Loneliness as a risk factor for frailty transition among Chinese old people

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Research article

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Abstract

Background: loneliness has been observed to be associated with subsequent adverse outcomes. Our study aims to investigate whether and how loneliness is related to frailty transition.

Methods: our study used 8425 participants (aged>=60) from 2008 and 2011 waves of Chinese Longitudinal Healthy Longevity Survey (CLHLS). Loneliness was assessed by a single question asking how often the respondent feels lonely and isolated and grouped into three levels of loneliness: never, seldom and often. Frailty was contrasted in physical frailty and frailty index. Frailty transition as outcome variable has been designed as two types according the measurement of frailty: remaining robust or prefrail, improvement, worsening and remaining frail was used to describe the transition of physical frailty, and we created three categories of frailty index change to investigate the association between loneliness and frailty transition.

Results: greater loneliness reduced the possibility of remaining robust or prefrail physical frailty state after adjusting: odds ratios (95% CI) was 0.78(0.67-0.90), adjusted for age, gender, components number of frail scale at baseline and all other confounding variables. Greater loneliness was associated with an increased risk of worsening physical frailty after 3 years: compared with those never loneliness, the odds ratios (95% CI) for people who often loneliness were 1.19(1.01-1.40), adjusted for age, gender and components number of frail scale at baseline and all other confounding variables. The association between loneliness and the possibility of remaining robust or prefrail physical frailty states had no gender difference, adjusted for age and components number of frail scale at baseline, whereas loneliness was no longer significant in female participants after adjusting for all covariates. Male participants with often loneliness had an increased risk of worsening physical frailty state even with all covariates. By contrast, loneliness showed no significant relationship with physical frailty improvement and remaining frail. We found no significant relationship with loneliness under the model of the frailty index.

Conclusion: old adults with a high level of loneliness tend to be physical frailty state in the future, and male older with a high level of loneliness had an increased risk of worsening physical frailty state.

Introduction

Loneliness is a common and dissatisfaction feeling of one’s social relationship [1, 2]. Loneliness has been observed to be associated with subsequent adverse outcomes, such as mortality [3, 4], comorbidity [5, 6], poor functional ability [7, 8], depression [9], cognitive decline [10], frailty [11-14].

Frailty is a syndrome that predicts vulnerability to adverse outcomes and is recognized as a dynamic state with the potential for reversibility [15-18]. Studies have been focused on frailty transition, incidence and its associated factors [15, 19, 20] while several studies investigated the relationship between loneliness and frailty transition. Frailty was found to be linked with social loneliness in cross-section and longitudinal design [11, 21, 22]. There was also evidence that frailty is found to be associated with an increase in loneliness over time and that high level of loneliness is associated with an increased risk of becoming physically frail or prefrail in the future [2]. Our study used data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS), aiming to investigate whether loneliness increased the risk of greater frailty in the future and how loneliness relates to frailty transition.

Research Methods

Questionnaire, design, and participants
The data comes from Chinese Longitudinal Healthy Longevity Survey (CLHLS) which was collected from half of the counties and cities and represents 85% of the total population of China[23]. The rationales, details of the survey design, data quality was described elsewhere[24, 25]. The questionnaire contained demographic information, lifestyle, diet, self-reported health, psychological health, activities of daily living (ADL) and instrumental activities of daily living (IADL). Follow-up interviews were conducted in 2000, 2005, 2008, 2011, 2014.

Our study utilizes the 2008 and 2011 waves of CLHLS. Briefly, among the 16786 participants (aged >=60 years) in 2008, 2728(16%) were lost to follow-up and 14058 (84%) remained. Among the 14058 participants, 5633 died before the 2011 wave and 8425 were alive in the 2011 wave. The Flowchart of the study is shown in Figure 1.

![Flowchart of participants](image.png)

**Figure 1** flow diagram of participants

Loneliness

Loneliness was measured in the 2008 and 2011 waves with a single question asking how often the respondent feels lonely and isolated. The 5-point response scale ranged from “never” to “always”. Single-item questions are sometimes known as self-rating measures of loneliness as they can ask directly for the individual’s assessment of how lonely they feel. The single-question of loneliness has been used widely and proved to be valid and highly correlated with multi-item loneliness scales[26, 27]. Because the question on loneliness in CLHLS is highly skewed with fewer respondents in the “always” and “often” categories, we classified “sometimes” “often” and “always” into one category and “seldom” and “never” into another category to show the level of loneliness.

Frailty status

FRAIL Scale[28] was created to measure physical frailty for our study. Those who met three or more components were defined as frail, those 1 or 2 components as prefrail and those without any were defined as robust[28, 29]. Based on the CLHLS questionnaire design, we made some adjustments to the FRAIL Scale indicators. Each item of FRIL Scale was dichotomized and mapped to the interval 0-1. Fatigue, using the question of “Do you feel the older you get, the more useless you are?” The analysis codes “never” “seldom” “sometimes” as 0 and 1 if otherwise. Resistance was measured with “Can you continuously crouch and stand up three times?” and Ambulation with “Can you walk continuously for 1 kilometer at a time by yourself?”. For the two variables, the analysis recodes 0 for “without assistance” and 1 for otherwise. For illness, self-reporting of more than 5 kinds of illness was coded as 1. Loss of weight was measured by BMI (weight (in kilograms)/height (in meters) $^2$) and has the same cutoff points of underweight (<18.6).

Our study also used another model of the frailty index to measure the dimensions of frailty. It has been suggested that at least 30 deficits are needed in the frailty index[30]. We used 37 indicators of various
dimensions of frailty status, which coded as 1 when deficits happened and assigned a score of 2 if the interviewees had a serious illness that caused him/her to be hospitalized or bedridden two or more times[31-33]. Full description of the frailty index can be found in Table 1.

**Table 1** list of items included in a frailty index

| NO. | Items                                                                 |
|-----|----------------------------------------------------------------------|
| 1   | ADLs: needs assistant in bathing                                     |
| 2   | ADLs: needs assistant in dressing                                   |
| 3   | ADLs: needs assistant in toileting                                  |
| 4   | ADLs: needs assistant in indoor transferring                        |
| 5   | ADLs: needs assistant in continence                                  |
| 6   | ADLs: needs assistant in eating                                     |
| 7   | IADLs: unable to visit neighbors by himself/herself                 |
| 8   | IADLs: unable to go shopping by himself/herself                      |
| 9   | IADLs: unable to cook a meal by himself/herself                      |
| 10  | IADLs: unable to wash clothing by himself/herself                    |
| 11  | IADLs: unable to walk continuously for 1 kilometer at a time by himself/herself |
| 12  | IADLs: unable to lift a weight of 5kg                                |
| 13  | IADLs: unable to continuously crouch and stand up three times        |
| 14  | IADLs: unable to take public transportation by himself/herself       |
| 15  | Cognitive impairment (based on Mini Mental State Examination)        |
| 16  | Poor self-reported health                                            |
| 17  | Health state compared to past year                                  |
| 18  | Poor interviewer-rated health                                        |
| 19  | Vision loss                                                          |
| 20  | Psychological distress (based on usefulness, fearfulness)           |
| 21  | Number of serious illnesses in the past two years*                  |
| 22  | Suffering from hypertension                                          |
| 23  | Suffering from diabetes                                              |
| 24  | Suffering from heart disease                                         |
| 25  | Suffering from stroke or cerebrovascular disease                     |
| 26  | Suffering from bronchitis, emphysema, pneumonia, asthma              |
| 27  | Suffering from tuberculosis                                          |
| 28  | Suffering from cataract                                              |
| 29  | Suffering from cancer                                                |
| 30  | Suffering from Parkinson’s disease                                   |
| 31  | Suffering from arthritis                                             |
| 32  | Suffering from dementia                                              |
| 33  | Functional limitations: unable to put hand behind neck                |
| 34  | Functional limitations: unable to put hand behind lower neck          |
| 35  | Functional limitations: unable to raise arm upright                   |
| 36  | Functional limitations: unable to stand up from sitting in a chair    |
| 37  | Functional limitations: unable to pick up a book from floor           |

*Two or more serious illnesses in the past two years are assigned a value of 2.

**Frailty transitions**

The change in frailty status between the baseline in 2008 and follow-up in 2011 was used as the outcome. Frailty transitions had been created in two types in our study since we used two kinds of frailty models.

In a study by Gill et al[15], nine transitions of frailty were possible in physical frailty, including six transitions between three frailty states (robust, prefrail, frail) and each frailty state to death. The number of frailty states in the 2008 and 2011 waves was made. Four transitions between frailty states were designed in our study by a frail scale: remaining robust or prefrail, which means that the elderly have remained healthy to some extent; improvement, which means improvement or a change from
prefrail to robust or from frail to robust or prefrail; worsening, which is a transition to greater frailty; and remaining frail, meaning that the elderly have remained unhealthy. Change in the frailty index was classified into three categories: robust, which means that the frailty scores of the elderly had not changed; worsening, which means that the frailty scores of the elderly had increased; and improvement, which means that the frailty scores declined to a lesser frailty state in the follow-up year.

Covariates
Covariates were measured at baseline and included age, gender, living arrangement, residential area, education year, relative economic status, smoking, drinking alcohol and baseline physical frailty state. Living arrangement was coded as 0 if participants were living independently, otherwise as 1. The residential area was commonly used in studies about China because urban and rural areas differ greatly in socioeconomic development. Participants were asked about their educational year, which is used as a continuous variable in our study. Relative economic status was measured with the question: “How do you rate your economic status compared with others in your local area?”. The response was classified into three categories and we reverse-coded these so that higher categories indicated greater economic status (1=poor; 2=so so; 3=rich). Frailty transition between frailty states was highly dependent on preceding frailty state and baseline frailty state were viewed as components number of baseline frail scale.

Analytical sample
In total, 14058 participants were conclude in the 2008-2011 wave, of which 5633 died before 2011 wave and 8425 were re-interviewed at the 2011 wave. Analysis of physical frailty transition and loneliness in relation to frailty transition is based on 5839 (69%) participants with completed data by re-interviewed participants. Analysis of frailty index change is based on 5618 (67%) participants with completed data among re-interviewed participants. Compared with the participants who were in our main analytical sample (n=5839), those who were excluded due to the loss to follow-up were older, frailer, lonelier, less residence in rural, less education year, more smokers, and fewer drinkers.

Statistical analysis
Descriptive statistics at baseline were summarized using the mean (±standard deviation) or counts (percentages). Chi-Square test and student’s test were measured to compare age, living arrangement, residential area, education year, relative economic status, smoking, drinking alcohol and baseline frailty state, according to gender.
Frailty index scores were log-transformed for analysis, after addition of 0.01 to avoid logarithms of zero. Logistic regression was used to derive odds ratio of loneliness for physical frailty transition types and frailty index change types. Logistic regression was also conducted for female and male separately since frailty status transition was affected by gender. Estimates are shown adjusted for age and the number of components of baseline physical frailty and more others. Gender was also adjusted for all of the participants. All analysis was performed using statistical package STATA version 13.0. A p-value<0.05 was calculated as statistically significant.

Results
Table 2 summarized the characteristic of participants by gender. In total, the prevalence of often loneliness at baseline was 32.5%, and females tend to be lonelier than males. Compared with males,
female participants at baseline were older, having less education year, less smoker, less drinker, and having a greater frailty level both in physical frailty scale and frailty index at baseline.

**Table 2** characteristic of the participants at baseline

|                          | Total        | Female        | Male          | p-value* |
|--------------------------|--------------|---------------|---------------|----------|
| Age, mean(SD)            | 87.0(11.5)   | 89.3(11.6)    | 83.9(10.7)    | <0.001   |
| Residency: Rural, n(%)   | 8950(63.7)   | 5180(64.3)    | 3770(62.8)    | 0.066    |
| Living arrangement: Ind., n(%) | 2113(15.0)   | 1252(15.5)    | 861(14.3)     | 0.05     |
| Education year, mean(SD) | 2.0(3.3)     | 0.8(2.2)      | 3.5(3.9)      | <0.001   |
| Relative economic status: rich | 2614(18.6)   | 1583(19.7)    | 1031(17.2)    | <0.001   |
| so so                    | 9556(68.2)   | 5482(68.2)    | 4074(68.1)    |          |
| poor                     | 1852(13.2)   | 970(12.1)     | 882(14.7)     |          |
| Current smoker, n(%)     | 2519(17.9)   | 454(5.6)      | 2065(34.4)    | <0.001   |
| Current drinker, n(%)    | 2517(17.9)   | 704(8.7)      | 1813(30.2)    | <0.001   |
| Loneliness, n(%)         |              |               |               |          |
| never                    | 4534(37.8)   | 2240(34.3)    | 2294(42.1)    | <0.001   |
| seldom                   | 3553(29.7)   | 1939(29.7)    | 1614(29.6)    |          |
| often                    | 3894(32.5)   | 2357(36.1)    | 1537(28.2)    |          |
| No. of components of frail scale at baseline, mean(SD) | 1.5(1.3) | 1.8(1.3) | 1.2(1.2) | <0.001 |
| Frailty index score at baseline, mean(SD)     | 0.2(0.1)     | 0.2(0.1)      | 0.1(0.1)      | <0.001   |

*Chi-Square test for proportions and student’s test for continuous measures

Table 3 shows the transition in frailty status between baseline and follow-up visit. At baseline, 2642(45.2%) participants at baseline were classified into the prefrail group, 2384(40.8%) participants into a robust group, 813(13.8%) populations into a frail group. There was a clear difference between female and male in the distribution of frail group at baseline, and 20.1% of female and 7.4% of the male were frail respectively. At follow-up year, 2627(45.0%) had remained in the same robust or prefrail states, whereas 1671(28.6%) had declined into greater frailty, 1215(20.1%) had recovered into the lower level of frailty and only 5.6% remained in the frail group. Among female participants, 39.5% had remained in the robust or prefrail state, whereas 29.8% of those in the robust or prefrail state at baseline worsened into frailty, and 22.0% of the female has recovered from greater frailty state. Among male participants, more than half remained in the robust or prefrail state, whereas 27.4% had worsened into greater frailty and 19.6% had recovered. Females tend to be worsened in physical frailty state more than males, whereas male had a lower prevalence of remaining frail than female.

**Table 3** physical frailty transitions between baseline and follow-up

| Frailty status (2008) | Frailty status (2011), n(%) | Total |
|-----------------------|----------------------------|-------|
|                       | nonfrail | prefrail | frail |       |
| Total                 |          |          |       | 2,384  |
| nonfrail              | 1277(53.6) | 905(38.0) | 202(8.5) | 2,384  |
| prefrail              | 728(27.6)  | 1350(51.1) | 564(21.3) | 2,642  |
| frail                 | 89(10.9)   | 398(49.0)  | 326(40.1) | 813    |
| Female                |          |          |       | 989    |
| nonfrail              | 466(47.1)  | 407(41.2)  | 116(11.7) | 989    |
| prefrail              | 314(22.6)  | 710(51.1)  | 365(26.3) | 1,389  |
| frail                 | 48(8.0)    | 293(48.8)  | 259(43.2) | 600    |
| Male                  | 811(58.1)  | 498(35.7)  | 86(6.2)   | 1,395  |
| nonfrail              | 414(33.0)  | 640(51.1)  | 199(15.9) | 1,253  |
| prefrail              | 41(19.3)   | 105(49.3)  | 67(31.5)  | 213    |
The associations between physical frailty transition types and loneliness are shown in Table 4. In the remaining robust or prefrail group, after adjusting for age, gender and components number in the frail scale at baseline, significant trends in remaining frail state was associated with a high level of loneliness were observed. Compared to never loneliness participants, those who always feel lonely were unlikely to remain healthy (robust or prefrail) states. This association remained significant after further adjustment for other covariates, and the odds ratios (95% CI) for people who feel often lonely was 0.78 (0.67-0.90). In the worsening group, loneliness was a significant risk factor that a high level of loneliness was associated with worsened frailty states after 3 years. Often loneliness remained significant after further adjustment for full covariates, and the odds ratios (95% CI) for people who feel often lonely were 1.19 (1.01-1.40). In improvement and remaining frail group, loneliness showed no significant influence on frailty transition.

We also investigated whether the association between levels of loneliness and physical frailty transition differed by gender. Both female and male participants had shown a significant relationship between often loneliness and remaining nonfrail and prefrail, and the odds ratios (95% CI) for people of often loneliness were 0.81 (0.67-0.99) for female, 0.74 (0.61-0.90) for male participants. But the relationship is undermined and no longer significant after adjustment for other covariates in female participants. No significant association was found in female participants, but male participants with often loneliness had an increased risk of worsening physical frailty state even with all covariates, and the odds ratios (95% CI) adjusted for all covariates was 1.37 (1.07-1.75).

Table 5 shows odds ratios (95% CI) for change in the frailty index from baseline to a follow-up visit, according to loneliness. There were no significant associations between loneliness and change in a frailty index. These associations also showed no difference between genders.

### Table 4

|                | Remaining nonfrail and prefrail | Worsening | Improvement | Remaining frail |
|----------------|---------------------------------|-----------|-------------|----------------|
| **Total (n=5802)** |                                 |           |             |                |
| never          | Reference (1.13)                | Reference | Reference   | Reference       |
| seldom         | 0.99 (0.87-1.13)                | 1.00 (1.00-1.14) | 1.04 (0.90-1.23) | Reference       |
| often          | 0.78 (0.68-0.89)                | 0.78 (0.67-0.90) | 1.21 (1.03-1.42)* | Reference       |
| **Female (n=2952)** |                                 |           |             |                |
| never          | Reference (1.18)                | Reference | Reference   | Reference       |
| seldom         | 0.98 (0.81-1.18)                | 1.01 (0.83-1.21) | 1.04 (0.85-1.27) | Reference       |
| often          | 0.81 (0.67-0.99)*               | 0.84 (0.69-1.03) | 1.09 (0.87-1.36) | Reference       |
| **Male (n=2850)** |                                 |           |             |                |
| never          | Reference (1.20)                | Reference | Reference   | Reference       |
| seldom         | 1.01 (0.84-1.20)                | 1.00 (0.84-1.20) | 1.07 (0.87-1.31) | Reference       |
| often          | 0.74 (0.61-0.90)**              | 0.73 (0.59-0.89)** | 1.37 (1.09-1.74)** | Reference       |

***P<0.0001, **P<0.01, *P<0.05.

Model 1 adjusted for age, and components number of frail scale at baseline. Model 2 adjusted for age, components number of frail scale at baseline, residence, education year, smoking and drinking alcohol at baseline. In total participants, adjustment for gender was also performed.

### Table 5

|                | Remaining nonfrail and prefrail | Worsening | Improvement | Remaining frail |
|----------------|---------------------------------|-----------|-------------|----------------|
| **Total (n=5802)** |                                 |           |             |                |
| never          | Reference (1.13)                | Reference | Reference   | Reference       |
| seldom         | 0.99 (0.87-1.13)                | 1.00 (0.88-1.14) | 1.04 (0.91-1.23) | Reference       |
| often          | 0.78 (0.68-0.89)                | 0.78 (0.67-0.90) | 1.21 (1.03-1.42)* | Reference       |
| **Female (n=2952)** |                                 |           |             |                |
| never          | Reference (1.18)                | Reference | Reference   | Reference       |
| seldom         | 0.98 (0.81-1.18)                | 1.01 (0.83-1.21) | 1.04 (0.85-1.27) | Reference       |
| often          | 0.81 (0.67-0.99)*               | 0.84 (0.69-1.03) | 1.09 (0.87-1.36) | Reference       |
| **Male (n=2850)** |                                 |           |             |                |
| never          | Reference (1.20)                | Reference | Reference   | Reference       |
| seldom         | 1.01 (0.84-1.20)                | 1.00 (0.84-1.20) | 1.07 (0.87-1.31) | Reference       |
| often          | 0.74 (0.61-0.90)**              | 0.73 (0.59-0.89)** | 1.37 (1.09-1.74)** | Reference       |

***P<0.0001, **P<0.01, *P<0.05.
Discussion

The present study investigated the association between frailty transitions from baseline to a follow-up visit around 3 years later, according to loneliness at baseline. We found that 45.0% of the population could remain in the robust or prefrail states, with more than a quarter of population transferring to greater frailty. Transitions to greater physical frailty were more common than transitions to less physical frailty, and this characteristic of transition rates was consistent with the previous studies [35]. Female and male participants in our study showed different transition rates. Females tend to process into worsened physical frailty more than male, whereas male showed less likely to remain in the frail state than female. This will have to be further confirmed by other studies since an earlier study of old people in Hong Kong between 2001 and 2003 found that females were less likely to decline in frailty status than male [19].

Our study designed four kinds of physical frailty transition types: remaining robust or prefrail, improvement, worsening and remaining frail to certain the specific relationship between loneliness and frailty transition. Previous studies were not consistent in the association between loneliness and frailty: a cross-sectional study of Mexican community-dwelling elderly adults found that loneliness was independently associated with frailty [21], and the prospective study found the relationship between frailty and loneliness was bidirectional [2, 22]. In our study, we found that greater loneliness reduced the possibility of remaining robust or prefrail physical frailty, and this finding is consistent with an indication of English longitudinal aging study, which found that greater loneliness was associated with increased risk of physical frailty [2]. Previous studies showed that loneliness was related to declining in frailty components. Loneliness was associated with a higher risk of comorbidity [5, 6], functional decline, for example, ADL problems [7, 8], upper difficulties and poor mobility [7] and may predict subsequent cognitive decline [10], no matter the loneliness is transient or chronic [36]. We found evidence on the
relationship between loneliness and different frailty transition types, and that greater loneliness was associated with an increased risk of worsening physical frailty after 3 years. There have been no prospective studies to identify whether the association between levels of loneliness and physical frailty by gender. A study had shown that loneliness varied by gender [37]. Low resilience was associated significantly with loneliness, which was more pronounced in males [38]. Resilience was newly used in the field of frailty, and high resilience may be protective and facilitate maintenance of health status, which resulted in frailty [39, 40]. Previous research also indicated the stressful impact of loneliness on men by showing increased inflammatory responses [41]. The inflammatory response was a specific physiological basis to the geriatric syndrome of frailty [42], which may be a mechanism underlying the gender difference in the relationship between loneliness and physical frailty. Moreover, females tended to have more multifaceted networks that lead to more social support, whereas males obtained social relationship more on the public that may not always support [43]. Here, we found consistent evidence that there was a clear difference in the association between levels of loneliness and physical frailty between men and women. The association of high level of loneliness at baseline with remaining robust or prefrail frailty at follow-up visit remained significant between men and women, whereas loneliness was no longer significant in female participants after adjusting for all covariates. In addition, we found that the association between loneliness and worsening physical frailty was no longer significant in female participants, but male participants with often loneliness had an increased risk of worsening physical frailty state even with all covariates.

Our study also used another model of frailty, the frailty index, to further verify results on the relationship between loneliness and frailty transition. We found no relationship with loneliness and frailty change types by the frailty index, and this finding is similar with the finding in an earlier study [2], which may indicate that a broader definition of frailty does not have the same risk factors with physical frailty only. Our finding highlighted that loneliness was associated with physical frailty transition. This may imply that we should pay close attention to physical frail old adults with loneliness and the effect of frailty interventions might have different efficacy in a different kind of frail elderly.

The strength of our study includes the large sample size and the fact that CLHLS was aimed to investigate the determinants of health and longevity of older adults in China from a multidisciplinary perspective [31]. The study has limitations. In total participants, 69% has complete data on the frail scale and 67% has complete data on the frail index. Those who did not complete the questionnaire may tend to be frailier and lonelier. Our finding may underestimate the relationship between frailty transition and loneliness, especially in the model of the frailty index. The second limitation was the formulation of the loneliness may affect our results. The question was asking how often the respondent feels lonely and isolated, and earlier had examined that social isolation was related to future frailty, but the relationship is not significant after controlling comorbidity [44]. Considering this limitation, we conducted a physical frailty transition with frail scale, which contains comorbidity as an item in advance.

**Conclusions**

Loneliness declined the possibility of remaining robust or prefrail frailty states and greater loneliness is associated with increased risk of worsening frailty. The association between loneliness and physical frailty transition differ obviously between men and women. In contrast, loneliness showed no relationship with frailty transition under the frailty index, which may represent a broader scope of frailty.
Declarations

Abbreviations
CLHLS, Chinese Longitudinal Healthy Longevity Survey

Ethics approval and consent to participate
Not applicable since the dataset used in the study is publicly available.

Competing interests
None.

Funding
None.

Authors' contributions
SHASHA designed, drafted, and revised the text. SHASHA also performed the analyses. Xu yuebin drafted and revised the text. Chenlin revised and interpreted the results. All authors read and approved the final version of the manuscript.

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The CLHLS datasets are publicly available at the Center for the Study of Aging and Human Development, Duke University (http://centerforaging.duke.edu/datadownloads). Researchers can obtain the datasets after sending a data user agreement to the CLHLS team. The English version of the questionnaires is free to download at the CLHLS website.

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Figures

Figure 1 flow diagram of participants
flow diagram of participants