, living arrangement, smoking status, drinking status, dietary diversity score type; Model 3: further adjusted body mass index, self-reported health status, hypertension, diabetes mellitus, respiratory diseases, CVD, ADL disability, Mini-Mental State Examination score, cancer, and mutually adjusted for regular exercise, leisure activities or physical work as appropriate.
Attained age was used as time scale.
Abbreviation: HR=hazard ratio; *CI*=confidence interval; CVD=cardiovascular diseases; ADL=activities of daily living.
* *P*<0.01.
† *P*<0.001.

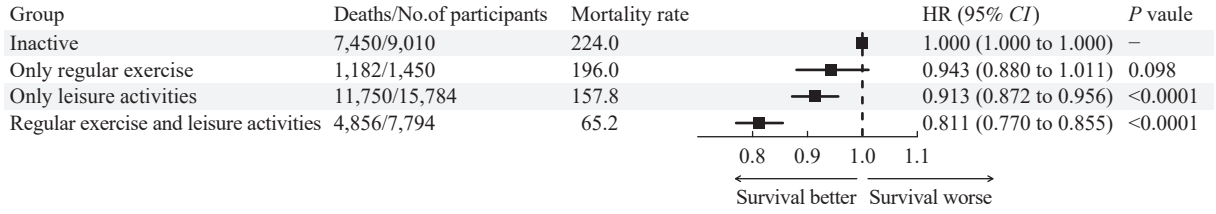

FIGURE 1. The joint associations between regular exercise and leisure activities and all-cause mortality among Chinese older adults, 1998–2018.
Note: Fully model adjusted sex, ethnicity, residence, marital status, occupation, income level, educational level, living arrangement, smoking status, drinking status, dietary diversity score type, body mass index, self-reported health status, hypertension, diabetes mellitus, respiratory diseases, CVD, ADL disability, Mini-Mental State Examination score, cancer, and mutually adjusted physical work. Mortality rates per 1,000 person-years.
Abbreviation: HR=hazard ratios; *CI*=confidence interval; CVD=cardiovascular diseases; ADL=activities of daily living.

capacity, muscular strength, endurance, balance, coordination, and flexibility) (*9*).

In contrast to some evidence (*2*,*10*), our study did not observe an association between occupational physical activity and all-cause mortality risk. This discrepancy in previous research can be attributed to the varying approaches in collecting data on intense physical activity. Consequently, continued research is warranted to explore the effect of objective measures of occupational physical activity on health outcomes.

For older adults, post-retirement leisure activities form a significant part of their daily routine. Considering their physical inability to partake in high-intensity workouts, a regimen combining leisure activities with regular, low-intensity exercises can be advantageous. Our results advocate improving health in older adults by prompting active physical pursuits amidst our rapidly aging society.

The interpretation of the results from this study should take into account several limitations. First, the physical activity data collected through face-to-face interviews is self-reported and potentially subject to biases and measurement errors. Second, physical activity was measured only at the baseline and did not consider possible fluctuations over time. Even though repeated measurements were available, this data was not exploited to account for temporal variations in behavior. Third, this study primarily included Chinese older adults, which could restrict the applicability of these findings to other racial demographics.

In conclusion, this study indicates that a combination of regular exercise and engagement in leisure activities is associated with a decreased risk of all-cause mortality among older adults in China. When pursued concurrently, these activities delivered more pronounced health benefits than when they were undertaken individually. Therefore, it is advisable to encourage older adults to partake in regular exercise and leisure activities simultaneously.

Conflicts of interest: No conflicts of interest.

Funding: Supported by the National Natural Science Foundation of China (grant number 82025030 for XMS and 82222063 for YBL).

doi: 10.46234/ccdcw2023.165

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Submitted: August 29, 2023; Accepted: September 19, 2023

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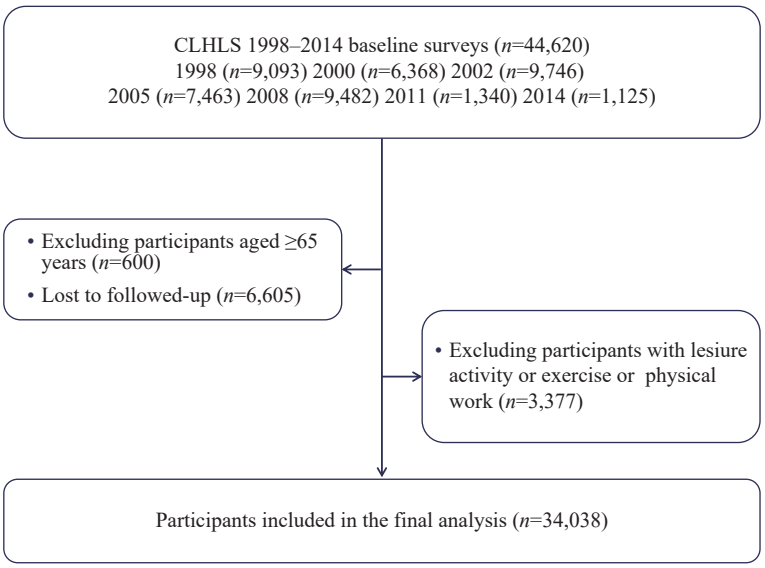
SUPPLEMENTARY MATERIAL



SUPPLEMENTARY FIGURE S1. Selection criteria for study participants, CLHLS 1998–2018.
Abbreviation: CLHLS=Chinese Longitudinal Healthy Longevity Survey.

SUPPLEMENTARY TABLE S1. Association between various types of physical activities and the risk of all-cause mortality, by age group and sex, among Chinese older adults from 1998 to 2018.

Physical activity	Hazard ratio (95% *CI*) for all-cause mortality	Hazard ratio (95% *CI*) for all-cause mortality	$P_{interaction}$
	<80 years old (*n*=6,814)	≥80 years old (*n*=27,224)	
Regular exercise			0.112
No	Reference	Reference	
Yes	1.049 (0.944–1.163)	0.885 (0.854–0.918)§	
Leisure activities			0.088
No	Reference	Reference	
Yes	0.817 (0.729–0.916)§	0.898 (0.856–0.943)§	
Physical work			0.046
No	Reference	Reference	
Yes	1.023 (0.884–1.183)	0.968 (0.928–1.009)	
	Male (*n*=14,152)	Female (*n*=19,886)	
Regular exercise			0.128
No	reference	reference	
Yes	0.882 (0.841–0.925)§	0.925 (0.882–0.970)§	
Leisure activities			0.023
No	Reference	Reference	
Yes	0.876 (0.821–0.934)*	0.930 (0.875–0.988)†	
Physical work			0.854
No	Reference	Reference	
Yes	0.963 (0.902–1.029)	0.981 (0.933–1.032)	

Note: The full model was adjusted for sex, ethnicity, residence, marital status, occupation, income level, educational level, living arrangement, smoking status, drinking status, dietary diversity score type, body mass index, self-reported health status, hypertension, diabetes mellitus, respiratory diseases, cardiovascular diseases, ADL disability, Mini-Mental State Examination score, and cancer, with mutual adjustments for regular exercise, leisure activities, or physical work as appropriate.
The age attained was utilized as the time scale.
Abbreviation: HR=hazard ratios; *CI*=confidence interval; ADL=activities of daily living.
* $P<0.05$.
† $P<0.01$.
§ $P<0.001$.