

Psychosocial Clusters and Their Associations with Depression, Anxiety and Stress Among Older Adults in Shanghai Communities: Results from a Longitudinal Study

Jiawen Kuang^{1,*}, Wei Zhang^{1,*}, Haoran Zhang^{2,*}, Nan Lin¹, Jialie Fang³, Rui Song⁴, Zhaohua Xin², Jingyi Wang¹

¹School of Public Health; NHC Key Laboratory of Health Technology Assessment, Fudan University, Shanghai, People's Republic of China; ²Lingqiao Community Health Center, Pudong New Area, Shanghai, People's Republic of China; ³Jing'an District Center for Disease Control and Prevention, Shanghai, People's Republic of China; ⁴Xiaodongmen Subdistrict Community Health Center, Huangpu District, Shanghai, People's Republic of China

*These authors contributed equally to this work

Correspondence: Jingyi Wang, School of Public Health; NHC Key Laboratory of Health Technology Assessment, Fudan University, 446-2 Zhaojiafang Road, Shanghai, 200032, People's Republic of China, Tel/Fax +86 21 3356 3933; +86 21 6416 9553, Email jingyi_wang@fudan.edu.cn; Zhaohua Xin, Lingqiao Community Health Center, 1236 Jiangdong Road, Pudong New Area, Shanghai, 200131, People's Republic of China, Tel/Fax +86 21 5864 2003, Email 115013251@qq.com

Purpose: Psychosocial factors have been found to profoundly impact mental health of older adults, but the main focus in the current literature has been on one particular aspect of these factors. This study aimed to identify latent classes of older adults based on four psychosocial factors (loneliness, social isolation, perceived social support, and social capital) and the transition of classes over 6 months. We also sought to assess the predictive role of changes in these classes in relation to depression, anxiety, and stress at 18-month follow-up.

Methods: We analyzed longitudinal data from 581 community-dwelling older adults in Shanghai, China. The data were collected at baseline (T0), 6-month follow-up (T1) and 18-month follow-up (T2) between March 2021 and April 2023. Using latent class analysis, we identified three underlying classes (Social Connectors, Subjective Social Isolates, and Social Isolates) of the sample. We also established five transition categories from T0 to T1 (Social Connectors T0-T1, Subjective Social Isolates T0-T1, Social Isolates T0-T1, Good Transition, and Bad Transition) using latent transition analysis. Logistic regression was employed to examine the temporal relationships between these transition categories and subsequent symptoms of depression, anxiety and stress, adjusting for age, sex, education, marital status, family income level, sleep quality, health status and outcome variables at T0.

Results: Multivariable associations revealed that compared to older adults with persistent good social environment (Social Connectors T0-T1), those with persistent high levels of loneliness and social isolation and low levels of perceived social support and social capital (Social Isolates T0-T1), and those who shifted towards a poorer social environment (Bad Transition) were more likely to experience depression, anxiety and stress at T2. Sustained subjective social isolation (Subjective Social Isolates T0-T1) was associated with more severe depressive symptoms at T2.

Conclusion: Our study indicated that adverse psychosocial environment worsened mental health in older adults. These findings highlight the importance of early identification of older individuals at long-term psychosocial risk and development of tailored interventions to improve their social environment and mental health.

Keywords: older adults, psychosocial factors, depression, anxiety, stress

Introduction

As the life expectancy of older adults has significantly increased, a corresponding rise in mental and neurological disorders among this population has been observed, with over 20% of individuals aged 60 and above being affected.¹ Predominantly, depression, anxiety, and stress emerge as the most prevalent emotional disturbances within this age

group. These problems not only profoundly impact the physical and mental well-being and overall quality of life of older adults but also escalate the risk of disability and suicide.² Furthermore, they impose a substantial economic burden on societal resources, necessitating urgent attention and intervention.²⁻⁵

Depression, anxiety, and stress are frequently encountered mental health problems among older adults. Meta-analytical data revealed that the global prevalence of major depression in this population stands at 13.3%.¹ Notably, about 45% of older adults in China reported frequent experiences of depressive or anxiety symptoms.⁶ A significant comorbidity exists between anxiety and depression among older adults, underscoring their interconnected nature.⁷ In specific locales, such as Changchun, China, detection rates of depressive and anxiety symptoms among community-dwelling older individuals were 40.3% and 17.7%, respectively.⁸ Stress is also common among older adults. In a study in Beijing, 61.2% of the older people experienced mild or above psychological stress.⁹

Psychosocial factors encompass a broad spectrum that is intricately linked to the psychological and social milieu of individuals.¹⁰ One potentially important modifiable psychosocial factor for emotional problems is the absence of good social relationships. Connecting with friends, family and society can improve older people's emotional well-being and increase their happiness.^{11,12} Poor social relationships have been associated with multiple mental health outcomes in older adults, including depression, anxiety and stress.¹³⁻¹⁵ Given that social relationships have a number of, often overlapping, concepts which vary along a continuum, there is a burgeoning need for more comprehensive evidence to elucidate the roles of psychosocial clusters. Recently, the attempts to classify social relationship patterns have been reported by several studies. For example, a study in Japan identified three unique social relationship classes of older adults based on various aspects of social interaction in daily settings: "Active", "Socially isolated", and "Less motivated".¹⁶ This type of studies often use latent class analysis to indicate diverse patterns of social relationships based on multiple measures, which have important implications for establishing basic knowledge for mental health practices among older adults in the community. Among various social relationship terms, loneliness, social isolation, social support and social capital have been frequently studied and have demonstrated significant impacts on mental health outcomes.

Loneliness is a subjective emotional state, stemming from a perceived discrepancy between an individual's ideal social relationships and their actual social experiences.¹⁷ A notable association exists between loneliness and depression. For instance, loneliness was found to be a robust predictor of changes in depressive symptoms among older adults in Shanghai.¹⁸ Further, a systematic review of longitudinal studies underscored loneliness as a predictive factor for the onset of depression and other common mental health problems, highlighting directions for future interventions.¹⁹

Social isolation, distinguished as an objective state, is characterized by a lack of social relationships and physical separation from others.²⁰ It significantly impairs the emotional well-being of older adults, often manifesting in symptoms of depression and anxiety.²¹ A longitudinal study reported a marked increase in depression, anxiety and stress among participants in the pre/post quarantine comparison during the COVID-19 pandemic.²² Some research suggested a bidirectional relationship between social isolation and mental health issues such as depression and anxiety.¹⁴

Social support represents the material and emotional aid one could receive from family, friends, neighbors, and broader social networks. It is bifurcated into received and perceived dimensions. Received social support is a rating of how often someone reports receiving particular supportive behaviors,²³ while perceived social support refers to people's beliefs about how much support is potentially available from their relationships and social contacts and about the quality of this support.²⁴ Evidence suggests that lower levels of perceived social support are predictive of more severe depressive symptoms in subsequent follow-ups.²⁵

Social capital refers to the assortment of resources available within a specific social group, encompassing trust, norm adherence, social support, and channels for information exchange.²⁶ Cohort studies have identified that higher levels of cognitive social capital act as protective factors against common mental disorders.^{27,28} Koryu's longitudinal study highlighted a negative association between depressive symptoms and dimensions of social capital, namely social cohesion, reciprocity, and community-level reciprocity.²⁹

While previous studies have contributed significantly to understanding psychosocial factors in older adults, they often focused narrowly on one particular aspect of these factors. Addressing this gap, our study integrates four psychosocial factors—loneliness, social isolation, perceived social support, and social capital—to explore their collective relationship with depression, anxiety, and stress among older adults. In addition, many previous studies of psychosocial clusters

adopted cross-sectional design, and limited longitudinal research did not investigate the impact of changes in psychosocial classes on mental health outcomes in older people. Therefore, our study conducted an 18-month, three-time-point survey, aiming to uncover the role of transition of psychosocial clusters in predicting depression, anxiety and stress among older adults using latent transition analysis.

In light of the identified research gaps, the objectives of this study were to 1) identify latent classes of older adults based on their psychosocial factors (loneliness, social isolation, perceived social support, and social capital) and the transition of classes within 6 months; and 2) assess the predictive role of changes in classes of psychosocial factors in relation to depression, anxiety, and stress at 18-month follow-up in older adults. We hypothesized that older individuals reporting higher levels of loneliness and social isolation, coupled with lower levels of perceived social support and social capital, would be more likely to experience depression, anxiety, and stress than participants who did not. We also hypothesized that the transition of classes towards a poorer social environment over two time points would be more likely to predict depression, anxiety and stress at 18-month follow-up.

Materials and Methods

Study Population

A longitudinal cohort study was conducted from March 2021 to April 2023, targeting the older population in Shanghai. The study focused on three districts: Pudong New Area, Huangpu District, and Jing'an District. Pudong New Area represents the remote suburbs, while the latter two districts represent the central city. To qualify for inclusion in the study, participants were required to satisfy several criteria: 1) they were permanent residents of Shanghai, aged 65 years or older; 2) they expressed their willingness to provide informed consent; and 3) they did not have communication barrier or severe cognitive disorders and were able to complete the study questionnaire.

In Pudong New Area, two community units were randomly chosen. Subsequently, simple random sampling was employed within each unit, taking into account the age and sex distribution of the older population in Shanghai. The survey of the sampled residents was conducted by medical professionals from the community health service centers of these two units. In instances where original participants were unavailable, unwilling to participate, or suffering from severe illness, substitute participants were enlisted. The selection criterion for these replacements was based on the closest match in terms of sex and age group (with an age difference of less than 5 years) to the non-participating individual, following the sequential order of the residents' list. This replacement process was iteratively executed until the predetermined sample size was attained, ensuring each selected replacement, if needed, aligned closely with the demographic profile of the initially intended participant.

In both Huangpu District and Jing'an District, one community from each area was strategically selected for the study. Due to the unavailability of a comprehensive residents' list, the study employed a convenience sampling approach in these districts. This method entailed the recruitment of participants with the assistance of community staff, who played a pivotal role in facilitating the process. To ensure effective data collection, interviews were conducted by a team comprising both community older volunteers and students from the School of Public Health at Fudan University. This collaborative approach not only leveraged the local knowledge and networks of the community volunteers but also incorporated academic expertise of the public health students.

Data collection for the baseline phase (T0) of this longitudinal study was conducted from March to June 2021. During this initial data acquisition period, a cohort of 675 senior individuals engaged in the structured questionnaire survey. Subsequently, the study progressed to its first follow-up stage six months later (T1), with data collection occurring from November 2021 to January 2022. In this phase, 647 participants from the original cohort successfully completed the survey, with a follow-up rate of 95.9%. The study's second follow-up data (T2) were collected between September 2022 and April 2023. A total of 609 older people completed the survey at T2, with a follow-up rate of 90.2%. Following a data cleaning process to exclude participants with missing values of the outcomes at T2, the latent class analysis (LCA) was performed on a refined dataset from 600 individuals who maintained participation throughout the study's duration. As 19 participants have missing values of the covariates at T0, the analyses involving these variables were conducted among 581 participants (Figure 1).

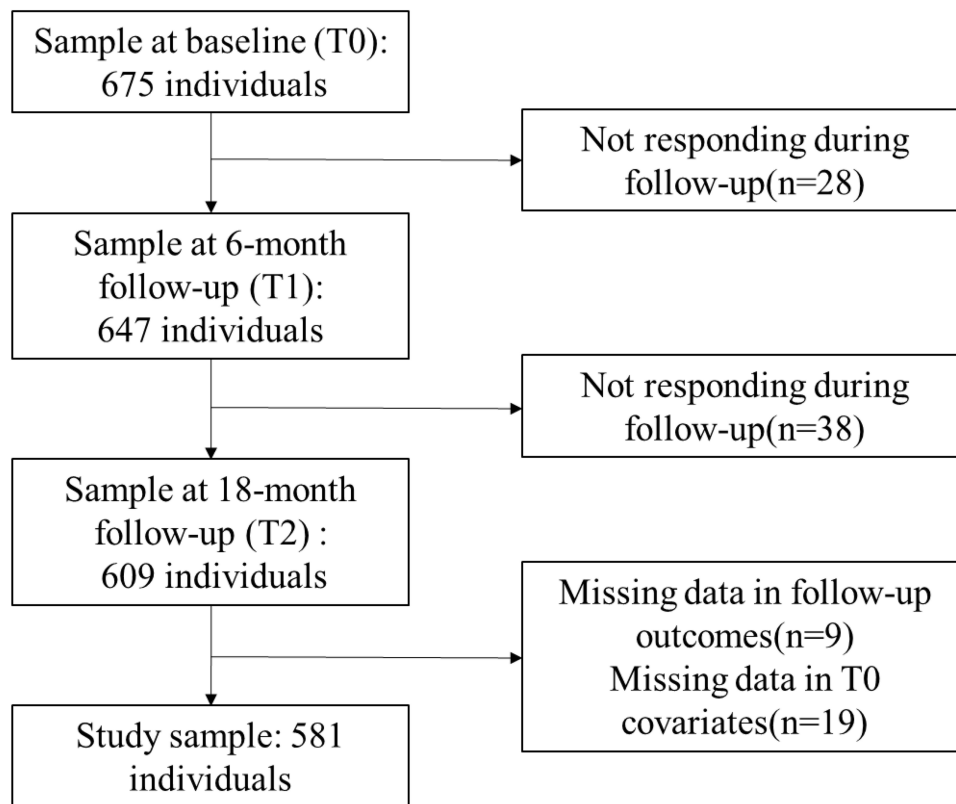


Figure 1 Participant flow from baseline to 18-month follow-up.

Measures

Psychosocial Factors

In this study, we operationalized the latent construct of psychosocial factors among older adults using four distinct scales: 1) loneliness; 2) social isolation; 3) perceived social support; and 4) social capital. We collected data pertaining to these scales at two different time points, referred to as T0 and T1.

Loneliness. Loneliness was quantitatively evaluated using the De Jong Gierveld Loneliness Scale (DJGL),³⁰ which is bifurcated into two distinct dimensions: social loneliness and emotional loneliness. The scale's cumulative scoring ranges from 0 to 11, with an ascending score reflecting an increased intensity of loneliness. Possible responses were "Yes", "More or less" and "No". The Chinese adaptation of the De Jong Gierveld Loneliness Scale has been validated and has shown satisfactory reliability (Cronbach's alpha = 0.820), along with content, discriminant, and construct validity.³¹

Social Isolation. Social isolation was measured using the Lubben Social Network Scale-6 (LSNS-6).³² This instrument dissects social isolation into two dimensions: familial networks and friendship networks. The LSNS-6 generates a score ranging from 0 to 30, where lower scores are indicative of heightened social isolation. Possible responses to the items were "None", "One", "Two", "Three or four", "Five thru eight" and "Nine or more". This scale has demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.83$) and robust construct validity within community-dwelling older adults across three European countries. For this study, the Chinese version of the LSNS-6 was employed. Previous research involving older adults in Beijing has corroborated the Chinese version's reliability (Cronbach's $\alpha = 0.83$) and construct validity, affirming its utility as an effective instrument for assessing social isolation among older adults in mainland China.³³

Perceived Social Support. Social Support was measured using the Social Support Rating Scale (SSRS), an instrument developed by Xiao et al.³⁴ This scale, which draws from international models and is tailored to the Chinese context, facilitates a comprehensive evaluation of an individual's social support. The SSRS is comprised of 10 items, with this study placing particular emphasis on perceived social support. This subscale Measures perceived social support from friends, neighbors, colleagues, and family members, with higher scores reflective of superior levels of perceived social support.

Social Capital. Social capital was assessed utilizing the Health and Lifestyles Survey Social Capital Questionnaire, an instrument comprising six items that measure social capital related to residential communities.³⁵ This questionnaire specifically evaluates components including residential satisfaction, perceptions of personal safety, neighborly care, availability of children's facilities, efficacy of public transportation, and provisions of entertainment amenities for older adults. Respondents were presented with three response options for each item: "Yes", "No" and "Do not know". The scoring metric for the questionnaire ranges from -6 to +6, with higher scores denoting more robust community social capital.

Covariates

In this research, the selection of Covariates was based on their associations with the four psychosocial factors and emotional problems in previous research. Important sociodemographic factors were used as independent control variables, including sex, age, education (primary education or lower, secondary education, university and above), self-rated household income level compared to other local residents (high, medium, low), and marital status (married, never married, previously married). In addition, the participants' self-reported health status over the past 6 months (very good, good, fair, poor, very poor) and sleep quality (Pittsburgh Sleep Quality Index) were incorporated as covariates and were categorized as good or poor.

Outcomes

Depression, Anxiety and Stress. Symptoms of depression, anxiety, and stress were evaluated utilizing the Depression Anxiety Stress Scales (DASS-21), a 21-item psychometric tool.³⁶ This scale is divided into three subscales (depression, anxiety, and stress), each comprising seven items that measure the respective psychological states. The scoring for each subscale ranges from 0 to 21, where an increased score is indicative of more severe symptomatology. Thresholds have been established to identify the severity of symptoms, with a score of 5 or more suggestive of mild to severe depression, a score of 4 or above indicating mild to severe anxiety, and a score of 8 or more representing mild to severe stress levels. The Chinese translation of the DASS-21 has been validated and has demonstrated satisfactory reliability and validity within Chinese population.³⁷

Statistical Analysis

Descriptive statistics of participant characteristics at T0 by depression, anxiety and stress at T2 were generated using frequency/percentage and median/interquartile range (IQR) where appropriate. Differences in distributions of participant characteristics were evaluated by *t*-test, χ^2 , Fisher's Exact test, and Wilcoxon Rank sum. Latent class analysis (LCA) was conducted separately at the T0 and T1 time points using the four psychological indicators (loneliness, social isolation, perceived social support and social capital). The optimal number of latent classes at both time points was determined by several fit statistics, including Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample size-adjusted Bayesian information criterion (aBIC). Lower values on these criteria indicated better model fit. The adjusted Lo-Mendell-Rubin likelihood ratio test (LMR LRT) was employed to compare (K-1)-class models to a K-class model. A significant p-value ($p < 0.05$) indicated a significant model fit improvement from K-1 to K class model. Additionally, the entropy was assessed for each model.³⁸ Higher entropy value, ranging from 0 to 1, indicated a better model fit. After determining the optimal latent classes at both time points, latent transition analysis (LTA) was performed to explore the transitions between latent classes from T0 to T1. LTA model was conducted following the recommendations of Karen Nylund-Gibson et al.³⁹ In the LTA model of this study, the conditional item probabilities were constrained to be equal across different time points. The item response probabilities were plotted by latent classes as stacked bar charts.

Differences in distributions of participant characteristics at T0 by latent transition categories were evaluated by *t*-test, χ^2 , Fisher's Exact test, and Wilcoxon Rank sum. Logistic regression was employed to assess the prevalence of depression at T2 using the latent transition categories as the primary predictor and adjusting for age, sex, education, marital status, family income level, sleep quality, health status over the past 6 months and depression at T0. Similar models were used for anxiety and stress. Adjusted odds ratios (ORs) along with their 95% confidence intervals (CIs) were reported. Statistical significance was set at p-value < 0.05 . All analytical steps were estimated with the software Mplus Version 7.4 and R version 4.3.1.

Results

Study Population Characteristics by Outcome Variables

A cohort of 581 older individuals was included in the analysis. In regard to socioeconomic characteristics at T0, the majority of participants were female (63.3%) and had secondary education (71.8%). The overall median age was 72.7 (IQR: 69.4–77.4) years. The majority of the participants' families had a moderate level of economic status (80.7%), and a significant proportion of them were married (80.7%). The health status of the participants in the past six months was reported as good by 91.6% of the respondents, while 83.0% of the participants reported having a good sleep quality. At 18-month follow-up (T2), the proportions of individuals identified with mild or higher levels of depressive symptoms, anxiety symptoms and stress were 10.0%, 17.0% and 3.4%, respectively. A larger proportion of participants who had depressive symptoms at T2 were found to be previously married or never married at T0 than those without symptoms. Participants who were previously married or never married and had poor sleep quality were more likely to have anxiety symptoms. Additionally, female and previously married or never married older adults were more likely to experience stress (Table 1).

Model Selection

Model fit statistics for two to five class models at T0 and T1 time points are reported in Table 2. LMR LRT value turned non-significant when three or four latent classes were specified at T0 and T1, respectively. The BIC and AIC of the three-class models at T0 and T1 were noticeably lower and the entropy values were higher than the two-class solutions, while the values were similar to four- and five-class models. Based on the fit statistics, interpretability, and overall model parsimony, the three-class model emerged as the optimal fitting measurement model for T0 and T1 time points. Subsequently, an LTA model was performed to examine the stability of these three latent classes between T0 and T1.

Latent Classes of Social Environment and Their Transitions from T0 to T1

Three mutually exclusive latent classes emerged from the LCA model. Class 1 (T0 = 31.83%, T1 = 49.83%) is characterized as Social Connectors, representing individuals with higher levels of social capital and perceived social support, and lower levels of loneliness and social isolation. Class 2 (T0 = 39.33%, T1 = 27.33%), or Subjective Social Isolates, is described as those who exhibit a moderate degree of objective measures of social capital and social isolation, but tend to perceive a higher degree of loneliness and have poorer perceived social support. Class 3 (T0 = 28.83%, T1 = 22.83%), or Social Isolates, is described as those who have lower levels of social capital and perceived social support, and higher levels of loneliness and social isolation. Figure 2 illustrates the distribution of the item response probabilities by latent classes.

Figure 3 shows the transitions among different latent classes across time. At T1 assessment, a large proportion of individuals remained in their original classes at T0 (Social Connectors 85%, Subjective Social Isolates 51%, Social Isolates 62%), showing a relatively high stability of all identified classes. In terms of transition to a poorer class of social environment, 7% and 8% of Social Connectors at T0 transitioned to Subjective Social Isolates and Social Isolates at T1, and 7% of Subjective Social Isolates changed to Social Isolates. In comparison, a larger proportion of participants transitioned to a better class from T0 to T1, including 42% from Subjective Social Isolates to Social Connectors, and 22% and 16% from Social Isolates to Social Connectors and Subjective Social Isolates. Ultimately, five transition categories were established. Social Connectors T0-T1, Subjective Social Isolates T0-T1 and Social Isolates T0-T1 represent individuals who remained in their original classes over time. Good Transition refers to participants who changed from a poorer class of social environment at T0 to a better class at T1. Bad Transition represents individuals who transitioned to a less favorable latent class from T0 to T1.

Participant Characteristics by Latent Transition Categories

Participant characteristics by latent transition categories are shown in Table 3. Individuals characterized as Social Connectors at both T0 and T1 (Social Connectors T0-T1, n=158) had a median age of 73.2 years (IQR: 69.4–77.0). Compared to the other latent transition categories, a larger percentage of individuals of Social Connectors T0-T1 were female (72.2%) and had high household income (12%) and good sleep quality (89.2%). The prevalence of depression,

Table I Participant Characteristics by Outcome Variables

	Overall n=581 (100%) N (%) or Median (IQR)	Depression		P	Anxiety		P	Stress		P
		No n=523 (90.0%) N (%) or Median (IQR)	Yes n=58 (10.0%) N (%) or Median (IQR)		No n=482 (83.0%) N (%) or Median (IQR)	Yes n=99 (17.0%) N (%) or Median (IQR)		No n=561 (96.6%) N (%) or Median (IQR)	Yes n=20 (3.4%) N (%) or Median (IQR)	
Sex				0.072			0.150			0.041
Male	213 (36.7)	198(37.9)	15 (25.9)		183 (38.0)	30 (30.3)		210(37.4)	3(15.0)	
Female	368 (63.3)	325 (62.1)	43 (74.1)		299 (62.0)	69 (69.7)		351(62.6)	17(85.0)	
Age	72.7(69.4, 77.4)	72.8(69.6, 77.4)	71.9(68.7, 78.5)	0.888	72.7 (69.5,77.2)	72.8 (69.0,79.4)	0.297	72.6 (69.3,77.3)	76.8 (71.8,79.5)	0.164
Education				0.251			0.157			0.817
Primary education or lower	99 (17.0)	92 (17.6)	7 (12.1)		72 (67.9)	34 (32.1)		96 (17.1)	3 (15.0)	
Secondary education	417 (71.8)	370 (70.7)	72 (16.0)		362 (81.2)	84 (18.8)		403 (71.8)	14 (70.0)	
University and above	65 (11.2)	61 (11.7)	47 (81.0)		56 (88.9)	7 (11.1)		62 (11.1)	3 (15.0)	
Household income				0.071			0.133			0.617
High	40 (6.9)	37 (7.1)	3 (5.2)		35 (7.3)	5 (5.1)		38 (6.8)	2 (10.0)	
Medium	469 (80.7)	427 (81.6)	42 (72.4)		393 (81.5)	76 (76.8)		454 (80.9)	15 (75.0)	
Low	72 (12.4)	59 (11.3)	13 (22.4)		54 (11.2)	18 (18.2)		69 (12.3)	3 (15.0)	
Marital status				0.001			0.004			0.014
Married	469 (80.7)	433 (82.8)	36 (62.1)		401 (83.2)	68 (68.7)		458 (81.6)	11 (55.0)	
Never married	12 (2.1)	10 (1.9)	2 (3.4)		8 (1.7)	4 (4.0)		11 (2.0)	1 (5.0)	
Previously married	100 (17.2)	80 (15.3)	20 (34.5)		73 (15.1)	27 (27.3)		92 (16.4)	8 (40.0)	
Health status over the past 6 months				0.316			0.147			0.233
Good	532 (91.6)	481 (92.0)	51 (87.9)		445 (92.3)	87 (87.9)		515 (91.8)	17 (85.0)	
Poor	49 (8.4)	42 (8.0)	7 (12.1)		37 (7.7)	12 (12.1)		46 (8.2)	3 (15.0)	
Sleep quality				0.130			0.007			0.061
Good	482 (83.0)	438 (83.7)	44 (75.9)		409 (84.9)	73 (73.7)		469 (83.6)	13 (65.0)	
Poor	99 (17.0)	85 (16.3)	14 (24.1)		73 (15.1)	26 (26.3)		92 (16.4)	7 (35.0)	

Notes: Continuous variables were analyzed using t-test. Categorical variables were analyzed using chi-square test or Fisher's exact test, where appropriate. Values with $p < 0.05$ are shown in bold.

Abbreviation: IQR, Interquartile range.

Table 2 Fit Statistics for 1- to 5-Class Solutions as Derived from LCA at Time Points T0 and T1

Number of Classes	BIC	AIC	aBIC	Entropy	LMR	Number of Participants in Each Class (%)				
						1	2	3	4	5
T0										
1	39,031.26	38,644.33	38,751.88	–	–	600(100.00)				
2	37,367.45	36,589.20	36,805.53	0.90	0.00	290(48.33)	310(51.67)			
3	36,834.95	35,665.37	35,990.48	0.93	0.77	141(23.50)	246(41.00)	213(35.50)		
4	36,674.51	35,113.60	35,547.48	0.93	0.77	192(32.00)	183(30.50)	128(21.33)	97(16.17)	
5	36,773.68	34,821.44	35,364.10	0.93	0.84	105(17.50)	81(13.50)	80(13.33)	156(26.00)	178(29.67)
T1										
1	37,652.07	37,265.14	37,372.70	–	–	600(100.00)				
2	35,537.30	34,759.04	34,975.37	0.93	0.00	312(52.00)	288(48.00)			
3	35,126.88	33,957.30	34,282.40	0.94	0.03	196(32.67)	286(47.67)	118(19.66)		
4	34,971.37	33,410.46	33,844.34	0.93	0.76	164(27.33)	175(29.17)	110(18.33)	151(25.17)	
5	34,962.63	33,010.39	33,553.05	0.94	0.76	99(16.50)	143(23.84)	167(27.83)	84(14.00)	107(17.83)

Abbreviations: BIC, Bayesian information Criteria, AIC, Akaike's information Criteria, aBIC, Adjust Bayesian information Criteria, LMR, Lo-Mendell-Rubin.

anxiety and stress of Social Connectors T0-T1 at baseline (2.5%, 7.6% and 0.6% respectively) was the lowest among all latent transition categories.

Individuals of Social Isolates T0-T1 (n=107) had a median age of 75.8 years (IQR: 71.2–82.0), older than the other latent transition categories. In addition, they presented higher proportions of low household income (16.8%), being previously married (27.1%) and never married (4.7%) and poor sleep quality (25.2%) compared to the other transition categories. The prevalence of depression, anxiety and stress of Social Isolates T0-T1 at baseline (22.4%, 32.7%, and 11.2% respectively) was the highest among all latent transition categories.

Individuals who transitioned to a less favorable latent class were categorized as Bad Transition (n=42), including from Social Connectors to Subjective Social Isolates and Social Isolates, and from Subjective Social Isolates to Social Isolates. The demographic characteristics of this category were most similar to those of the Social Isolates T0-T1. Compared to the category of Good Transition, a larger proportion of individuals of Bad Transition reported symptoms of depression, anxiety and stress.

Longitudinal Associations Between Latent Transition Categories and Depression, Anxiety and Stress

Compared to Social Connectors T0-T1, Subjective Social Isolates T0-T1 (Odds ratio, OR: 3.58; 95% CI: 1.04–12.29; $p = 0.043$), Social Isolates T0-T1 (OR: 9.10; 95% CI: 2.89–28.69; $p < 0.001$), and Bad Transition (OR: 7.45; 95% CI: 1.99–27.83; $p = 0.003$) were more likely to experience depression at T2. Findings were independent of age, sex, education, marital status, family income level, sleep quality, health status and depression at T0. Compared to Social Connectors T0-T1, Social Isolates T0-T1 (OR: 4.23; 95% CI: 1.98–9.40; $p < 0.001$) and Bad Transition (OR: 2.82; 95% CI: 1.07–7.45; $p = 0.036$) were more likely to experience anxiety at T2 after adjustment for covariates and baseline anxiety. In regard to stress, Social Isolates T0-T1 (OR: 22.87; 95% CI: 2.61–200.09; $p = 0.004$) were more likely to report stress at T2 after adjustment for covariates and baseline stress compared to Social Connectors T0-T1 (Table 4). In the multivariable models, latent transition categories overrode the other covariates. Apart from psychosocial clusters and mental health outcomes at T0, only previously married status was associated with depressive symptoms at T2.

Discussion

This study employed latent class analysis to explore the psychosocial clusters of older individuals at two sequential time points, denoted as T0 and T1, and discerned three distinct latent classes: Social Connectors, Subjective Social Isolates, and Social Isolates. Subsequently, latent transition analysis was applied to discern the trajectories and probabilities of transitions within these latent classes over a span of six months. This process generated five transition categories: Social



Figure 2 Item response probabilities by latent classes.

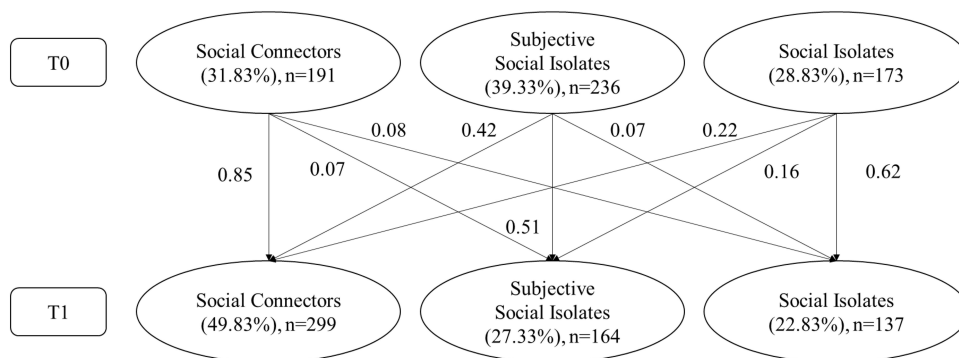


Figure 3 Latent transition probabilities based on the estimated model. This figure shows the transition proportions between latent classes from T0 to T1. The values beside the arrow lines indicate the percentage of participants transitioning between classes.

Connectors T0-T1, Subjective Social Isolates T0-T1, Social Isolates T0-T1, Good Transition and Bad Transition. The findings were consistent with our hypothesis, revealing that individuals in the Subjective Social Isolates T0-T1, Social Isolates T0-T1 and Bad Transition categories were more likely to experience depressive symptoms at T2 than those in the

Table 3 Participant Characteristics by Latent Transition Categories

Participant Characteristics at T0	Overall n=581 (100%) N (%) or Median (IQR)	Social Connectors T0-T1	Subjective Social Isolates T0-T1	Social Isolates T0-T1	Good Transition	Bad Transition	P
		n=158 (27.2%) N (%) or Median (IQR)	n=119 (20.5%) N (%) or Median (IQR)	n=107 (18.4%) N (%) or Median (IQR)	n=155 (26.7%) N (%) or Median (IQR)	n=42 (7.2%) N (%) or Median (IQR)	
Sex							0.012
Male	213 (36.7)	44 (27.8)	57 (47.9)	38 (35.5)	61 (39.4)	13 (31.0)	
Female	368 (63.3)	114 (72.2)	62 (52.1)	69 (64.5)	94 (60.6)	29 (69.0)	
Age	72.7 (69.4,77.4)	73.2 (69.4,77.0)	71.5 (68.6,76.0)	75.8 (71.2,82.0)	72.0 (69.3,77.0)	71.7 (68.7,74.5)	<0.001
Education							0.086
Primary education or lower	99 (17.0)	20 (12.7)	28 (23.5)	22 (20.6)	22 (14.2)	7 (16.7)	
Secondary education	417 (71.8)	113 (71.5)	85 (71.4)	74 (69.2)	114 (73.5)	31 (73.8)	
University and above	65 (11.2)	25 (15.8)	6 (5.0)	11 (10.3)	19 (12.3)	4 (9.5)	
Household income							0.032
High	40 (6.9)	19 (12.0)	6 (5.0)	3 (2.8)	8 (5.2)	4 (9.5)	
Medium	469 (80.7)	127 (80.4)	95 (79.8)	86 (80.4)	126 (81.3)	35 (83.3)	
Low	72 (12.4)	12 (7.6)	18 (15.1)	18 (16.8)	21 (13.5)	3 (7.1)	
Marital status							0.009
Married	469 (80.7)	133 (84.2)	105 (88.2)	73 (68.2)	126 (81.3)	32 (76.2)	
Never married	12 (2.1)	2 (1.3)	3 (2.5)	5 (4.7)	1 (0.6)	1 (2.4)	
Previously married	100 (17.2)	23 (14.6)	11 (9.2)	29 (27.1)	28 (18.1)	9 (21.4)	
Health status over the past 6 months							0.105
Good	532 (91.6)	151 (95.6)	107 (89.9)	93 (86.9)	141 (91.0)	40 (95.2)	
Poor	49 (8.4)	7 (4.4)	12 (10.1)	14 (13.1)	14 (9.0)	2 (4.8)	
Depression							<0.001
Yes	58 (10.0)	4 (2.5)	10 (8.4)	24 (22.4)	13 (8.4)	7 (16.7)	
No	523 (90.0)	154 (97.5)	109 (91.6)	83 (77.6)	142 (91.6)	35 (83.3)	
Anxiety							<0.001
Yes	99 (17.0)	12 (7.6)	19 (16.0)	35 (32.7)	24 (15.5)	9 (21.4)	
No	482 (83.0)	146 (92.4)	100 (84.0)	72 (67.3)	131 (84.5)	33 (78.6)	
Stress							<0.001
Yes	20 (3.4)	1 (0.6)	2 (1.7)	12 (11.2)	3 (1.9)	2 (4.8)	
No	561 (96.6)	157 (99.4)	117 (98.3)	95 (88.8)	152 (98.1)	40 (95.2)	

Notes: Social Connectors T0-T1: Individuals characterized as Social Connectors across T0 and T1; Subjective Social Isolates T0-T1: Individuals characterized as Subjective Social Isolates across T0 and T1; Social Isolates T0-T1: Individuals characterized as Social Isolates across T0 and T1; Good Transition: Individuals who transitioned to a more favorable latent class of social environment from T0 to T1; Bad Transition: Individuals who transitioned to a less favorable latent class of social environment from T0 to T1. Values with $p < 0.05$ are shown in bold.

Abbreviation: IQR, Interquartile range.

Table 4 Multivariable Logistic Regression Models of Associations Between Latent Transition Categories and Depression, Anxiety and Stress

	Depression		Anxiety		Stress	
	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
Latent transition category (N=581)						
Social Connectors T0-T1 (n=158)	Referent		Referent		Referent	
Subjective Social Isolates T0-T1 (n=119)	3.58 (1.04–12.29)	0.043	1.72 (0.76–3.87)	0.190	4.43 (0.37–52.56)	0.238
Social Isolates T0-T1 (n=107)	9.10 (2.89–28.69)	<0.001	4.23 (1.98–9.04)	<0.001	22.87 (2.61–200.09)	0.004
Good Transition (n=155)	2.91 (0.89–9.51)	0.077	1.58 (0.73–3.41)	0.244	3.54 (0.35–36.20)	0.287
Bad Transition (n=42)	7.45 (1.99–27.83)	0.003	2.82 (1.07–7.45)	0.036	9.01 (0.76–106.78)	0.081
Sex						
male	Referent		Referent		Referent	
female	1.94 (0.98–3.84)	0.056	1.34 (0.80–2.25)	0.263	3.44 (0.92–12.85)	0.066
Age (per 10-year increase)	1.04 (0.62–1.74)	0.883	1.06 (0.71–1.59)	0.774	1.02 (0.45–2.33)	0.955
Education						
University and above	Referent		Referent		Referent	
Secondary education	1.56 (0.49–5.02)	0.453	1.50 (0.61–3.68)	0.372	0.57 (0.13–2.55)	0.466
Primary education or lower	0.43 (0.11–1.75)	0.238	1.48 (0.55–3.99)	0.437	0.25 (0.04–1.56)	0.139
Marital status						
Married	Referent		Referent		Referent	
Never married	1.89 (0.36–10.02)	0.454	1.28 (0.32–5.15)	0.729	2.33 (0.24–22.61)	0.464
Previously married	2.23 (1.10–4.53)	0.026	1.33 (0.72–2.44)	0.362	2.49 (0.84–7.42)	0.101
Family income						
High	Referent		Referent		Referent	
Medium	0.88 (0.24–3.19)	0.844	1.25 (0.44–3.58)	0.679	0.30 (0.06–1.59)	0.159
Low	1.65 (0.39–6.99)	0.496	1.72 (0.52–5.69)	0.377	0.32 (0.04–2.62)	0.290
Sleep quality						
Good	Referent		Referent		Referent	
Bad	0.83 (0.39–1.76)	0.623	1.08 (0.59–1.96)	0.807	1.49 (0.49–4.53)	0.485
Health status over the past 6 months						
Good	Referent		Referent		Referent	
Bad	0.73 (0.26–2.00)	0.535	0.80 (0.36–1.77)	0.582	0.77 (0.13–4.48)	0.772
Depression at T0	3.24 (1.65–6.38)	<0.001	—	—	—	—
Anxiety at T0	—	—	3.46 (2.01–5.95)	<0.001	—	—
Stress at T0	—	—	—	—	2.53 (0.52–12.40)	0.253

Notes: Social Connectors T0-T1: Individuals characterized as Social Connectors across T0 and T1; Subjective Social Isolates T0-T1: Individuals characterized as Subjective Social Isolates across T0 and T1; Social Isolates T0-T1: Individuals characterized as Social Isolates across T0 and T1; Good Transition: Individuals who transitioned to a more favorable latent class of social environment from T0 to T1; Bad Transition: Individuals who transitioned to a less favorable latent class of social environment from T0 to T1. Values with $p < 0.05$ are shown in bold. Models were adjusted for all covariates shown in Table 1 and the outcome variable at T0.

Social Connectors T0-T1 category. Furthermore, the Social Isolates T0-T1 group and those within the Bad Transition category were observed to have an increased likelihood of encountering anxiety symptoms at T2, while the Social Isolates T0-T1 group also showed a greater tendency towards stress at 18-month follow-up than the Social Connectors T0-T1 category.

Our research revealed that older individuals exhibited a substantial probability of maintaining their initial class over a temporal span (>50%), particularly notable among Social Connectors (85%) and Social Isolates (62%). In other words, a majority of older adults in Social Connectors and Social Isolates were prone to retain their status, even though they were in less advantageous circumstances. The findings aligned with the existing literature positing the enduring nature of loneliness.⁴⁰ Similar observation was also found in a longitudinal study conducted in Ireland, which indicated the inherent difficulty in altering social isolation among the older population.⁴¹

When transitions among classes were observed, Subjective Social Isolates predominantly transitioned to Social Connectors (42%) rather than Social Isolates (7%). Similarly, the probabilities of Social Isolates shifting to Social Connectors were 22% and 16% to Subjective Social Isolates. The findings of our research are in line with a study conducted in the United States, which revealed stability or growth in social network size and community involvement among most older participants over ten years.⁴² Wu et al reported conflicting Results in their study, where older individuals in the Emotional Loneliness category tended to gravitate towards a more severe loneliness group, whereas the participants in Social Loneliness demonstrated a prominent trend to a less problematic status.⁴³ It is worth noting that the timing of our baseline and six-month follow-up surveys coincided with the COVID-19 pandemic, and the evolution of preventive and control measures had impacts on social interactions. However, the public health strategies in Shanghai remained stable during T0 and T1, and thus may not have significant influence on the transition of psychosocial classes. The aforementioned discoveries challenge the traditional perception that social withdrawal is a general phenomenon in late adulthood, and highlight the dynamic character of psychosocial states among the older population.

Compared with the Social Connector T0-T1 category, individuals identified as Social Isolates T0-T1 and Bad Transition categories exhibited a heightened likelihood of experiencing depressive and anxiety symptoms at T2 after adjusting for covariates and emotional symptoms at T0. The emotional disturbances associated with these transition categories for older adults merit sufficient attention. A systematic review has demonstrated that diminished perceived social support at baseline predicted more pronounced depressive symptoms at subsequent assessments.²⁵ Older adults who experience loneliness often display more severe depressive and anxiety symptoms, as life transitions and disruptive life events often occur in older age, such as loss of intimate relationship and retirement, which put them at particular risk.^{44,45} Prior findings have also linked the objective state of being physically separated from others, as might occur during COVID-19 containment efforts, with increased anxiety and deteriorating mental health in the older population.⁴⁶ Additionally, Subjective Social Isolates T0-T1 demonstrated a higher likelihood of experiencing depression at T2 rather than anxiety, underscoring the strong ties between the subjective aspects of social environment (namely loneliness and perceived social support) and depression. Our prior research in older people has reported that loneliness predicted changes in depressive symptoms, but social isolation alone did not, a finding corroborated by additional geriatric literature.^{14,18} The current study bolstered the evidence for the efficacy of depression interventions targeting subjective aspects of social connections among older adults. With regard to stress, our findings were consistent with the main hypothesis and demonstrated that individuals in Social Isolates T0-T1 were more likely to report elevated stress levels at T2 than the Social Connectors T0-T1 after adjusting for covariates and stress at T0. Previous studies have demonstrated social support as a buffer against stress among older adults.⁴⁷ The World Health Organization identified that older people, especially in isolation, may become more stressed during the COVID-19 outbreak or while in quarantine.⁴⁸ It is therefore imperative to assist older individuals changing poor or deteriorating social ties to avoid negative health outcomes.²⁵

Our findings suggested that the participants who maintained in the Social Isolates class during T0 and T1 were older, had a low degree of household income, were never/previously married, had poor sleep quality, and experienced symptoms of depression, anxiety and stress. It is noteworthy that the primary distinctions between “Good Transition” and “Bad Transition” were manifested in emotional dimensions, namely depression, anxiety, and stress levels at the initial time point (T0). Despite the primary focus of this study on the pivotal role of psychosocial factors in predicting changes in mental health outcomes, we should also acknowledge the potential impact of mental health deterioration on psychosocial states. A multitude of prior research suggested that emotional states had a detrimental effect on social relationships of older individuals.⁴¹ For instance, McHugh et al demonstrated that elevated baseline depression scores were predictive of subsequent social isolation.⁴⁹ This association may be attributable to the propensity of people with depression to diminish expectations of social engagement, deter the maintenance of social ties, and lessen the initiative towards social activity participation.⁵⁰ Recent research has continuously reported the intricate bidirectional interplay between psychosocial factors and mental health, especially between loneliness and depression.^{51–53} Specifically, loneliness often serves as a catalyst for the exacerbation of depressive symptoms, and the distressing symptoms, in turn, may further intensify an individual’s sense of loneliness, thereby generating a vicious cycle. Our study suggested the bidirectional link between emotional problems and psychosocial factors. Further, the current study extended our knowledge by providing evidence that emotional problems may lead to persistence of poor social environment or transition to

a poorer psychosocial state over time, emphasizing the need for comprehensive interventions targeting both difficulties to foster a positive interaction.

Strengths and Limitations of the Study

A major strength of this study is the longitudinal data gathered from the three waves of assessments. This approach permits an in-depth exploration of the associations between variables over time. Despite the growing acknowledgment of the impact of psychosocial factors on psychological health of older adults, as evidenced by existing research,^{10,17,23,27,29} much of the current literature focused narrowly on single factors such as loneliness or social capital,^{17,27} often relying on cross-sectional study designs. This study addressed the gap in the field by thoroughly examining four key psychosocial factors in the older population—loneliness, social isolation, perceived social support, and social capital. It not only identified potential classes based on these factors but also demonstrated the stability and dynamics of their transformations over time. The study advances our understanding of how cumulative psychosocial factors impact the mental health outcomes of older adults and highlights their potential for change over time.

However, this study has some limitations. First, despite an adequate sample size, the use of convenience sampling in two districts may lead to an underrepresentation of isolated individuals, as they may not have enough contact with community staff or volunteers and thus did not participate in our study. Second, the reliance on self-reported data had the potential for reporting bias. Third, there is the possibility of changes in some confounding variables over time, such as health status, which may affect the outcomes. Fourth, the assessment of mental health outcomes relied on screening tools, which may yield different results compared with clinical evaluations. Fifth, the data collection was conducted during the COVID-19 pandemic, which could have affected people's psychosocial states to a certain extent. Future research should explore psychosocial states and their impact among older adults during the post-pandemic period to further verify our findings. Sixth, performing a large number of statistical tests may increase the chances of type I error, potentially affecting reliability of the results. When interpreting the findings, we need to be cautious and consider the practical significance of our results. Finally, further research is warranted to delve into the underlying causes for shifts in psychosocial clusters among older adults. This would aid in developing more targeted interventions to enhance mental health of the older population.

Implications for Practice

This study emphasizes the importance of paying attention to the psychosocial factors influencing older adults. By enhancing older individuals' awareness of the detrimental impacts of negative psychosocial states, it may motivate them to seek assistance or proactively alter their circumstances. Our findings indicate a probability for isolated older adults to experience positive transitions over time. This highlights the importance of early identification of older individuals with poor psychosocial states. Such identification could be facilitated through screenings conducted by community health centers.⁴³ This proactive approach could play a pivotal role in mitigating adverse psychological outcomes and improving the overall well-being of the older population. Even for older individuals with currently positive psychosocial states, it is imperative to remain vigilant against potential declines in their social and psychological well-being. Regular organization of various activities, such as mutual support groups, can be instrumental in helping older adults maintain social connections and prevent mental health problems. This underscores the necessity for long-term tracking, dynamic monitoring, and adaptable services to address the psychosocial needs of older individuals within community settings. Additionally, our findings indicate that individuals identified as Subjective Social Isolates were more likely to experience improvements in their condition. This suggests that interventions targeting subjective factors such as loneliness could be particularly effective. Initiatives including social prescribing and community-level interventions could address and positively impact the subjective psychosocial states of older adults.⁵⁴ Moreover, to avoid the persistent poor or deteriorating social environment in older people, practitioners should actively address emotional problems which had great impact on initiative towards social activity participation and ability to maintain social ties.

Conclusion

In conclusion, this study emphasizes the significant association between adverse psychosocial environment and poor mental health outcomes among older individuals. Persistent negative psychosocial conditions, as well as transitions toward more disadvantaged psychosocial classes, were predictive of changes in symptoms of depression, anxiety, and stress during an 18-month follow-up period. Although social environment among older adults tend to be relatively stable, they are modifiable over time. It is of great interest that isolated older adults, particularly those identified as Subjective Social Isolates, were more likely to experience positive transitions compared to negative transitions. The results highlight the critical importance of early identification of older individuals who are at risk of psychosocial difficulties. The development and implementation of effective and practical interventions targeting social connections are essential to mitigate poor psychosocial environment and enhance mental health of older adults.

Informed Consent

The study procedures were conducted in compliance with the ethical principles outlined in the Declaration of Helsinki. Ethics approval was obtained from the Research Ethics Committee of the School of Public Health, Fudan University (IRB#2021-02-0876), and participants provided written informed consent. All participants participating in our study provided informed consent prior to study participation. Informed consent procedures were used to collect all study data.

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Disclosure

The authors report no conflicts of interest in this work.

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