Association between social activity frequency and overall survival in older people: results from the Chinese Longitudinal Healthy Longevity Survey (CLHLS)

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ABSTRACT

Background This study aimed to explore the impact of social activity frequency on mid- and long-term overall survival in older Chinese people.

Methods The association between social activity frequency and overall survival was analysed in 28 563 subjects from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) cohorts.

Results A total of 21 161 (74.1%) subjects died during the follow-up of 132 558.6 person-years. Overall, more frequent social activity was associated with longer overall survival. From baseline to 5 years of follow-up, adjusted time ratios (TRs) for overall survival were 1.42 (95% CI 1.21 to 1.66, p<0.001) in the not monthly but sometimes group, 1.48 (95% CI 1.18 to 1.84, p=0.001) in the not weekly but at least once/month group, 2.10 (95% CI 1.63 to 2.69, p<0.001) in the not daily but at least once/week group, and 1.87 (95% CI 1.44 to 2.42, p<0.001) in the almost everyday group versus never group. From 5 years to the end of follow-up, adjusted TRs for overall survival were 1.05 (95% CI 0.74 to 1.50, p=0.766) in the not monthly but sometimes group, 1.64 (95% CI 1.01 to 2.65, p=0.046) in the not weekly but at least once/month group, 1.23 (95% CI 0.73 to 2.07, p=0.434) in the not daily but at least once/week group, and 3.04 (95% CI 1.69 to 5.47, p<0.001) in the almost everyday group versus the never group. Stratified and sensitivity analysis revealed similar results.

Conclusion Frequent participation in social activity was significantly associated with prolonged overall survival in older people. However, only participating in social activity almost every day could significantly prolong long-term survival.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Population ageing is a global issue. The concept of active ageing has been given the priority for improving the long life and well-being for older individuals, and plenty of research has indicated that social activity can benefit their physical and mental health.

WHAT THIS STUDY ADDS

⇒ Few previous studies have investigated the dose–response relationship and determined the appropriate social activity frequency for better health outcomes in Asian older people. In addition, we do not know whether the impact of social activity frequency on health outcomes changes with time. In the present study, we found that social activity significantly prolonged the overall survival in older Chinese people—the greater the social activity frequency, the greater the likelihood of prolonged overall survival. However, we also observed a threshold effect and only participating in social activity almost every day could significantly prolong long-term overall survival.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Frequent participation in social activity was significantly associated with prolonged overall survival in older Chinese people. However, in order to achieve a long-term beneficial effect of social activity, policymakers should focus on the appropriate social interventions to enhance the daily social activity participation in older people, and thus contribute to successful ageing in the era of global ageing.

INTRODUCTION

Population ageing has become a major challenge facing most countries in the world. The global population aged 60 years or over was 962 million in 2017, and the number of older people is expected to double by 2050.[1] Similarly, the elderly population (aged ≥65 years) in China has also continued to increase and reached 158.31 million by the end of 2017.[2] Therefore, as the world's elderly population grows, the concept of 'active ageing' or 'successful ageing', which was defined as 'the process of optimising opportunities for health, participation, and security in order to enhance quality of life as people age' by the World Health Organization in 2013,[3] has become an important topic, focusing on their long life and well-being. Some common risk factors, such as salt and fat intake, physical inactivity, smoking and alcohol use, have been prioritised for modification to reduce the overall risk of morbidities and mortalities; participation in social activity is another critical factor, which should be advocated to promote an active ageing society.[4 5]

There is a well-established literature investigating the physical and mental health benefits of participation in social activity. It has been reported that maintaining an active social involvement reduces the risk of dementia,[4] coronary artery disease,[5] and mental health problems,[6] as well as reducing all-cause mortality risk.[7] On the other hand, social isolation has been associated with a higher risk of cardiovascular diseases and all-cause mortality.[8–10]

However, some studies have also indicated that there is no significant association between participation in social activity and health status, especially after consideration of other conventional risk factors.[11–13] The inconsistent results could be partially explained by different ethnicities, different genders, different types of social activities, various sociodemographic variables, and the lack of a universally accepted level of participation in social activity. However, the evidence about the health consequences of participation in social activity is largely derived from general populations of western countries; little is known about the association between participation in social activity and health outcomes in older people in non-western countries. Only a few studies have filled this gap. Chiao *et al* demonstrated that continuously participating or initiating participation in social activities reduced depressive symptoms among older Taiwanese adults.[6] In another study, Yu *et al* revealed that social isolation was associated with increased risk of mortality in older subjects with cardiovascular disease in Taiwan.[9] However, both studies had only a small sample size, and they focused on specific mental disease or sub-populations with confirmed disease. Few studies have investigated the dose–response relationship and determined the appropriate frequency of participation in social activity for better health outcomes; whether the impact of social activity frequency on health outcomes changes with time also needs further exploration.

Therefore, in this study, we aim to examine the association between social activity frequency and overall survival in a relatively large cohort of Chinese older people, and analyse the mid- and long-term impact of social activity frequency on overall survival.

METHODS

Study subjects

The Chinese Longitudinal Healthy Longevity Survey (CLHLS) is an ongoing, prospective cohort study of community-dwelling Chinese older people.[14] Details can be found elsewhere.[15] Briefly, the CLHLS is a nationwide survey. The population in the survey areas constitutes about 85% of the whole population in China, which provides representative data to investigate determinants of longevity. It began in 1998, and examinations are carried out every 2–3 years. To reduce the attrition due to death and loss to follow-up, new participants are enrolled during the follow-up. The surveys are administered in participants' homes by trained interviewers with a structured questionnaire. Proxy respondents, usually a spouse or other close family members, are interviewed when the participants are unable to answer questions, but questions regarding cognitive function and mood are answered by the participants themselves.

Because social activity frequency has been collected since wave 2002, the current study was based on five successive waves (2002, 2005, 2008, 2011, and 2014) within the CLHLS, with the final interview in 2018–2019. According to the inclusion and exclusion criteria, a total of 28 563 subjects were included as the study population (figure 1).

The CLHLS study was approved by the Research Ethics Committee of Peking University (IRB00001052-13074), and all participants or their proxy respondents provided written informed consent.

Assessment of social activity frequency and covariates

Social activity frequency was assessed by the question 'Do you take part in some social activities?' in the questionnaire, and the options for this question include: 1, almost everyday; 2, not daily, but at least once/week; 3, not weekly, but at least once/month; 4, not monthly, but sometimes; 5, never.

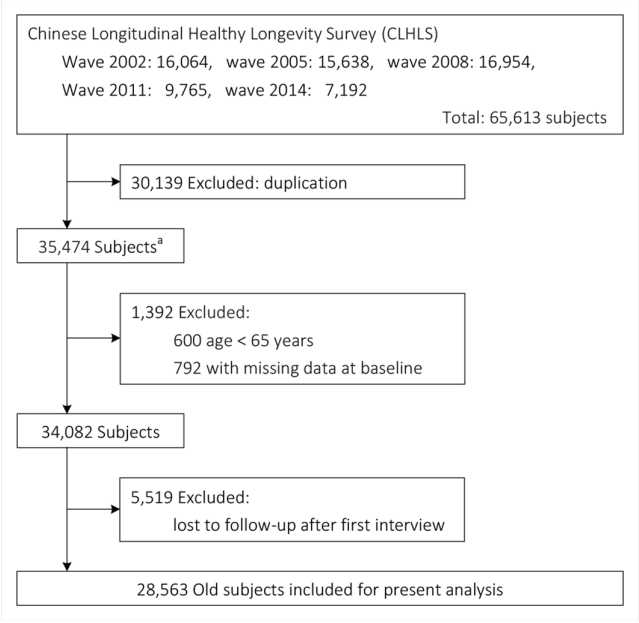

Figure 1 Flow chart. [a]Among these subjects, 174 subjects who were all-cause mortality in the original data were redefined as lost to follow-up for lacking the years and months of deaths. Five hundred subjects lacked the days of deaths, and we reassigned the middle day, namely 15th, of a month to the date of a death. Seventy-six subjects were defined as lost to follow-up for the negative length of follow-up.

In the present study, we also adjusted some potential confounding variables associated with social activity frequency and mortality, including sex, age, education, marital status, residence, co-residence, household income, eating fresh fruit, eating fresh vegetables, current smoking, current drinking, current regular exercise, hypertension, diabetes, heart disease, cerebrovascular disease, respiratory disease, cancer, and self-rated health. For these variables, online supplemental table S1 shows the detailed information about the reclassifications used in the present study.

Study outcome

The study outcome was overall survival, defined as the time from baseline to any cause of death. Survival status and date of death were collected through interviews with close family members during each survey. All subjects were followed from the first interview up to the outcome or the most recent interview. A 'lost to follow-up' status was assigned to those who could not be contacted after baseline interview.

Statistical analysis

The missing values of baseline variables were mostly less than 0.70%. Due to such low missing rates, we deleted the cases with missing values in the statistical analyses, without imputing the missing values; online supplemental table S2 shows the distributions of baseline variables with missing data.

Baseline characteristics of the study population were described as median with interquartile range (IQR) for continuous variables or percentages for categorical variables according to the social activity frequency. Survival proportions were estimated using the Kaplan-Meier method, and

Table 1 Baseline characteristics

Variable	All	Social activity frequency					P for trend*
		Never	Not monthly, but sometimes	Not weekly, but at least once/month	Not daily, but at least once/week	Almost everyday	
Number of subjects	28 563	25 406	1379	693	553	532	
Sex: male	11 855 (41.50%)	9921 (39.05%)	803 (58.23%)	448 (64.65%)	332 (60.04%)	351 (65.98%)	<0.001
Age (years)	89.00 (80.00– 98.00)	90.00 (81.00– 100.00)	80.00 (70.00– 89.00)	80.00 (70.00– 88.00)	81.00 (70.00– 88.00)	79.00 (69.00– 89.00)	<0.001
Hypertension							
Yes	4655 (16.30%)	4018 (15.82%)	266 (19.29%)	152 (21.93%)	111 (20.07%)	108 (20.30%)	<0.001
No	22 853 (80.01%)	20 431 (80.42%)	1060 (76.87%)	530 (76.48%)	420 (75.95%)	412 (77.44%)	
Unknown	1055 (3.69%)	957 (3.77%)	53 (3.84%)	11 (1.59%)	22 (3.98%)	12 (2.26%)	
Diabetes							
Yes	578 (2.02%)	466 (1.83%)	48 (3.48%)	30 (4.33%)	15 (2.71%)	19 (3.57%)	<0.001
No	26 844 (93.98%)	23 908 (94.10%)	1275 (92.46%)	646 (93.22%)	515 (93.13%)	500 (93.98%)	
Unknown	1141 (3.99%)	1032 (4.06%)	56 (4.06%)	17 (2.45%)	23 (4.16%)	13 (2.44%)	
Heart disease							
Yes	2245 (7.86%)	1908 (7.51%)	149 (10.80%)	83 (11.98%)	50 (9.04%)	55 (10.34%)	<0.001
No	25 251 (88.40%)	22 514 (88.62%)	1189 (86.22%)	596 (86.00%)	486 (87.88%)	466 (87.59%)	
Unknown	1067 (3.74%)	984 (3.87%)	41 (2.97%)	14 (2.02%)	17 (3.07%)	11 (2.07%)	
Cerebrovascular disease							
Yes	1442 (5.05%)	1293 (5.09%)	57 (4.13%)	39 (5.63%)	21 (3.80%)	32 (6.02%)	0.389
No	26 106 (91.40%)	23 197 (91.31%)	1274 (92.39%)	637 (91.92%)	510 (92.22%)	488 (91.73%)	
Unknown	1015 (3.55%)	916 (3.61%)	48 (3.48%)	17 (2.45%)	22 (3.98%)	12 (2.26%)	
Respiratory disease							
Yes	3303 (11.56%)	2921 (11.50%)	174 (12.62%)	83 (11.98%)	64 (11.57%)	61 (11.47%)	0.362
No	24 335 (85.20%)	21 651 (85.22%)	1162 (84.26%)	598 (86.29%)	465 (84.09%)	459 (86.28%)	
Unknown	925 (3.24%)	834 (3.28%)	43 (3.12%)	12 (1.73%)	24 (4.34%)	12 (2.26%)	
Cancer							.
Yes	100 (0.35%)	86 (0.34%)	6 (0.44%)	5 (0.72%)	2 (0.36%)	1 (0.19%)	0.001
No	27 221 (95.30%)	24 188 (95.21%)	1313 (95.21%)	668 (96.39%)	532 (96.20%)	520 (97.74%)	
Unknown	1242 (4.35%)	1132 (4.46%)	60 (4.35%)	20 (2.89%)	19 (3.44%)	11 (2.07%)	
Self-rated health							
Good	12 860 (45.02%)	10 985 (43.24%)	778 (56.42%)	398 (57.43%)	355 (64.20%)	344 (64.66%)	<0.001
Fair	8734 (30.58%)	7756 (30.53%)	458 (33.21%)	238 (34.34%)	145 (26.22%)	137 (25.75%)	
Poor	3986 (13.96%)	3733 (14.69%)	119 (8.63%)	52 (7.50%)	41 (7.41%)	41 (7.71%)	
Not able to answer	2983 (10.44%)	2932 (11.54%)	24 (1.74%)	5 (0.72%)	12 (2.17%)	10 (1.88%)	

Values are median (IQR) or n (%). Because the table is large, some baseline information is shown in online supplemental table S3.
*Across the groups of social activity frequency. For continuous variables, p value for trend was computed from the Pearson test when row-variable was normal distribution and from the Spearman test when it was non-normal distribution. When the row-variable was categorical, p value for trend was computed from Mantel-Haenszel test of trend.

Table 2 Unadjusted associations of social activity frequency with all-cause mortality, and adjusted sensitivity analyses

	Social activity frequency				
	Never	Not monthly, but sometimes	Not weekly, but at least once/month	Not daily, but at least once/week	Almost everyday
0–end					
Number of subjects	25 406	1379	693	553	532
Number of deaths	19 417	781	392	320	251
Number of person-years	112 862.5	8394.3	4330.6	3572.2	3399.0
Mortality rate (95% CI)*	17.2 (17 to 17.4)	9.3 (8.7 to 9.9)	9.1 (8.2 to 9.9)	9.0 (8.0 to 9.9)	7.4 (6.5 to 8.3)
Unadjusted TR (95% CI), p	1.00 (ref)	18.10 (13.53 to 24.22), <0.001	22.04 (14.65 to 33.17), <0.001	28.60 (18.24 to 44.87), <0.001	54.84 (33.41 to 90.04), <0.001
Sensitivity analysis					
Considering the losses censored at the end of the study†	1.00 (ref)	2.58 (1.92 to 3.47), <0.001	2.63 (1.73 to 3.99), <0.001	2.97 (1.87 to 4.71), <0.001	7.68 (4.72 to 12.50), <0.001
Excluding deaths within the first year†	1.00 (ref)	1.57 (1.23 to 2.01), <0.001	1.63 (1.15 to 2.30), 0.006	2.00 (1.37 to 2.90), <0.001	3.15 (2.11 to 4.71), <0.001
0–5 years					
Number of subjects	25 406	1379	693	553	532
Number of deaths	14 726	461	222	165	154
Number of person-years	79 832.6	5231.1	2676.8	2201.8	2096.6
Mortality rate (95% CI)*	18.4 (18.2 to 18.7)	8.8 (8.0 to 9.6)	8.3 (7.2 to 9.3)	7.5 (6.4 to 8.6)	7.3 (6.2 to 8.5)
Unadjusted TR (95% CI), p	1.00 (ref)	5.64 (4.70 to 6.78), <0.001	6.54 (5.05 to 8.47), <0.001	8.28 (6.17 to 11.12), <0.001	8.40 (6.21 to 11.38), <0.001
Sensitivity analysis					
Considering the losses censored at the end of the study†	1.00 (ref)	1.71 (1.44 to 2.03), <0.001	1.70 (1.34 to 2.17), <0.001	2.16 (1.64 to 2.85), <0.001	2.30 (1.74 to 3.05), <0.001
Excluding deaths within the first year†	1.00 (ref)	1.33 (1.14 to 1.56), <0.001	1.31 (1.05 to 1.62), 0.015	1.66 (1.31 to 2.11), <0.001	1.64 (1.28 to 2.12), <0.001
≥5 years–end					
Number of subjects	8420	688	350	295	272
Number of deaths	4691	320	170	155	97
Number of person-years	75 129.9	6603.3	3403.8	2845.4	2662.4
Mortality rate (95% CI)*	6.2 (6.1 to 6.4)	4.8 (4.3 to 5.4)	5.0 (4.3 to 5.7)	5.4 (4.6 to 6.3)	3.6 (2.9 to 4.4)
Unadjusted TR (95% CI), p	1.00 (ref)	4.29 (2.79 to 6.61), <0.001	4.29 (2.36 to 7.78), <0.001	2.91 (1.57 to 5.42), 0.001	14.70 (7.13 to 30.31), <0.001
Sensitivity analysis					
Considering the losses censored at the end of the study†	1.00 (ref)	1.40 (0.87 to 2.24), 0.163	1.20 (0.63 to 2.29), 0.572	0.80 (0.40 to 1.60), 0.530	5.49 (2.51 to 12.00), <0.001

*Per 100 person-years.
†Adjusted for sex, age, education, marital status, residence, co-residence, household income, fresh fruit, fresh vegetables, current smoking, current drinking, current regular exercise, hypertension, diabetes, heart disease, cerebrovascular disease, respiratory disease, cancer, and self-rated health.
CI, confidence interval; TR, time ratio.

the log-rank test was used for comparison. Multivariable parametric accelerated failure time (AFT) models were used to evaluate the association of social activity frequency with survival, because Schoenfeld Residuals indicated a violation of proportional hazards assumption in the Cox proportional hazards models. The logistic distribution was selected for AFT models based on the minimum Akaike Information Criterion among different survival distributions (ie, Weibull, exponential, loglogistic, and gaussian). The AFT model estimates the time ratio (TR), which is interpreted as the expected time to events in one category relative to the reference group. Unlike the interpretation of proportional hazard model results where hazard ratios larger than 1 are equal to higher risk, a TR of greater than 1 is considered to have a longer time to events compared with the reference group. Additionally, we did landmark analyses to assess outcomes at 5 years and between 5 years and the end of follow-up. The hypothesised causal diagram is shown in online supplemental figure S1.

Furthermore, stratified analysis assessed the consistency of association between social activity frequency and outcome in various subgroups, and interactions were examined by likelihood ratio testing. To assess robustness of the results, we performed two sensitivity analyses: (1) to address the issue of loss to follow-up, we conducted a sensitivity analysis by considering the losses censored at the end of the study; and (2) to exclude the deaths that occurred within the first year of follow-up, we also conducted a sensitivity analysis to reduce potential reverse causation.

The statistical analyses were performed with the use of R software, version 4.1.0 (R Project for Statistical Computing). For all statistical analyses, a two-sided p value of 0.050 was considered statistically significant.

RESULTS

Baseline characteristics

Baseline characteristics of the 28 563 study subjects (median age 89.00 years, IQR 80.00 to 98.00 years, 11 855 males) by social activity frequency are shown in table 1 and online supplemental table S3). Among them, 25 406, 1379, 693, 553, and 532 subjects were, respectively, in the never group, the not monthly but sometimes group, the not weekly but at least once/month group, the not daily but at least once/week group, and the almost everyday group. Results revealed statistically significant differences in age, sex, education, marital status, residence, co-residence, household income, fresh fruit and fresh vegetables intake, lifestyle factors, and self-rated health, as well as several morbidities, including hypertension, diabetes, heart disease, and cancer across the five groups. Generally speaking, male subjects were more likely to attend social activity than female subjects. Subjects who were younger and received a longer period of education were more likely to engage in social activity as well. Subjects who stayed in marriage and subjects who lived in an urban community or co-residence with family members were more socially active than their counterparts. In addition, subjects with no morbidities or with good self-rated health were more likely to be involved in social activity.

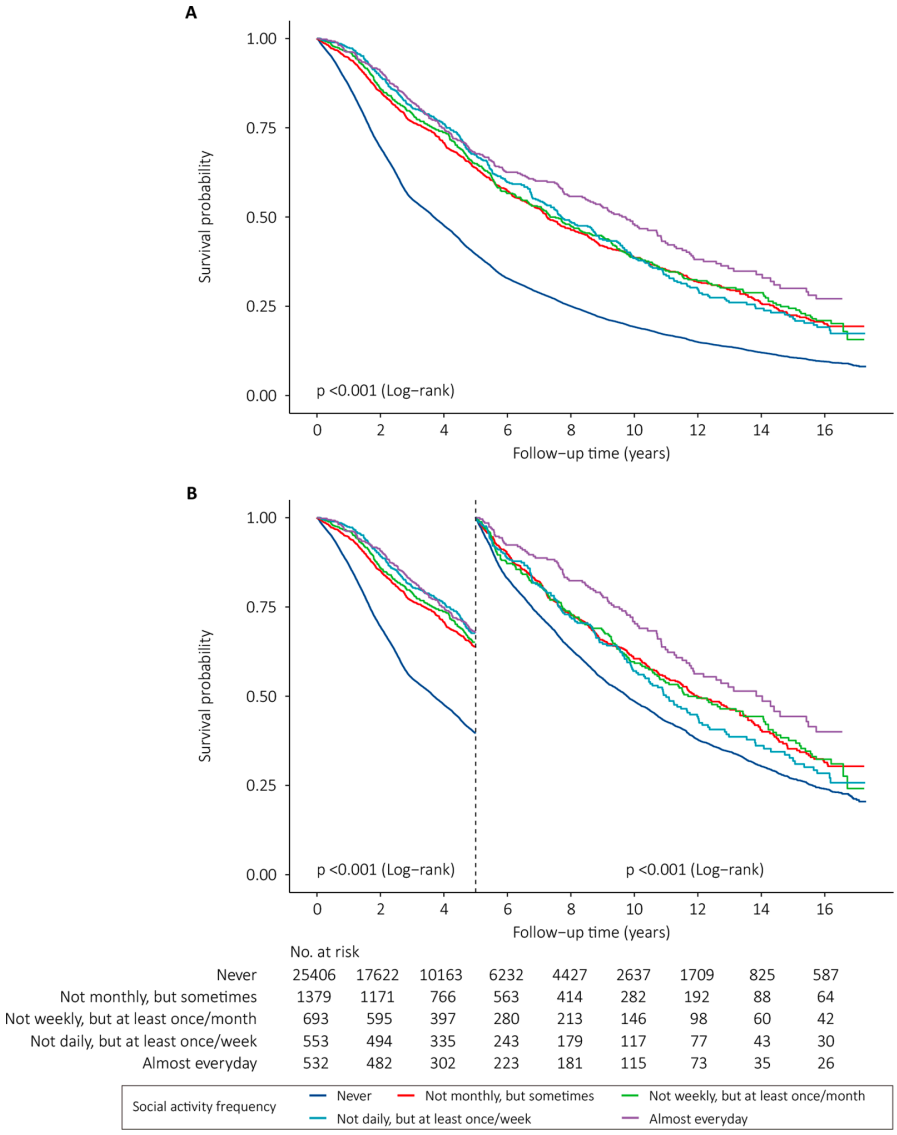

Figure 2 Kaplan-Meier survival curves of baseline social activity frequency for overall survival. (A) Survival probability in different groups. (B) Landmark analysis discriminating between survival probability before and after 5 years of follow-up.

Association between social activity frequency and overall survival from baseline to the end of follow-up

Overall, 21 161 (74.1%) deaths occurred during the follow-up of 132 558.6 person-years. The all-cause mortality rate gradually decreased from never to almost everyday groups, and the rates in each group were 17.2 (95% CI 17 to 17.4), 9.3 (95% CI 8.7 to 9.9), 9.1 (95% CI 8.2 to 9.9), 9.0 (95% CI 8 to 9.9), and 7.4 (95% CI 6.5 to 8.3) per 100 person-years, respectively (table 2). Kaplan-Meier analysis also demonstrated that the survival probability was significantly higher in the groups with more frequent social activity (log-rank p<0.001) (figure 2A). In the AFT analysis, when comparing to the never group, the unadjusted TRs were 18.10 (95% CI 13.53 to 24.22, p<0.001) in the not monthly but sometimes group, 22.04 (95% CI 14.65 to 33.17, p<0.001) in the not weekly but at least once/month group, 28.60 (95% CI 18.24 to 44.87, p<0.001) in the not daily but at least once/week group, and 54.84 (95% CI 33.41 to 90.04, p<0.001) in the almost everyday group (table 2). After adjusting for potential confounding factors, results showed that the overall survival time of subjects with more frequent social activity was longer compared to subjects who never participated in social activity. Adjusted TRs were 1.71 (95% CI 1.35 to 2.15, p<0.001) in the not monthly but sometimes group, 1.85 (95% CI 1.32 to 2.59, p<0.001) in the not weekly but at least once/month group, 2.58 (95% CI 1.79 to 3.71, p<0.001) in the not daily but at least once/week group, and 3.48 (95% CI 2.36 to 5.12, p<0.001) in the almost everyday group (figure 3). The associations between other variables and survival are shown in online supplemental table S4. Stratified analyses indicated that the survival benefit of social activity was more prominent in female subjects (p for interaction=0.022), in the oldest-old subjects over 80 (p for interaction=0.041), and in subjects who lived with family members (p for interaction=0.003); no significant interaction was detected in other subgroups (online supplemental figure S2).

Association between social activity frequency and overall survival from baseline to 5 years of follow-up

From baseline to 5 years of follow-up, the results remained similar with the above findings. The all-cause mortality rate gradually decreased from 18.4 (95% CI 18.2 to 18.7) per 100

Social activity frequency	No. of subjects	No. of deaths	No. of person–years	Mortality rate[a] (95% CI)	Adjusted TR[b] (95% CI)	p
0–end						
Never	25406	19417	112862.5	17.2 (17.0–17.4)	1.00 (ref)	
Not monthly, but sometimes	1379	781	8394.3	9.3 (8.7–9.9)	1.71 (1.35–2.15)	<0.001
Not weekly, but at least once/month	693	392	4330.6	9.1 (8.2–9.9)	1.85 (1.32–2.59)	<0.001
Not daily, but at least once/week	553	320	3572.2	9.0 (8.0–9.9)	2.58 (1.79–3.71)	<0.001
Almost everyday	532	251	3399.0	7.4 (6.5–8.3)	3.48 (2.36–5.12)	<0.001
0–5 years						
Never	25406	14726	79832.6	18.4 (18.2–18.7)	1.00 (ref)	
Not monthly, but sometimes	1379	461	5231.0	8.8 (8.0–9.6)	1.42 (1.21–1.66)	<0.001
Not weekly, but at least once/month	693	222	2676.8	8.3 (7.2–9.3)	1.48 (1.18–1.84)	0.001
Not daily, but at least once/week	553	165	2201.8	7.5 (6.4–8.6)	2.10 (1.63–2.69)	<0.001
Almost everyday	532	154	2096.6	7.3 (6.2–8.5)	1.87 (1.44–2.42)	<0.001
≥5years–end						
Never	8420	4691	75129.9	6.2 (6.1–6.4)	1.00 (ref)	
Not monthly, but sometimes	688	320	6603.2	4.8 (4.3–5.4)	1.05 (0.74–1.50)	0.766
Not weekly, but at least once/month	350	170	3403.8	5.0 (4.3–5.7)	1.64 (1.01–2.65)	0.046
Not daily, but at least once/week	295	155	2845.4	5.4 (4.6–6.3)	1.23 (0.73–2.07)	0.434
Almost everyday	272	97	2662.4	3.6 (2.9–4.4)	3.04 (1.69–5.47)	<0.001

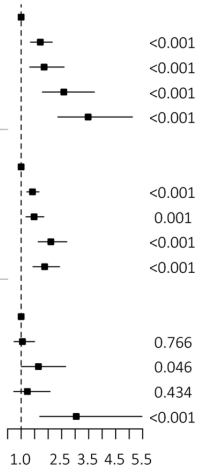

Figure 3 Adjusted associations of social activity frequency with overall survival.[a]Per 100 person-years. [b]Adjusted for sex, age, education, marital status, residence, co-residence, household income, fresh fruit, fresh vegetables, current smoking, current drinking, current regular exercise, hypertension, diabetes, heart disease, cerebrovascular disease, respiratory disease, cancer, and self-rated health. TR, time ratio.

person-years in the never group to 7.3 (95% CI 6.2 to 8.5) per 100 person-years in the almost everyday group (table 2). Landmark analysis also showed that subjects with more frequent social activity tended to have significantly higher survival probability (log-rank p<0.001) (figure 2B). Comparing to the never group, the overall survival time was significantly longer in the not monthly but sometimes group (TR 1.42, 95% CI 1.21 to 1.66, p<0.001), in the not weekly but at least once/month group (TR 1.48, 95% CI 1.18 to 1.84, p=0.001), in the not daily but at least once/week group (TR 2.10, 95% CI 1.63 to 2.69, p<0.001), and in the almost everyday group (TR 1.87, 95% CI 1.44 to 2.42, p<0.001) (figure 3). The associations between other variables and survival are shown in online supplemental table S4. Stratified analyses also revealed that sex (p for interaction=0.005), age (p for interaction <0.001), marital status (p for interaction=0.046), co-residence (p for interaction=0.047), and self-rated health (p for interaction=0.032) had interactive effects, and there was no significant interaction between other variables and social activity for survival (online supplemental figure S3).

Association between social activity frequency and overall survival from 5 years to the end of follow-up

From 5 years to the end of follow-up, although landmark and unadjusted AFT analyses indicated similar results to the previous findings (table 2 and figure 2B), the results of adjusted AFT analysis changed materially. Adjusted TRs were 1.05 (95% CI 0.74 to 1.50, p=0.766) in the not monthly but sometimes group, 1.64 (95% CI 1.01 to 2.65, p=0.046) in the not weekly but at least once/month group, 1.23 (95% CI 0.73 to 2.07, p=0.434) in the not daily but at least once/week group, and 3.04 (95% CI 1.69 to 5.47, p<0.001) in the almost everyday group versus never group (figure 3). That is to say, a threshold effect was observed, and only subjects participating in social activity almost everyday could have significantly longer overall survival time after 5 years of follow-up. The association between other variables and survival are shown in online supplemental table S4). No significant interaction was found in all subgroups (online supplemental figure S4).

Sensitivity analysis

After considering the losses censored at the end of the study or excluding deaths within the first year, the results remained unchanged (table 2). From baseline to 5 years of follow-up, more frequent social activity could exert more survival benefits. After 5 years of follow-up, there was a threshold effect regarding the survival benefits of social activity, and only those who participated in social activity almost every day could have significantly longer overall survival time.

DISCUSSION

This study found that frequent participation in social activity was associated with prolonged overall survival time. From baseline to 5 years of follow-up, the more frequent the social activity, the more prolonged the survival time. However, after 5 years of follow-up, there was a threshold effect regarding the association between social activity frequency and overall survival time, and only participating in social activity almost every day could significantly extend the overall survival time.

Previous studies have investigated the frequency of social participation in health maintenance. A population-based study in Chile, involving individuals aged >60 years, observed that subjects' participation in social activities had a 22% lower risk of death than those who did not participate during the 5-year study period.[16] The Nord-Trøndelag Health Study (HUNT), a longitudinal study with a mean follow-up of 8.15 years in Norway, demonstrated that the frequency of social participation of 0.5 to less than 1, 1 to less than 2, and 2 or more times per week significantly reduced the mortality risk by 18%, 31%, and 39%, respectively.[17] Shimatani *et al* also explored the association between the change of the frequency in social participation and all-cause mortality for individuals aged ≥60 years in Japan; they found that continued or decreased frequency of social participation was associated with a decreased risk of all-cause mortality. Initiation of social participation after the age of 60 years failed to reduce the mortality risk.[18] In the present study, we mainly focused on the impact of the social activity frequency on mid- and long-term overall survival, and confirmed that social participation was a strong protective factor of health and longevity

for older people. In the stratified analysis, for the oldest-old subjects, social activity showed an even more profoundly protective effect on extending overall survival time within the first 5 years. However, a previous study reported that the social participation rate decreases significantly over time in subjects aged over 85. Thus, interventions that contribute to the maintenance of participation in social activity in very old subjects should be encouraged.

Mechanisms behind the association between social participation and health outcomes are not completely understood, but there are some possible explanations. In one aspect, social participation could affect individuals' health behaviour. Previous studies have indicated that baseline daily smokers who had remained as daily smokers had higher rates of non-participation,[19] while high social participation contributed to the maintenance of smoking cessation.[20] Additionally, it has been reported that social participation among Japanese older people was associated with more physical activity and less sedentary time,[21] which had potential benefits for some types of chronic diseases. Social participation may also encourage healthier dietary behaviours, such as increased intake of fresh fruit and vegetables,[22] and sufficient fruit and vegetable consumption was significantly correlated with better quality of life in older people.[23] Therefore, subjects involved in social participation are exposed to peer and social influences, which may ultimately have an impact on their normative views and subsequent behaviours, such as dropping risky health behaviours (eg, smoking) and engaging in beneficial health behaviours (eg, physical activity, healthy dietary habitats), and these healthy behaviours may partially mediate the association between social participation and health outcomes. In another aspect, social participation may also buffer the deleterious influence of acute or chronic stressors on health, contributing to the subjects' psychological well-being.[24] In our study, although the association between social activity frequency and overall survival attenuated after adjusting for sociodemographic factors, socioeconomic status, healthy behaviours and several morbidities, it still remained statistically significant, which indicated that social activity participation per se was an independent predictor for overall survival in older people.

One of the interesting findings is that we observed a threshold effect regarding the association between social activity frequency and long-term overall survival. In order to prolong long-term overall survival, daily social activity participation is suggested for older people. Whereas we cannot confirm the causality, a word of caution is that we only considered the baseline social activity frequency. The long-term association could be much more complicated due to the possible change of social activity frequency, as well as other health-related variables such as socioeconomic status, lifestyle behaviour, comorbidities, psychological distress and so on during the follow-up time. Since no other historical studies reported similar results, whether this is a chance finding or not needs further exploration.

Some limitations need to be acknowledged. First, the present study used information from the baseline survey; we did not account for the changes in social participation over the follow-up period. Other health related variables could also change over time, which can bias our estimates. Second, although we have included a wide range of control variables for adjustment, there might be other factors linking social participation to mortality risk. Third, we only focused on the objective social activity frequency. The association between different types of social participation which the respondents participated in and the likelihood of survival were not analysed. However, a previous study based on the five waves of CLHLS have reported that both secular social participation and religious participation contributed to deceased mortality risk.[25] Fourth, the present study only included Chinese people, and over 90% of them were Han Chinese. We did not differentiate between Han Chinese and minorities in our study. Extending the present findings to other ethnicities should be approached with caution. Fifth, several variables were collected by questionnaire and based on subjects' self-report. Thus, recall bias may exist. However, it would be hard to address this issue considering the nature of the epidemiological study. These limitations suggest the need for more in-depth analysis regarding the impact of social activity frequency on mid- and long-term mortality risk for older people.

CONCLUSION

Frequent participation in social activity was significantly associated with prolonged overall survival in older Chinese people. However, in order to achieve long-term survival benefits of social activity, daily participation in social activity should be urged.

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