Physical Work and Exercise Reduce the Risk of Cognitive Impairment in Rural Older Adults: A Population-based Longitudinal Study

Fan He
School of public health, Fudan University; Zhejiang Provincial Center for Disease Control and Prevention
https://orcid.org/0000-0001-6027-7157
Junfen Lin
Zhejiang Provincial Center for Disease Control and Prevention
Fudong Li
Zhejiang Provincial Center for Disease Control and Prevention
Yujia Zhai
Zhejiang Provincial Center for Disease Control and Prevention
Tao Zhang
Zhejiang Provincial Center for Disease Control and Prevention
Xue Gu
Zhejiang Provincial Center for Disease Control and Prevention
Genming Zhao (gmzhao@shmu.edu.cn)
https://orcid.org/0000-0002-9625-478X

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Abstract

Background: The effect of physical work on the risk of cognitive impairment in Chinese older adults living in rural areas remains to be elucidated. We investigated whether physical work and exercise can reduce the risk of cognitive impairment. **Methods:** We collected data from 7,000 individuals without cognitive impairment (age ≥60 years) over a follow-up period of 2 years. The Chinese version of the Mini-Mental State Examination was used to assess cognitive function, and the multivariable Cox regression model was used to identify associations between physical work/exercise and cognitive impairment. **Results:** Over a median follow-up period of 1.93 years, 1,224 (17.5%) of 7,000 participants developed cognitive impairment, with a total incidence of 97.69 per 1,000 person-years. Participation in physical work (hazard ratio [HR]: 0.66; 95% confidence interval [CI], 0.55-0.78) or exercise (HR: 0.76; 95% CI, 0.62-0.93) was associated with a reduced risk of cognitive impairment. Agricultural work (HR: 0.60; 95% CI, 0.49-0.73) and walking/tai chi (HR: 0.75; 95% CI, 0.60-0.93) exerted significant protective effects against cognitive impairment. **Conclusions:** Physical work and exercise can reduce the risk of cognitive impairment in older adults. Reasonable types and appropriate intensities of physical activity are recommended to prevent or delay the progression of cognitive impairment.

1. Background

In 2017, there were 962 million individuals over the age of 60 worldwide, and this number is expected to more than double by 2050 and triple by 2100 [1]. Rapid growth in the population of older adults has presented severe challenges to the health care system, patients themselves, and their caregivers. In addition, the incidence of age-related diseases including neurodegenerative dementias such as Alzheimer’s disease (AD) is expected to increase dramatically in the coming years, exerting a substantial impact on individual patients and society [2–5].

Accumulating evidence from epidemiological studies has illustrated the protective effect of physical activity against cognitive impairment and dementia in older adults [6–10]. In addition to enhancing hippocampal neurogenesis, synaptic plasticity, neurotrophin levels, and cardiovascular fitness, physical activity has been associated with greater white matter integrity and increased functional connectivity in the brain [11,12]. However, the definitions of physical activity have been inconsistent across studies, some of which focused on physical exercise alone. According to the World Health Organization, physical activity refers to any bodily movement produced by skeletal muscles that requires energy expenditure. Thus, physical activity encompasses exercise, any other physical activity conducted during leisure time, and work-related physical activities [13].

Previous studies have projected that the number of people over the age of 60 in China will increase to approximately 255 million, accounting for 17.8% of the total population, by 2020 [14]. At present, nearly half of older adults live in rural areas. Thus, participating in physical work, especially agricultural work, represents the main form of physical activity in this population. However, few studies have investigated the independent and interactive effects of physical work and exercise on the risk of cognitive impairment in Chinese older adults living in rural areas.

Therefore, in the current large-scale, population-based study, we aimed to explore the relationships among physical work, physical exercise, and the risk of cognitive impairment in Chinese older adults over a 2-year follow-up period.

2. Methods

2.1. Participants

All participants were enrolled in the Zhejiang Major Public Health Surveillance (ZJMPHS) Program, a prospective study of health issues and related factors among older adults. The program was conducted in rural and suburban areas of

Zhejiang province, which is an economically developed province located in the Yangtze river delta on the southeastern coast of China. It has a humid monsoon climate with abundant light and rainfall and a resident population of 57.37 million (10.8 million people over the age of 60). Detailed information about the program has been described in previous reports [15]. At baseline (2014), six counties were randomly selected from the 90 counties in Zhejiang province. Then, one town in each county and several villages/communities in each town were randomly selected. All permanent residents aged ≥ 60 years in these selected communities were recruited. Finally, we interviewed a total of 9,353 of the 9,425 eligible residents. Data regarding questionnaires, scales, and physical examinations (including height, weight, waist circumference, hip circumference, blood pressure and heart rate) were obtained by trained community general practitioners in community hospitals or by visiting the participants at their homes. Because we were interested in whether physical work and exercise are associated with the prospective risk of developing cognitive impairment, we excluded participants with cognitive impairment at baseline. Among the 9,353 participants, 7,947 exhibited no cognitive impairment at baseline. During the 2-year follow-up period, 447 (5.6%) participants died, while 500 (6.3%) were unavailable for follow-up. The remaining 7,000 participants who completed cognitive function tests at baseline and follow-up constituted the analytic cohort of this study. For missing values, the practitioner was instructed to conduct a timely re-interview or supplement the data at the next follow-up. Participation was voluntary, and written informed consent was obtained from each person. The program was approved by the Ethics Committee of the Zhejiang Provincial Center for Disease Control and Prevention.

2.2. Assessment of Physical Work and Exercise

Physical activity in this study included two aspects: physical work and physical exercise. For investigation of physical work, participants first reported whether they had engaged in agricultural work (including farming, forestry, animal husbandry, and fishery) in recent years. Those who did not participate in agricultural work further reported whether they had participated in other forms of physical activity and the type of activity performed. We collected data regarding retirement status, housework, unemployment, physical disabilities, sedentary activities (e.g., knitting, sewing, etc.), work performed while standing (e.g., janitorial work, retail work, etc.), light physical work (e.g., carpentry, electrical work, etc.), and intense physical work (e.g., mining, loading/construction, etc.). Participants also reported the type of transportation taken to work (walking, bicycle, motorcycle, car, or bus).

Because physical exercise may exert a significant protective effect on cognitive function, we considered the interactions between agricultural work and physical exercise. Thus, we asked participants to report their physical exercise habits over the past year, including type (walking/tai chi, brisk walking/yangko, running/aerobics, public square dancing, etc.) and intensity (frequency and duration).

2.3. Assessment of Cognitive Function

We used the Chinese version of the Mini-Mental State Examination (MMSE) to assess cognitive function in each participant. The MMSE includes 30 items, and the maximum score is 30. Higher MMSE scores indicate better cognitive function. We used the following, widely accepted education-specific cut-off points to define cognitive impairment: 17/18 for those with no education, 20/21 for those with primary education only, and 24/25 for those with education beyond the primary level [16].

2.4. Other Variables

At baseline (2014), we collected demographic data regarding sex, ethnic group (Han, She, Miao, Hui, etc.), age, body mass index (BMI), education level (illiterate or semiliterate, primary school, junior high school, high school graduation or higher), marital status (married, unmarried, widowed, or divorced), job (never worked, farmer, housework, standard work, and others), and family income.

The study also collected information regarding the following: living alone, eating alone, participation in group activities (never, occasionally, frequently), sleep quality (always poor, frequently poor, occasionally poor, always good), napping (never or occasionally, sometimes, frequently), smoking status (non-smokers, current smokers, and ex-smokers), passive smoking in the family, passive smoking in public places, alcohol consumption (non-drinkers, current drinkers, and ex-drinkers), tea consumption (non-drinkers, current drinkers, ex-drinkers), and intake of drinking water per day. We used patient medical records to assess the presence of underlying diseases (stroke, high blood pressure, hyperlipidemia, diabetes, coronary heart disease, chronic bronchitis, gallstones, tumor, arthritis, cataracts, and others).

2.5. Statistical Analysis

We compared the distributions of demographic variables, physical work, exercise, and other covariates between participants with and without cognitive impairment using univariate Cox regression analysis. We used multivariable Cox regression analyses to calculate adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) as measures of the associations among physical work, exercise, and cognitive impairment after controlling for sex, ethnicity, age, BMI, education, marital status, job type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking and passive smoking, alcohol consumption, tea consumption, water consumption and disease history. We utilized stratified analyses and interaction terms to examine the modulatory effects of exercise on the interaction between physical work and cognitive impairment after considering the above variables as confounding factors [17]. All analyses were performed using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA), statistical significance was set as at $p < 0.05$, and the “enter” method was used when building multivariable models.

3. Results

The incidence of cognitive impairment was 97.69 per 1,000 person-years among older adults in Zhejiang, China. In this study, the incidence of cognitive impairment was higher among women (114.96 per 1,000 person-years) than men (79.73 per 1,000 person-years). The incidence of cognitive impairment in each age group (< 65, 65–69, 70–74, 75–79, 80–84, and 85+) was as follows: 63.20, 71.26, 94.06, 132.08, 186.12, and 213.90 per 1,000 person-years, respectively.

Among the 7,000 participants with normal cognitive function at baseline, 1,224 (17.5%) developed cognitive impairment. Table 1 shows the characteristics of participants with normal cognitive function and those with cognitive impairment. The proportion of participants with cognitive impairment was higher among women, widows, those who had never worked or performed housework only, and those considered elderly. Those with cognitive impairment were more likely to have lower BMI (< 18.50); education; or family income; and to live alone, eat alone, or never participate in group activities. Moreover, those with cognitive impairment appeared to exhibit poorer sleep quality, a lower frequency of napping, and tended to be non-smokers/non-drinkers of tea or alcohol. Our results also suggested that cognitive impairment was associated with certain underlying diseases, such as stroke and hyperlipidemia.

Table 1
Characteristics of participants with normal cognitive function and cognitive impairment based on selected covariates.

	Cognitive impairment		Normal cognitive function		HR	95% CI	P value
	No.	%	No.	%			
Gender							
Female	757	21.1	2834	78.9	1.00	Ref.	
Male	505	14.8	2904	85.2	0.67	0.60−0.75	< 0.001
Ethnicity							
She, Miao, Hui, etc.	38	15.1	213	84.9	1.00	Ref.	
Han	1224	18.1	5524	81.9	0.92	0.64−1.34	0.676
Age (years)							
< 65	194	10.9	1580	89.1	1.00	Ref.	
65−69	284	13.2	1860	86.8	1.03	0.86−1.24	0.757
70−74	231	17.9	1060	82.1	1.41	1.17−1.72	< 0.001
75−79	229	25.1	685	74.9	1.95	1.61−2.37	< 0.001
80−84	228	35.4	416	64.6	2.61	2.15−3.17	< 0.001
≥ 85	96	41.2	137	58.8	3.28	2.56−4.20	< 0.001
BMI (kg/m^2)							
18.5-24.99	765	17.6	3588	82.4	1.00	Ref.	
< 18.50	100	29.2	242	70.8	1.50	1.22−1.85	< 0.001
> 24.99	312	15.9	1649	84.1	0.99	0.87−1.13	0.873
Education							
Illiterate or semiliterate	738	21.7	2657	78.3	1.00	Ref.	
Primary school	454	14.7	2635	85.3	0.70	0.62−0.79	< 0.001
Junior high school	61	13.9	377	86.1	0.67	0.51−0.87	0.003
High school graduation or higher	9	11.5	69	88.5	0.58	0.30−1.12	0.105
Marital status							
Unmarried	13	13.5	83	86.5	1.00	Ref.	
Married	887	16.1	4628	83.9	1.55	0.90−2.70	0.116
Widowed	352	26.1	995	73.9	2.27	1.30−3.96	0.004
Divorced	6	20.7	23	79.3	1.71	0.65−4.52	0.278

HR: hazard ratio; CI: confidence interval; BMI: body mass index.

	Cognitive impairment		Normal cognitive function		HR	95% CI	P value
	No.	%	No.	%			
Job Type							
Never worked	425	25.2	1260	74.8	1.00	Ref.	
Farmers	514	16.7	2562	83.3	0.45	0.39–0.53	< 0.001
Housework	164	20.0	658	80.0	0.46	0.37–0.56	< 0.001
Workers	87	11.8	649	88.2	0.39	0.30–0.49	< 0.001
Others	69	10.6	584	89.4	0.32	0.24–0.41	< 0.001
Family income (1,000 ￥ per year)							
< 10	320	30.3	737	69.7	1.00	Ref.	
10–19	349	22.8	1185	77.2	0.73	0.62–0.85	< 0.001
20–49	239	12.4	1690	87.6	0.41	0.34–0.49	< 0.001
50–99	192	15.7	1031	84.3	0.45	0.37–0.55	< 0.001
≥ 100	160	12.8	1090	87.2	0.27	0.22–0.34	< 0.001
Living alone							
No	1023	17.1	4943	82.9	1.00	Ref.	
Yes	239	23.1	795	76.9	1.30	1.13–1.51	< 0.001
Eating alone							
No	1012	17.0	4927	83.0	1.00	Ref.	
Yes	250	23.6	811	76.4	1.38	1.20–1.58	< 0.001
Participating in group activities							
Never	911	21.3	3372	78.7	1.00	Ref.	
Occasionally	262	14.3	1568	85.7	0.74	0.64–0.86	< 0.001
Frequently	89	10.1	794	89.9	0.51	0.41–0.64	< 0.001
Sleep quality							
Always poor	64	19.3	267	80.7	1.00	Ref.	
Frequently poor	172	19.9	692	80.1	0.98	0.74–1.31	0.913
Occasionally poor	334	16.1	1746	83.9	0.64	0.49–0.85	0.002
Always good	692	18.6	3028	81.4	0.86	0.66–1.11	0.250
Napping							
Never or occasionally	726	18.8	3132	81.2	1.00	Ref.	

HR: hazard ratio; CI: confidence interval; BMI: body mass index.

	Cognitive impairment		Normal cognitive function		HR	95% CI	P value
	No.	%	No.	%			
Sometimes	233	18.4	1032	81.6	1.16	0.99–1.35	0.068
Frequently	303	16.2	1569	83.8	1.10	0.96–1.27	0.170
Smoking							
Non-smokers	979	19.7	3982	80.3	1.00	Ref.	
Current smokers	194	14.3	1166	85.7	0.67	0.58–0.79	< 0.001
Ex-smokers	89	13.1	589	86.9	0.68	0.54–0.84	0.001
Passive smoking in the family							
No	1111	18.1	5030	81.9	1.00	Ref.	
Yes	151	17.6	708	82.4	1.24	1.04–1.48	0.015
Passive smoking in public places							
No	1176	19.0	5025	81.0	1.00	Ref.	
Yes	86	10.8	713	89.2	0.67	0.54–0.85	0.001
Alcohol consumption							
Non-drinkers	918	19.5	3781	80.5	1.00	Ref.	
Current drinkers	269	14.7	1559	85.3	0.75	0.65–0.86	< 0.001
Ex-drinkers	71	15.3	392	84.7	0.83	0.65–1.06	0.139
Tea consumption							
Non-drinkers	1003	19.8	4059	80.2	1.00	Ref.	
Current drinkers	239	13.4	1544	86.6	0.66	0.57–0.77	< 0.001
Ex-drinkers	13	9.9	118	90.1	0.54	0.31–0.94	0.028
Water consumption (ml per day)							
≤ 500	818	18.7	3564	81.3	1.00	Ref.	
501–1000	337	17.5	1590	82.5	0.90	0.79–1.03	0.119
> 1000	103	15.8	547	84.2	0.98	0.80–1.22	0.879
Disease history							
Stroke							
No	1212	17.8	5606	82.2	1.00	Ref.	
Yes	50	27.8	130	72.2	1.46	1.10–1.94	0.009
High blood pressure							

HR: hazard ratio; CI: confidence interval; BMI: body mass index.

	Cognitive impairment		Normal cognitive function		HR	95% CI	P value
	No.	%	No.	%			
No	678	18.3	3033	81.7	1.00	Ref.	
Yes	583	17.7	2705	82.3	1.02	0.91–1.15	0.687
Hyperlipidemia							
No	1230	18.4	5463	81.6	1.00	Ref.	
Yes	32	10.7	268	89.3	0.86	0.60–1.23	0.404
Diabetes							
No	1155	18.3	5153	81.7	1.00	Ref.	
Yes	107	15.6	579	84.4	1.03	0.85–1.26	0.743
Coronary heart disease							
No	1205	17.9	5534	82.1	1.00	Ref.	
Yes	57	22.1	201	77.9	1.22	0.93–1.6	0.144
Chronic bronchitis							
No	1229	17.9	5619	82.1	1.00	Ref.	
Yes	33	22.4	114	77.6	1.50	1.06–2.13	0.021
Gallstones							
No	1229	18.2	5522	81.8	1.00	Ref.	
Yes	33	13.4	213	86.6	0.92	0.65–1.31	0.654
Tumor							
No	1241	18.2	5595	81.8	1.00	Ref.	
Yes	21	13.0	140	87.0	0.82	0.53–1.27	0.376
Arthritis							
No	1218	18.0	5532	82.0	1.00	Ref.	
Yes	44	18.5	194	81.5	1.29	0.95–1.75	0.097
Cataracts							
No	1206	18.1	5444	81.9	1.00	Ref.	
Yes	56	16.2	290	83.8	1.47	1.11–1.95	0.007
Others							
No	1209	18.1	5458	81.9	1.00	Ref.	
Yes	53	15.9	280	84.1	1.01	0.76–1.33	0.949

HR: hazard ratio; CI: confidence interval; BMI: body mass index.

When compared to those not engaged in physical work (retired, housework, unemployment, or physical disability), those engaged in physical work exhibited a decreased risk of cognitive impairment. In particular, participating in agricultural work exerted a significant protective effect against cognitive impairment (HR: 0.60; 95% CI, 0.49–0.73) after adjusting for sex, ethnicity, age, BMI, education, marital status, employment type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking/passive smoking, alcohol consumption, tea consumption, water consumption, disease history, and physical exercise (Table 2).

Table 2
HRs (95% CI) for associations between physical work and cognitive impairment (ZJMPHS Program, Zhejiang, China).

	Cognitive impairment		Normal cognitive function		Unadjusted			Multi-adjusted [a]		
	No.	%	No.	%	HR	95% CI	P value	HR	95% CI	P value
Physical work										
No	1007	21.8	3617	78.2	1.00	Ref.		1.00	Ref.	
Yes	250	10.6	2099	89.4	0.44	0.38–0.51	< 0.001	0.66	0.55–0.78	< 0.001
Type of physical work										
Retired, housework, unemployment or physical disability	1,007	21.8	3,617	78.2	1.00	Ref.		1.00	Ref.	
Mainly sedentary work	31	14.2	188	85.8	0.57	0.40–0.82	0.002	0.83	0.56–1.23	0.343
Mainly standing work	13	7.3	164	92.7	0.37	0.21–0.64	< 0.001	0.64	0.35–1.16	0.141
Light physical work	33	12	242	88	0.56	0.40–0.80	0.001	0.88	0.60–1.30	0.531
Intense physical work	4	6.2	61	93.8	0.34	0.13–0.90	0.030	0.64	0.24–1.75	0.389
Agricultural work	169	10.5	1,444	89.5	0.41	0.34–0.49	< 0.001	0.60	0.49–0.73	< 0.001
Mode of agricultural work						-				
Manual	165	10.6	1403	89.4	1.00	Ref.				
Semi-mechanized or mechanized	4	8.9	41	91.1	0.97	0.34–2.72	0.948	0.96	0.32–2.89	0.943
Type of transportation to work										
Never worked/work at home or nearby	1,122	19.8	4,544	80.2	1.00	Ref.		1.00	Ref.	

[a] Adjusted for sex, ethnicity, age, BMI, education, marital status, job type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking and passive smoking, alcohol consumption, tea consumption, water consumption, disease history, and physical exercise. ZJMPHS Program: Zhejiang Major Public Health Surveillance Program.

	Cognitive impairment		Normal cognitive function		Unadjusted			Multi-adjusted [a]		
	No.	%	No.	%	HR	95% CI	P value	HR	95% CI	P value
Walking	78	12.2	562	87.8	0.75	0.60–0.95	0.017	0.71	0.56–0.91	0.008
Bicycle	25	8.7	264	91.3	0.43	0.29–0.64	< 0.001	0.53	0.35–0.81	0.003
Motorcycle	28	11.2	222	88.8	0.59	0.40–0.87	0.007	0.98	0.64–1.48	0.910
Private/public transportation (car, subway, ferry)	8	5.3	144	94.7	0.33	0.17–0.67	0.002	0.46	0.22–0.98	0.045

[a] Adjusted for sex, ethnicity, age, BMI, education, marital status, job type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking and passive smoking, alcohol consumption, tea consumption, water consumption, disease history, and physical exercise. ZJMPHS Program: Zhejiang Major Public Health Surveillance Program.

Participants who traveled to work by walking (HR: 0.71; 95% CI, 0.56–0.91), bicycle (HR: 0.53; 95% CI, 0.35–0.81), or private/public transportation (HR: 0.46; 95% CI, 0.22–0.98) had a significantly lower risk of cognitive impairment than those who had never worked, those who worked from home, and those who worked near their homes. Approximately 12% of participants with cognitive impairment and 21% of those with normal cognitive function reported engaging in physical exercise, which exerted a significant protective effect on cognitive function (HR: 0.76; 95% CI, 0.62–0.93) after adjusting for related covariates. When compared to a lack of physical exercise, walking/tai chi (HR: 0.75; 95% CI, 0.60–0.93) exerted significant protective effects on cognitive function. In addition, exercise 1–4 days per week (HR: 0.52; 95% CI, 0.33–0.79) and 30–59 minutes per session (HR: 0.61; 95% CI, 0.46–0.79) reduced the risk of cognitive impairment, relative to that observed for a lack of exercise (Table 3).

Table 3

HRs (95% CI) for associations between physical exercise and cognitive impairment (ZJMPHS Program, Zhejiang, China).

	Cognitive impairment		Normal cognitive function		Unadjusted			Multi-adjusted[a]		
	No.	%	No.	%	HR	95% CI	P value	HR	95% CI	P value
Physical exercise										
No	1,104	19.6	4,516	80.4	1.00	Ref.		1.00	Ref.	
Yes	156	11.4	1,217	88.6	0.66	0.55–0.79	< 0.001	0.76	0.62–0.93	0.006
Type of physical exercise										
None	1104	19.6	4,520	80.4	1.00	Ref.		1.00	Ref.	
Walking/tai chi	127	11.5	977	88.5	0.66	0.54–0.80	< 0.001	0.75	0.60–0.93	0.008
Brisk walking/yangko	17	12.1	124	87.9	0.70	0.43–1.14	0.154	0.77	0.45–1.32	0.340
Running/aerobics	4	14.3	24	85.7	0.67	0.25–1.80	0.427	0.72	0.26–1.94	0.511
Public square dancing	6	7.4	75	92.6	0.69	0.31–1.56	0.377	0.92	0.41–2.08	0.840
Exercise (days per week)										
None	1104	19.6	4,521	80.4	1.00	Ref.		1.00	Ref.	
1–4 days	24	8	277	92	0.42	0.28–0.64	< 0.001	0.52	0.33–0.79	0.003
5–7 days	132	12.4	935	87.6	0.74	0.61–0.90	0.002	0.84	0.68–1.04	0.104
Exercise duration per session (min)										
None	1104	19.6	4,521	80.4	1.00	Ref.		1.00	Ref.	
< 30	38	18	173	82	0.93	0.67–1.29	0.653	1.14	0.81–1.62	0.456
30–59	73	10.4	628	89.6	0.56	0.44–0.72	< 0.001	0.61	0.46–0.79	< 0.001

[a] Adjusted for sex, ethnicity, age, BMI, education, marital status, job type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking and passive smoking, alcohol consumption, tea consumption, water consumption, disease history, and agricultural work.

	Cognitive impairment		Normal cognitive function		Unadjusted			Multi-adjusted[a]		
	No.	%	No.	%	HR	95% CI	P value	HR	95% CI	P value
≥ 60	43	9.6	407	90.4	0.69	0.51–0.95	0.021	0.86	0.61–1.20	0.367

[a] Adjusted for sex, ethnicity, age, BMI, education, marital status, job type, family income, living or eating alone, participating in group activities, sleep quality, napping, smoking and passive smoking, alcohol consumption, tea consumption, water consumption, disease history, and agricultural work.

Stratified analyses revealed that physical work and exercise exerted independent effects on cognitive impairment, with HRs of 0.73 (95% CI, 0.58–0.91) and 0.64 (95% CI, 0.53–0.77), respectively. The estimated HR for the combination of physical work and exercise was 0.58 (95% CI, 0.39–0.85), which was more than that expected from adding (0.37) and multiplying (0.47) their independent associations, suggesting an interaction between physical work and exercise under the additive and multiplicative models.

4. Discussion

In the present prospective study, we explored the relationship between physical activity (including physical work and exercise) and the incidence of cognitive impairment among older adults. Our results indicated that both physical work and exercise exerted significant protective effects against cognitive impairment. In particular, agricultural work and walking/tai chi were among the types of activity shown to protect against cognitive impairment.

At the end of the 2-year follow-up period, the incidence of cognitive impairment was 97.7 per 1,000 person-years, similar to that reported for the neighboring city of Shanghai (96.9/1,000 person-years) [18] yet significantly higher than the estimated incidence rates reported in other countries (from 13.2 to 76.8 per 1,000 person-years) [19–23]. This finding implies that cognitive impairment represents a much more serious problem among Chinese older adults.

In accordance with the findings of previous studies, our data provide strong evidence for the protective effect of physical activity against cognitive impairment. Physical work and exercise are the main subcategories of physical activity, and the latter is defined as “a subcategory of physical activity that is planned, structured, repetitive, and purposeful” [24]. Therefore, the effect of physical work on cognitive function was considered to differ from that of physical exercise. Notably, some studies have reported that physical work is a risk factor for cognitive impairment [25,26]. However, this conclusion may be inappropriate, as physical work was compared to mental labor in these previous studies. In contrast, our results verified the protective effect of physical work (especially agricultural work) against cognitive impairment. The mechanisms by which physical work reduces the risk of cognitive impairment may be analogous to those associated with physical exercise: maintenance of cerebral blood flow, improvements in aerobic capacity and cerebral nutrient supply, expansion of cognitive reserves, decreases in chronic stress, and promotion of a healthy lifestyle [27]. Moreover, our study demonstrated the additive and multiplicative effects of physical work and exercise, suggesting that those engaged in manual work should also perform regular exercise to more effectively reduce their risk of cognitive impairment and dementia.

Although the protective effect of walking on dementia remains controversial [10], several studies have noted its beneficial effects on cognitive impairment [28,29], including the present study. Although we observed protective effects of brisk walking, yangko, and running in the multivariable analyses, the HR suggested that they exerted no significant effects on cognitive impairment after accounting for confounding factors. As this may have been due to insufficient sample sizes in these groups, further epidemiological studies are required to determine the relationship between running/public square dancing and the risk of cognitive impairment.

Although different levels of physical exercise were shown to exert protective effects against cognitive impairment, a frequency of 1–4 days per week and a duration of 30–60 minutes were more strongly associated with a reduced risk of cognitive impairment than other levels. As reported in previous studies [30–32], we observed significant trends of increasing protection as the level of physical activity increased. Thus, based on this finding, we recommend that older adults regularly engage in moderate physical activity for > 30 minutes 1–4 days per week.

Our study is advantageous in that our findings are based on a rigorous prospective design, avoiding biases related to retrospective investigation of regular activities and other exposures. Of course, after onset of cognitive impairment, the normal physical work or exercise of older adults would also be restricted. In addition, physical activities were divided into physical work and exercise, helping us to quantitatively assess their independent and interactive effects on cognitive impairment. However, our study also possesses several limitations. First, some possible protective factors including several types of exercise (running and public square dancing) and types of physical work other than agricultural work exhibited no significant associations with the risk of cognitive impairment due to the limited population. Second, the study was conducted in the rural and suburban areas, and the results may not generalize to urban populations because of the different types and levels of physical work. Third, a longer follow-up period is required to avoid underestimation or overestimation of the protective effects of physical activity. Fourth, loss to follow-up and compliance are unavoidable in prospective studies, and these factors may have influenced the reliability and stability of our findings. To combat these issues, we adopted some effective measures (including mobilization, community education, etc.) to ensure that the rate of loss to follow-up remained under 10 percent. In addition, the Montreal cognitive assessment (MoCA) and other more specific scales may have been better suited for cognitive function assessment; however, scales such as MoCA are greatly influenced by the education level of participants [33]. We used the MMSE scale to measure cognitive function instead of MoCA since the education level of most participants in this study was below the primary school level.

5. Conclusions

Our findings demonstrated that both physical work and exercise were associated with a reduced risk of cognitive impairment among older adults. Based on our results, we recommend that older adults engage in reasonable types and appropriate intensities of physical activity [34], such as walking over 30–60 minutes per day or participating in agricultural work, in order to prevent or delay the progression of cognitive impairment. “Green” forms of transportation including walking, bicycling, or taking the bus should also be encouraged. Nonetheless, further studies are required to determine the mechanisms by which physical activity protects against cognitive impairment.

List Of Abbreviations

HR, hazard ratio

CI, confidence interval

AD, Alzheimer’s disease

ZJMPHS, Zhejiang Major Public Health Surveillance

MMSE, Mini-Mental State Examination

BMI, body mass index

MoCA, Montreal cognitive assessment
v>

Declarations

Ethics approval and consent to participate: All participants were enrolled in the Zhejiang Major Public Health Surveillance Program. Participation was voluntary, and written informed consent was obtained from each participant. The program was approved by the Ethics Committee of the Zhejiang Provincial Center for Disease Control and Prevention.

Consent for publication: Not applicable.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Competing interests: The authors declare that they have no competing interests.

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