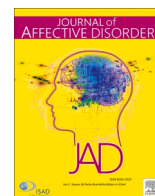




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## Research paper

# Social isolation transitions and psychological distress among older adults in rural China: A longitudinal study before and during the COVID-19 pandemic

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## ABSTRACT

**Background:** The COVID-19 pandemic could increase the number of older adults who are socially isolated including community-dwelling older adults, and result in the secondary damage of mental health. This study aimed to examine the longitudinal association between social isolation transitions and psychological distress among the community-dwelling older adults before and during the COVID-19 pandemic in rural China.

**Methods:** A total of 2749 community-dwelling older adults aged 60 years and older in rural Shandong, China were included. We used the generalized estimating equations (GEE) model to estimate the impact of social isolation transitions on psychological distress before and during the COVID-19 pandemic.

**Results:** The percentage of high and very high psychological distress ( $K10 \geq 22$ ) was 23.54% and 31.36% before and during the COVID-19 pandemic, respectively, indicating a 7.82% increase ( $P < 0.001$ ). Compared with the group remaining nonisolated, “became socially isolated” and “remained isolated” groups were more likely to have a deterioration of psychological distress after experiencing the COVID-19 pandemic (became socially isolated:  $b = 0.92$ ,  $P < 0.001$ ; remained isolated:  $b = 0.98$ ,  $P < 0.001$ ).

**Limitations:** The main variables in this study were measured by self-report information, which might result in recall bias.

**Conclusions:** During the COVID-19 pandemic, psychological distress increased among the community-dwelling older adults in rural China. There was a significant risk of psychological distress among those who had transitioned from nonisolation before the pandemic to social isolation after experiencing the pandemic, thus intervention on social isolation process during the pandemic may be important to protect older adults' mental health.

## 1. Introduction

COVID-19 has spread rapidly worldwide since December 2019 (Zhu et al., 2020). On 11 March 2020, the WHO declared the COVID-19 to be a pandemic (World Health Organization, 2021). The Chinese government took quick actions and measures, such as stay-at-home policies, bans on public gatherings, and physical distancing strategies, which helped to contain the spread of the COVID-19 pandemic effectively. The COVID-19 pandemic has caused a huge impact on individuals, not only physical but also mental health consequences (Connor et al., 2020).

Older adults are one of the most vulnerable groups during the COVID-19 pandemic, largely owing to their weaker immune systems and higher likelihood of having a chronic condition (United Nations, 2020). The COVID-19 pandemic is not just threatening their lives and safety, but also threatening their social networks, their access to health services, their mental health, and well-being.

Social isolation, defined as an “objective deficit in the number of relationships with and frequency of contact with family, friends, and the community” (Escalante et al., 2020), is a serious public health problem among older adults. Older adults are more susceptible to social isolation

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due to their health conditions, such as hearing impairment, and functional limitations (Holt-Lunstad, 2017). In addition, those older adults who live in rural areas and have poor use of social media may be particularly at risk of social isolation. Previous studies have demonstrated the long-term negative health outcomes of social isolation, which is associated with increased risk of cardiovascular (Gronewold and Hermann, 2021), suicide rates (Calati et al., 2019), and all-cause mortality (Stephoe et al., 2013) among older adults.

Theoretically, Berkman's social relationship model (Berkman et al., 2000) contends that companionship and social engagement have a positive impact on one's health status, and large-scale social change or crisis may tear the fabric of social networks which in turn have adverse consequences on health. There are widespread concerns about the current and long-term mental health effects of the COVID-19 pandemic among community-dwelling older adults (Cosco et al., 2021; Wu, 2020), as the COVID-19 pandemic could profoundly change their lives. Thus, they could experience more social isolation during the COVID-19 pandemic and result in the secondary damage of mental health.

Social isolation has been significantly associated with increased psychological distress among community-dwelling populations in previous studies (Kim and Jung, 2021; Taylor et al., 2018). However, this association among older people experiencing COVID-19 has not yet been broadly studied. In addition, limited by use of convenience samples and a lack of pre-pandemic baseline data, little is known about the consequences of social isolation in the current context of COVID-19 (Carvalho Aguiar Melo and de Sousa Soares, 2020). Negative psychological effects due to social isolation during the COVID-19 pandemic should be evaluated.

This study aimed to examine the longitudinal association between social isolation transitions and psychological distress among the community-dwelling older adults before and after the onset of the COVID-19 pandemic. Specifically, we used two-wave panel data, the baseline survey was conducted before the outbreak of COVID-19. We hypothesized that social isolation transitions due to the COVID-19 pandemic may increase the risk of psychological distress.

## 2. Methods

### 2.1. Participants

The data used in the current study were derived from the Shandong Rural Elderly Health Cohort (SREHC). The SREHC is a longitudinal panel study that observes the physical and psychological well-being of older adults in rural Shandong province. The SREHC sample was recruited through three-stage stratified cluster sampling. The procedure of the study has been reported elsewhere (Wang et al., 2021). The baseline survey was conducted between May and June 2019. The follow-up survey was conducted between August and September 2020, after the declaration of COVID-19 as a pandemic by World Health Organization. A total of 3243 participants aged 60 years and above were recruited at the baseline survey and 2785 responded to the follow-up survey. We further excluded 36 participants who had not responded to the items about psychological distress, social isolation status, physical disability, alcohol consumption, smoking status, chronic conditions, and physical activity. Thus, 2749 participants were included in the final analyses. We compared the difference between the study population ( $n = 2749$ ) and the participants ( $n = 494$ ) excluded from the study due to dropout and missing data. No significant differences in mental health, social isolation status, and other variables between these two groups were found except for chronic conditions (Supplementary Table 1).

### 2.2. Measures

#### 2.2.1. Psychological distress

The 10-items Kessler Psychological Distress Scale (K10) was used to assess psychological distress (Kessler and Mroczek, 1994). The Chinese

version of the K10 has been proven to have good reliability and validity (Zhou et al., 2008). The scale consists of 10 items about how often an individual has felt the following in the past four weeks: tired, nervous, severely nervous, helpless, restless, severely restless, depressed, everything is difficult, hopeless, and worthless. Each item is scored from 1 (none of the time) to 5 (all of the time). The total score of the K10 ranged from 10 to 50, with higher scores indicating the higher risk of psychological distress, and respondents with scores of 22 or above were considered to suffer from high to very high psychological distress. This classification for screening mental illness has been validated in previous research (Baxter et al., 2021; Xu et al., 2005). In the analysis model we used continuous values of K10 score, rather than the cutoff point, because we could observe marginal change of K10 score with psychological distress. Internal consistency (Cronbach's  $\alpha$ ) was 0.90 at baseline and 0.91 at follow-up.

#### 2.2.2. Social isolation status

Based on the previous research (Guo et al., 2021; Smith et al., 2021), the social isolation index used in our study was constructed from three questions: 1) Including yourself, how many people are living together in your household (1 point was given for living alone); 2) how often do you contact (e.g. phone, meet, email) family members (1 point was given for answering about rarely or never, monthly, or no family outside household); 3) which of the following (e.g. interacted with friends; played chess or cards; going to the community club; went to a sport, social, or other clubs; did voluntary or charity work) do you engage in once a week or more often (1 point was given for answering none of the above). Individual scores were summed to calculate an overall score ranging from 0 to 3, with higher scores indicating greater isolation. Social isolation scores were positively skewed, we defined social isolation as social index score  $\geq 1$  (Gale et al., 2018). Based on their social isolation status before and during the COVID-19, the participants were classified into 4 groups: "remained nonisolated," "became socially isolated," "became not socially isolated," and "remained isolated".

#### 2.2.3. Control variables

Based on the existing studies (Kuriyama et al., 2009; Zhang and Chen, 2014), control variables can be divided into three categories: socio-demographic characteristics, health behaviors and health status. Socio-demographic characteristics include sex (male or female), age, education (illiteracy, primary school, or junior school or above), marital status (married or divorced/widowed/unmarried), and household income per capital. Health behaviors include smoking (current or ex/non-smoker), alcohol drinking (current or ex/non-drinker), and physical activity (light, moderate, or vigorous). Smoking status was measured by the question "What is your current smoking status?". Respondents answer "smoker", "ex-smoker" or "non-smoker" for this question. Drinking status was measured by the question "What is your current drinking status?". Respondents answer "drinker", "ex-drinker" or "non-drinker" for this question. Physical activity was assessed using the short version of the International Physical Activity Questionnaire (IPAQ-S) (Fan et al., 2014). According to weekly physical activity in the last 7 days, we categorized participants into three groups: light (3.3 metabolic rate, METs), moderate (4.0 METs), and vigorous (8.0 METs) physical activity. Health status include the number of chronic diseases (zero, one, or two and above), and physical disability. Participants were asked to report whether they had a chronic disease that had been diagnosed in the town clinic or superior level hospital. The self-reported chronic diseases were also validated by the village doctors in the sampling villages using the non-communicable chronic case registration system. We used the number of chronic diseases to represent chronic conditions. Physical disability was assessed by the Activities of Daily Living Scale (Katz et al., 1963; Lawton and Brody, 1969). The 14-item ADL ranged from 14 to 56, with higher scores indicating the worse ability of daily living activities.

2.3. Statistical analysis

First, we compared individual characteristics between the four groups of social isolation transitions using the descriptive statistics. McNemar's test was used to examine the percentage of people who scored 22 or more in the K10. Second, we used the generalized estimating equations (GEE) (Zeger et al., 1988) model with unstructured working correlation matrix to estimate the impact of social isolation change on psychological distress before and during the COVID-19 pandemic. To determine whether the psychological distress changed before and during the COVID-19 pandemic, we included time (year) in the model as a categorical covariate. The interaction terms between the social isolation change and time were examined to see the changes in the psychological distress of participants with different social isolation transitions before and during the COVID-19 pandemic. Third, a sensitivity analysis was performed using multiple linear regression analysis to examine the effects of social isolation on psychological distress during the COVID-19, and the effects of social isolation change on psychological distress change. Continuous isolation scores and its change were used in the sensitivity analysis. We conducted all analyses in Stata 15.1 (StataCorp, College Station, TX). Statistical significance was set at two-side *p* value <0.05.

2.4. Ethical considerations

This study was approved by the Ethics Committee of Shandong University (approval No. 20181228; approval date, 28 December 2018). Written informed consents clarifying the study purposes, significance, methods, and risks were obtained from each participant before the survey. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 1989).

3. Results

A total of 2749 rural older people who completed both the baseline and follow-up surveys were included in the analyses. As shown in Table 1, the percentage of high and very high psychological distress (K10 ≥ 22) was 23.54% and 31.36% in the baseline and follow-up surveys, respectively, indicating a 7.82% increase (*P* < 0.001). From baseline to follow-up, K10 score values increased from 16.64 ± 7.44 to 18.23 ± 8.06 in the whole sample (*P* < 0.001). Table 2 shows the baseline characteristics of the participants. According to the social isolation status before and during the COVID-19 pandemic, 1028 (37.40%), 489 (17.79%), 437 (15.89%), 795 (28.92%) were in the “remained nonisolated,” “became socially isolated,” “became not socially isolated,” and “remained isolated” groups, respectively (shown in Fig. 1). All the K10 were increased during the COVID-19 pandemic (“remained nonisolated” group: increased from 15.17 ± 6.36 to 16.22 ± 7.14; “became socially isolated” group: from 16.43 ± 7.73 to 18.54 ± 8.27; “became not socially isolated” group: from 18.05 ± 7.92 to 19.34 ± 8.18; “remained isolated” group: 17.89 ± 7.90 to 20.04 ± 8.41).

Model 1 in Table 3 shows the effect of different social isolation transitions before and during the COVID-19 pandemic on changes in

Table 1

K10 score values and psychological distress of rural older adults before and during COVID-19 pandemic.

	Before COVID-19	During COVID-19	<i>P</i> -value
K10 score (range:10–50)			
Mean (SD)	16.64 (7.44)	18.23 (8.06)	0.001
Psychological distress			
Low or moderate (K10 < 22)	2102 (76.46%)	1887 (68.64%)	0.001
High to very high (K10 ≥ 22)	647 (23.54%)	862 (31.36%)	

Note: K10, Kessler Psychological Distress Scale.

Table 2

Baseline characteristics of the total sample by category of social isolation change (N = 2749).

Characteristics	Social isolation change			
	Remained nonisolated	Became socially isolated	Became not socially isolated	Remained isolated
No. of subjects	1028 (37.39)	489 (17.79)	437 (15.90)	795 (28.92)
Age	68.84 ± 5.57	69.75 ± 5.64	70.08 ± 6.44	72.32 ± 6.41
Gender				
Male	373 (36.28)	207 (42.33)	149 (34.10)	275 (34.59)
Female	655 (63.72)	282 (57.67)	288 (65.90)	520 (65.41)
Educational level				
Illiteracy	387 (37.65)	188 (38.45)	181 (41.42)	387 (48.68)
Primary school	385 (37.45)	192 (39.26)	182 (41.65)	307 (38.62)
Junior school or above	256 (24.90)	109 (22.29)	74 (16.93)	101 (12.70)
Marital status				
Divorced/widowed/unmarried	101 (9.82)	52 (10.63)	67 (15.33)	474 (59.62)
Married	927 (90.18)	437 (89.37)	370 (84.67)	321 (40.38)
Household income per capita, median (Q25, Q75)	5440 (2730, 12,573)	4914 (2280, 11,460)	4000 (2140, 8640)	3440 (1576, 6880)
Smoking				
Current smoker	211 (20.53)	110 (22.49)	94 (21.51)	159 (20.00)
Ex or non-smoker	817 (79.47)	379 (77.51)	343 (78.49)	636 (80.00)
Alcohol intake				
Current drinker	220 (21.40)	125 (25.56)	85 (19.45)	183 (23.02)
Ex or non-drinker	808 (78.60)	364 (74.44)	352 (80.55)	612 (76.98)
Number of chronic diseases				
Zero	302 (29.38)	147 (30.06)	106 (24.25)	182 (22.89)
One	370 (35.99)	171 (34.97)	167 (38.22)	309 (38.87)
Two and above	356 (34.63)	171 (34.97)	164 (37.53)	304 (38.24)
Physical activity				
Light physical activity	181 (17.61)	100 (20.45)	132 (30.21)	219 (27.55)
Moderate physical activity	379 (36.87)	181 (37.01)	132 (30.21)	316 (39.75)
Vigorous physical activity	468 (45.53)	208 (42.54)	173 (39.58)	260 (32.70)
ADL disability score	16.24 ± 3.47	16.36 ± 3.56	18.05 ± 5.10	17.60 ± 4.48
K10 score (baseline)	15.17 ± 6.36	16.43 ± 7.73	18.05 ± 7.92	17.89 ± 7.90
K10 score (follow-up)	16.22 ± 7.14	18.54 ± 8.27	19.34 ± 8.18	20.04 ± 8.41

Note: Values are mean ± standard deviation (SD) or n (%).

ADL, activities of daily living; K10, Kessler Psychological Distress Scale.

psychological distress. GEE model 1 showed that, for all individuals, compared with before the COVID-19 pandemic, K10 score values during the pandemic significantly increased with an estimated change of 1.59 (*P* < 0.001), which indicated that the psychological distress deteriorated during the pandemic. All the K10 score were significantly higher than the group remaining nonisolated. The K10 scores of became socially isolated group (*b* = 1.79, *P* < 0.001), became not socially isolated group (*b* = 3.00, *P* < 0.001), and remained isolated group (*b* = 3.27, *P* < 0.001) were significantly higher than those of remained nonisolated

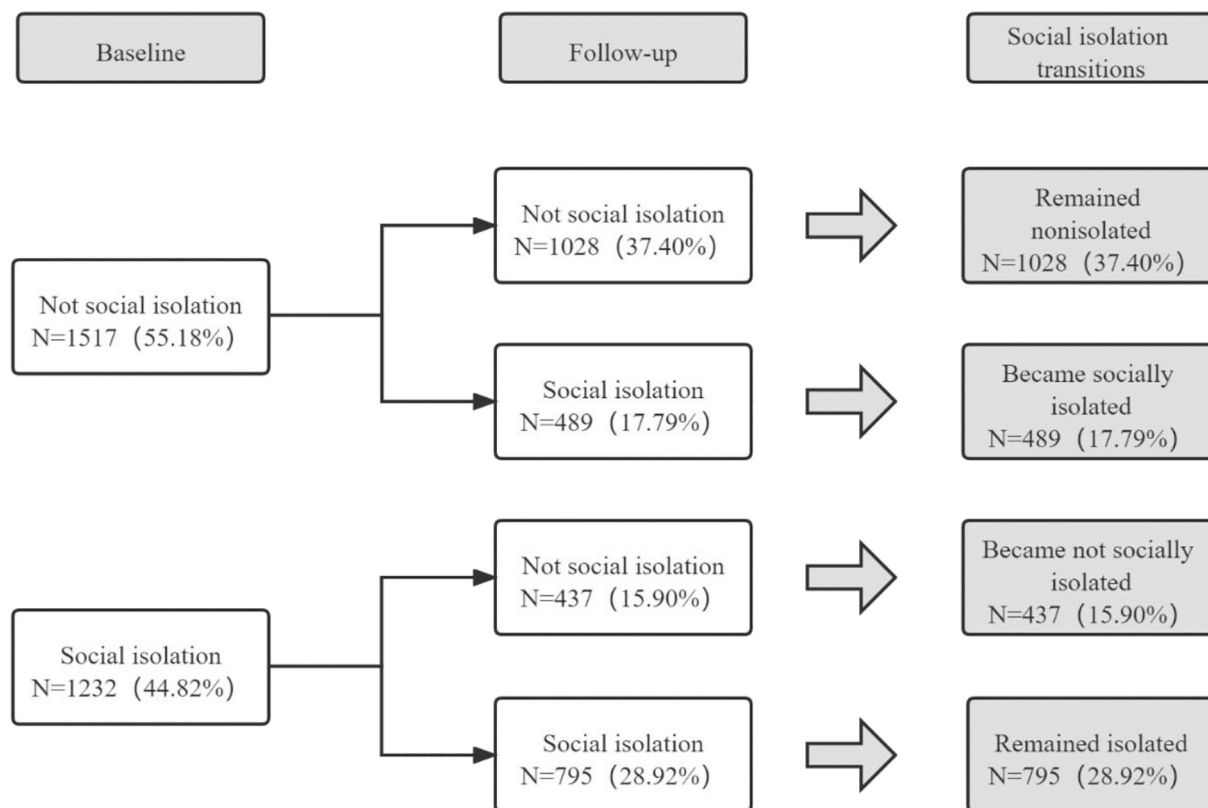


Fig. 1. Different social isolation transitions before and during the COVID-19.

group. Model 2 in Table 3 shows that, regarding the change of K10 score before and during the COVID-19 pandemic, compared with the group remaining nonisolated, there was a significant increase among those who had transitioned from nonisolation to social isolation ( $b = 0.92, P < 0.001$ ) and remained isolated ( $b = 0.98, P < 0.001$ ).

The sensitivity analysis (Supplementary Table 2) shows a consistent finding with the main analyses, that higher level of social isolation at baseline was associated with more severe psychological distress at follow-up.

#### 4. Discussion

The general connection between social isolation and poor mental health has been demonstrated (Kim and Jung, 2021; Taylor et al., 2018). In the context of COVID-19, social isolation may especially have detrimental impact on older adults' health. We examined the effect of social isolation transitions on psychological distress among 2749 community-dwelling older people before and during the COVID-19 pandemic in rural China. To our knowledge, it is the first study to examine the longitudinal association between social isolation transitions and psychological distress in the context of the COVID-19 pandemic. We found that social isolation transitions could increase the risk of psychological distress during the COVID-19 pandemic, which provides more evidence for the secondary psychological impact of the COVID-19 pandemic. It is worth noting that our follow-up survey was carried out from August to September 2020, when the pandemic in China has controlled, but there was still a risk of imported cases and sporadic case. Future studies will need to monitor the trajectory of mental health outcomes, in order to investigate longer term impacts of the COVID pandemic.

Our study suggested that psychological distress had increased compared with pre-COVID-19 trends among community-dwelling older adults, which was similar to previous studies that the COVID-19 pandemic may place considerable psychological burden on people (Fujita et al., 2021). As an inevitable stressful life event, the pandemic

could cause negative psychological impact with more anxiety and depression among the older adults (Vindegaard and Benros, 2020). The adverse psychological consequences of the pandemic should not be neglected. In our study, all the groups of social isolation transition increased during the pandemic. This may be because that, self-protection (e.g., keeping social distance) due to the pandemic by the older adults might aggravate social exclusion and have negative psychological consequences. In addition, higher mortality and the fears of COVID-19 can also increase their anxiety and depression (Ran et al., 2020).

Our study found that the adults who remained social isolation had a greater risk of psychological distress, which confirmed that social isolation was positively associated with psychological distress. Interestingly, early reports on mental health consequences of COVID-19 social distancing measures have found that mental health outcomes of older adults remain stable (Van Tilburg et al., 2021). These early surveys may be influenced by the perception that such measures were temporary. Mental health challenges may be more prominent after prolonged exposure to social isolation. For the older generation, double burden of age-related diminishing social spheres and the implementation of social distancing measures were likely to contribute to increasing social isolation and loneliness generally (Loades et al., 2020), which would adversely affect their psychological health. Social isolation in our study represents the objective lack of social contact including living alone, social connection, and participation with others. To begin with, it is well established that living alone has adverse effects on mental health (Stone et al., 2013). Next, the fundamental role of social connectedness as a protective factor for mental health has been emphasized (Thoits, 2011). Finally, engaging informal social participation could protect against declining mental health (Santini et al., 2021). Therefore, the lack of social connections and companionship and low frequency of social participation might be detrimental to mental health of older adults, that is social isolation may present health risks for older adults. In addition, biological pathways may explain the negative psychological effects of

**Table 3**  
Longitudinal association between social isolation and psychological distress by GEE.

Variable	Model 1			Model 2		
	b	SE	P	b	SE	P
Intercept	14.90	0.23	<0.001	15.13	1.72	<0.001
Social isolation transitions						
Remained nonisolated	Ref.			Ref.		
Became socially isolated	1.79	0.38	<0.001	1.40	0.40	<0.001
Became not socially isolated	3.00	0.40	<0.001	2.39	0.42	<0.001
Remained isolated	3.27	0.33	<0.001	2.73	0.38	<0.001
Time						
Before COVID-19	Ref.			Ref.		
During COVID-19	1.59	0.12	<0.001	1.12	0.20	<0.001
Social isolation × time						
Remained nonisolated × during COVID-19				Ref.		
Became socially isolated × during COVID-19				0.92	0.34	0.006
Became not socially isolated × during COVID-19				0.40	0.35	0.250
Remained isolated × during COVID-19				0.98	0.29	0.004
Control variables						
Women	1.95	0.31	<0.001	1.97	0.31	<0.001
Age	-0.07	0.02	<0.001	-0.07	0.02	0.002
Primary school	0.13	0.29	0.664	0.12	0.29	0.686
Junior school or above	-0.26	0.38	0.481	-0.28	0.38	0.457
Married	0.66	0.31	0.030	0.68	0.31	0.027
Income	-0.01	0.01	0.014	-0.01	0.01	0.020
Current smoker	0.61	0.30	0.038	0.60	0.30	0.043
Current drinker	-0.74	0.07	0.005	-0.68	0.27	0.010
ADL disability	0.16	0.02	<0.001	0.16	0.02	<0.001
One chronic condition	0.98	0.22	<0.001	0.99	0.22	<0.001
2/more chronic conditions	2.14	0.24	<0.001	2.15	0.24	<0.001
Moderate physical activity	-0.58	0.23	0.011	-0.61	0.23	0.008
Vigorous physical activity	-0.98	0.23	<0.001	-0.97	0.23	<0.001

Note: GEE: generalized estimating equation; SE, standard error; ADL, activities of daily living; Ref.: reference.

social isolation in older adults (Cacioppo and Hawkey, 2009). In detail, social isolation would activate neural, neuroendocrine, and behavioral responses, and its effects include anxiety, hostility, negativity, and depressive symptoms.

Importantly, our study identified that not only the older adults who remained social isolation, but also those who became socially isolated had a greater risk of psychological distress after experiencing the pandemic, which reinforces the importance of intervention on social isolation. Since the COVID-19 pandemic could profoundly change their lives and their social network status (Martinez-Ferran et al., 2020), social isolation was a great challenge for older people as they tend to have smaller social networks than younger counterparts (Gerst-Emerson and Jayawardhana, 2015). The COVID-19 pandemic has exacerbated these challenges (Ammar et al., 2021), decrease in social interaction and social participation can worsen pre-existing social isolation. Reducing social isolation might prevent negative effects on older adults' mental health. During the pandemic, maintaining social networks and social engagement was beneficial for older adults to decrease social isolation. Studies have shown that social support can mediate social isolation and reduce psychological distress (Gong et al., 2020; Zhang and Chen, 2014). During the COVID-19 pandemic, it is crucial for older adults to maintain contact with their family and friends by existing technologies such as telephone, e-mail, and Wechat (Zhang et al., 2017). In China, the

epidemic has been successfully controlled, and social interaction is gradually back to normal. However, the epidemic in many countries is not over, social isolation should be identified as one of the public health priorities during the COVID-19 pandemic.

This study has several limitations. First, the information used in this study was measured by self-report, which might result in recall bias. Second, our study only recruited rural older people, further study including urban older people is needed. Third, although we took multiple covariates into account, other confounding factors, such as COVID-19 related exposure (e.g., being quarantined, knowing significant others who were hospitalized or died because of the disease), could affect their social isolation and psychological health. Despite these limitations, this study used a longitudinal design to reveal the association between social isolation transitions and psychological distress before and during the COVID-19 pandemic. In addition, it has a large number of subjects, thus drawing significantly reliable conclusions.

### 5. Conclusion

During the COVID-19 pandemic, psychological distress increased among the community-dwelling older adults in rural China. Mental health measures should be taken together with protective measures against COVID-19 infection. There was a significant risk of psychological distress among those who had transitioned from non-isolation to social isolation after experiencing the pandemic, thus intervention on social isolation process during the pandemic may be important to protect older adults' mental health.

### Author statement contributors

Jie Li performed all statistical analyses and wrote the paper. Jie Li supervised the data analysis and contributed to revising the paper, Chen Yan, Shijun Yang, Zhixian Li, and Wenjuan Li helped to plan the study, including the instrumentation, and developed the study procedures and oversaw data collection. Chengchao Zhou planned the study, supervised the data analysis, and contributed to the writing and revision of the article. All authors read and approved the final manuscript.

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### Conflict of interest

The authors have no conflicts of interest to declare.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2022.04.045>.

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