



# Fear of COVID-19 and Adverse Psychological Health Outcomes Among Chinese Elderly: a Serial Mediation Model of Social Participation and Loneliness

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## Abstract

This cross-sectional study examined fear of COVID-19, social participation, loneliness, and adverse psychological health outcomes among Chinese older adults after the pandemic control measures were relaxed. We also tested the correlations among these variables and examined the serial-mediating effects of social participation and loneliness on the relationship between fear of COVID-19 and adverse psychological health outcomes. Participants were 508 Chinese elderly individuals ( $M_{\text{age}} = 70.53 \pm 7.90$  years; 56.5% women). We used Pearson correlation analyses and Hayes' PROCESS macro analysis (Model 6). Respondents had a relatively higher level of fear of COVID-19 compared to the general population. Their levels of loneliness, anxiety, and depression were higher than those of Chinese older adults who were surveyed before the restriction policy changed in previous research. The correlations among fear of COVID-19, social participation, loneliness, and adverse psychological health outcomes were significant, supporting the serial-mediating effects of social participation and loneliness on the relationship between fear of COVID-19 and adverse psychological health outcomes. Attention should be paid to the mental health issues of Chinese older adults, and the impacts of fear of COVID-19 and social participation on their mental health should be emphasized. Future researchers should use random systematic sampling methods, conduct longitudinal tracking and perform intervention studies.

**Keywords** COVID-19 · Older adults · Fear · Loneliness · Social participation

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## Introduction

The coronavirus disease 2019 (COVID-19) pandemic is an unprecedented global public health crisis that has significantly impacted public health and led countries worldwide to adopt various medical, health, and public management policies to combat pandemic transmission. China, where the pandemic was first detected in 2019, implemented strict measures, such as lockdowns and travel restrictions, to contain its spread. However, after three years of rigorous control, China relaxed its pandemic restriction policies in December 2022, which potentially led to a surge in COVID-19 infections in a short period. As the virus continues to mutate, Chinese citizens, like those in other countries, also face the risk of repeated infections. The elderly population in China is the most vulnerable demographic to the health risks associated with the pandemic. According to the data from Shanghai Municipal Health Commission, more than 90% of COVID-related deaths in Shanghai China have occurred among older adults (Shanghai Municipal Health Commission, 2022). As China has the world's largest elderly population, it is essential to pay more attention to how Chinese elderly people are affected by the COVID-19 pandemic (Lancet, 2022). However, the recent relaxation of pandemic restriction policies in China has left a gap in the analysis of psychological health risks and living conditions faced by the elderly after the policy change. Therefore, it is necessary to conduct more research on this issue.

The COVID-19 pandemic may have various impacts on people. One prevalent psychological impact of the pandemic is the fear of COVID-19. It is a form of affective response that arises in reaction to the pandemic threat. This response is characterized by the presence of subjective feelings of apprehension and unease related to the perceived risk of contracting the virus or experiencing negative outcomes associated with the disease (Satici et al., 2021). The fear of COVID-19 has been particularly pronounced among elderly individuals, who are at higher risk of severe illness and death from the virus. Current evidence suggests that there could be regional variations in the level of fear experienced by the elderly. While studies from Bangladesh ( $M = 19.4$ ) and Turkey ( $M = 19.1$ ) showed slightly elevated mean scores of fear among the older adults in comparison to the score of the general population ( $M = 18.5$ ) reported in a systematic review, a study conducted in Taiwan found that the level of fear among elderly individuals in Taiwan was not high and was lower than the scores reported in the earlier study from Bangladesh (Li et al., 2021; Luo et al., 2021; Mistry et al., 2021; Savci et al., 2021). Although a systematic review by Liu et al. (2022a) reported that older adults in China expressed 55.7% of worry and fear during the pandemic, specific scores were not provided.

The impact of the COVID-19 pandemic on social behaviors and psychological health outcomes is a growing area of research. Some literature suggests that fear of contracting the virus could cause individuals to reduce their participation in social activities to avoid infection (Rahman et al., 2020; Valeri et al., 2021). Research also indicates that the pandemic could increase feelings of loneliness and exacerbate anxiety and depression levels (Ausín et al., 2021; Bu et al., 2020;

Elran-Barak & Mozeikov, 2020; Mistry et al., 2021; Torales et al., 2020). Older individuals, in particular, are more vulnerable to social isolation, loneliness, anxiety, and depression than their younger counterparts (Girdhar et al., 2020; Rolandi et al., 2020; Tomaz et al., 2021).

Although existing aging research has shown a significant association between social participation and adverse psychological outcomes such as loneliness, anxiety, and depression in older adults, limited research has explored the interrelationships between these factors in the context of the COVID-19 pandemic. A single study from Israel emphasized that loneliness was the most significant risk factor for anxiety and depression among older adults during the COVID-19 outbreak (Palgi et al., 2020). Further, it is necessary to investigate whether fear of the pandemic in older adults is significantly associated with their sense of loneliness, anxiety, and depression. Thus, further investigation is needed to explore the complex relationship and interactive mechanisms between fear of the pandemic, social participation, loneliness, anxiety, and depression among older adults during the pandemic. Determining whether social participation and loneliness play a serial-mediating role in the relationship between fear of COVID-19 and adverse psychological health outcomes is essential.

The Protection Motivation Theory (Rogers & Prentice-Dunn, 1997) provides a relevant framework to understand how people respond to threats and risks by assessing their perceived vulnerability and the efficacy of potential coping strategies. According to this theory, people assess their perceived vulnerability to a threat and the efficacy of potential coping strategies to determine how they will respond. In the case of the COVID-19 pandemic, older adults perceive the virus as a significant threat owing to their increased vulnerability to the disease. Consequently, many older adults engage in protective behavior, such as avoiding social participation and staying home to reduce their risk of infection. While these protective behaviors can help prevent the spread of COVID-19, they can also have adverse psychological consequences for older adults. For instance, avoiding social participation can lead to increased loneliness, social isolation, and disconnection, contributing to adverse psychological outcomes such as depression and anxiety. Moreover, the combination of fear of COVID-19, social isolation, and loneliness can intensify these adverse psychological outcomes—creating a negative cycle that can further decrease social participation and increase loneliness.

Therefore, the Protection Motivation Theory highlights the importance of considering not only the immediate health risks but also the potential long-term psychological consequences of protective behaviors, which are perceived as the essential aspects of their quality of life, particularly among vulnerable populations such as older adults.

In China, the focus of research on the elderly population during the COVID-19 pandemic has primarily been on analyzing the incidence and correlates of anxiety and depression (Meng et al., 2020; Zhou et al., 2021). However, only a small number of studies have assessed the severity of negative health outcomes by estimating the mean scores of loneliness, social participation, anxiety, and depression (Lam et al., 2010; Liu et al., 2022b; Niu et al., 2020; Song, 2020; Wu et al., 2010). Moreover, there is a lack of comprehensive analysis regarding the impact of the

pandemic on the elderly, particularly after the restriction policy has been altered. Since China has the world's largest elderly population, it is imperative to conduct a thorough investigation of the elderly's issues during the pandemic. Therefore, further research is necessary to examine the interactive mechanisms and relationship between social functioning and adverse psychological health outcomes, especially among older adults, in the context of the changed restriction policies in China.

To address the aforementioned research gaps, this study employs a descriptive cross-sectional design to measure the levels of fear of COVID-19, social participation, loneliness, and adverse psychological health outcomes (depression and anxiety) among older adults in China. This study analyzes the interrelationships among these variables. It evaluates whether the effect of fear of COVID-19 on adverse psychological outcomes is mediated by social participation and loneliness with a serial multiple mediation model. This model helps to elucidate the link between fear of COVID-19 and adverse psychological health outcomes, shed light on any sequential causality between the two mediators (social participation and loneliness), and determine whether fear of COVID-19 has direct or indirect effects on these psychological outcomes.

## Materials and Methods

### Participants and Procedure

Eligible participants were older adults aged 60 years or older, residing in Guangzhou, China, and could complete a survey written in Chinese either alone or with the assistance of another person. A mixed-mode approach was used for data collection, combining paper-based and electronic surveys. The paper-based survey was home-distributed via a routine home-visit program with the assistance of a local community service institution in Guangzhou. The electronic survey was constructed and distributed using "Questionnaire Star"—an online crowdsourcing platform in China that provides functions equivalent to Amazon Mechanical Turk. On average, the survey took 20 min to complete, and participants were fully informed of the research purpose, data confidentiality process, and their rights and obligations before data collection. Participants completed a consent sheet if they agreed to participate. This study received ethical approval from an appropriate institution [blinded for review].

Convenience sampling was used to recruit 508 participants, resulting in a response rate of 97.50%. Of the 521 participants who opened the survey, 13 participants' data were withdrawn owing to incomplete survey measures ( $n=7$ ) or failing to satisfy the age inclusion criteria ( $n=6$ ). Additional information about participants is provided in Table 1.

### Measures

The present study employed four measures to assess the variables of interest, namely fear of COVID-19, social participation, loneliness, and two adverse

**Table 1** Participants' demographic characteristics (*N* = 508)

Variable		<i>n</i>	%
Age (years)	60–70	296	58.3
	71–80	147	28.9
	> 80	65	12.8
Sex	Male	221	43.5
	Female	287	56.5
Living with family	Yes	378	74.4
	No	130	25.6
Monthly household income (RMB)	< 2,000	111	21.9
	2,000–5,000	212	41.7
	> 5,000	185	36.4

*n* = number of cases; COVID-19 = coronavirus disease 2019. The monthly household income is computed in China's currency: the renminbi (RMB)

psychological health outcomes, namely depression and anxiety. Demographic variables, such as age, sex, living arrangement and household income, were also collected to provide contextual information for the sample. These variables were subsequently included in the serial model analysis to control for potential confounding biases.

## Fear of COVID-19

The Fear of COVID-19 Scale, a unidimensional self-report instrument, was utilized to gauge the severity of fear of COVID-19. The scale comprises seven items. Responses are rated on a five-point Likert scale, with higher scores indicating a greater degree of fear. The scale was created by Ahorsu et al. (2022), and its internal consistency in the current sample was excellent, as indicated by a Cronbach's alpha coefficient of 0.93. The total score on the scale ranges from 7 to 35.

## Social Participation

To assess social participation, items were selected from the China General Social Survey, a comprehensive and household-based continuous social survey in China. The survey measures the types of social activities elderly individuals engage in and comprises three domains: participating in entertaining activities, gatherings with relatives and friends, and involvement in cultural activities. It comprises 12 items, with responses rated on a five-point frequency scale. Higher scores on the scale, ranging from 5 to 25, indicate a stronger sense of social participation (Liu et al., 2022a, b). The scale's internal consistency in the current sample was acceptable, with a Cronbach's alpha coefficient of 0.77.

## Loneliness

The shorter version of the UCLA Loneliness Scale (Hays & DiMatteo, 1987) was used to assess loneliness. The scale comprises eight items, with responses rated on a four-point Likert scale ranging from “never” to “always.” The total score on the scale is obtained by summing all the items, with higher scores indicating a greater degree of loneliness. The scale’s internal consistency in the current sample was good, with a Cronbach’s alpha coefficient of 0.87.

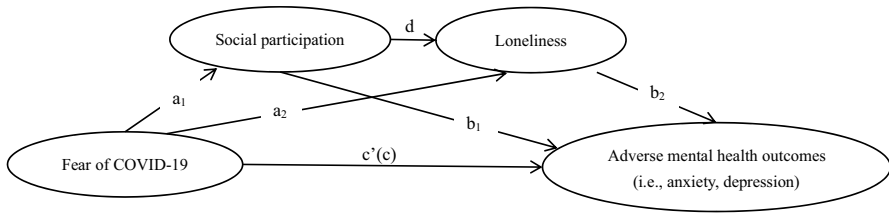
## Anxiety and Depression

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used to evaluate symptoms of anxiety and depression. This self-rating instrument comprises 14 items, with seven items measuring the severity of anxiety (HADS-A) and seven items measuring the severity of depression (HADS-D). Each item is rated on a scale from 0 to 3 points, with scores ranging from 0 to 21 points for both HADS-A and HADS-D. Higher scores indicate more severe symptoms of anxiety or depression. In this study, the scale’s internal consistency was acceptable, with a coefficient alpha of 0.80 (0.73 for HADS-A and 0.66 for HADS-D).

## Data Analysis

Prior to analysis, the data were organized, coded, and entered into SPSS 23.0 (IBM Corp., Armonk, NY, USA). The normality of the data was assessed by checking skewness and kurtosis values, which did not exceed  $\pm 2$  (George & Mallery, 2003), indicating that the data met the assumption of normality.

The analyses were conducted in three steps. First, demographic characteristics were examined using descriptive statistics and frequencies. Means and standard deviations were calculated for study variables. Second, Pearson correlations were used to test the relationships among study variables. Cohen (1992) proposed that correlation coefficients around 0.10 indicate a minimum effect size, coefficients near 0.30 indicate a moderate effect size, and coefficients above 0.50 indicate a strong effect size. Third, a serial mediation model (PROCESS macro, Model 6) proposed by Hayes (2018) was used to estimate the indirect effects of social participation and loneliness (with social participation as the first-order mediator and loneliness as the second-order mediator) on the relationship between fear of COVID-19 and adverse psychological health outcomes. The model had two mediators and two outcomes, resulting in six specific indirect paths: (1) fear of COVID-19 → social participation → anxiety; (2) fear of COVID-19 → loneliness → anxiety; (3) fear of COVID-19 → social participation → loneliness → anxiety; (4) fear of COVID-19 → social participation → depression; (5) fear of COVID-19 → loneliness → depression; and (6) fear of COVID-19 → social participation → loneliness → depression. To determine the significance of the indirect effects, 95% bias-corrected accelerated confidence intervals (CIs) were calculated using



**Fig. 1** A two-mediator serial mediation chain of the association between fear of COVID-19 and adverse psychological health outcomes. Note. COVID-19=coronavirus disease 2019.  $a_1$ =effect of fear of COVID-19 on social participation;  $a_2$ =effect of fear of COVID-19 on loneliness;  $b_1$ =effect of social participation on adverse psychological health distress;  $b_2$ =effect of loneliness on adverse psychological health distress;  $c'$  = direct effect of fear of COVID-19 on adverse psychological health outcomes;  $c$ =total effect of fear of COVID-19 on adverse psychological health outcomes;  $d$ =effect of social participation on loneliness

5000 re-samples. Indirect effects were considered significant if the 95% CI did not include zero. Standardized effect sizes were estimated and reported. In the present study, demographic factors were investigated as a priori potential confounders. The covariates selected for analysis included age, sex, living arrangement and household income. Figure 1 illustrates the conceptual model of the serial mediation chain.

## Results

### Descriptive Statistics

A total of 508 elderly Chinese participants were included in this study, aged 60 to 98 years ( $M=70.53$ ,  $SD=7.90$ ). The sample consisted of 287 women (56.5%) and 221 men (43.5%), with 74.4% living with families and only 25.6% living alone. Regarding household income, 63.6% had an average monthly earned income of 5000 renminbi (equivalent to 724 US dollars) or below (Table 1).

The mean score of fear of COVID-19 was 19.40 ( $SD=6.52$ ), social participation was 30.73 ( $SD=7.69$ ), and loneliness was 16.85 ( $SD=5.16$ ). The HADS was used to assess anxiety and depression symptoms, with a mean score of 8.02 ( $SD=3.51$ ) for HADS-A and 8.98 ( $SD=3.78$ ) for HADS-D (Table 2).

**Table 2** Descriptive statistics for all study measures

Variable	<i>M</i>	<i>SD</i>	Cronbach's alpha
Fear of COVID-19	19.400	6.521	0.926
Social participation	30.730	7.692	0.767
Loneliness	16.845	5.157	0.865
Anxiety	8.020	3.508	0.727
Depression	8.978	3.781	0.661

*M*=mean; *SD*=standard deviation; COVID-19=coronavirus disease 2019

**Table 3** Correlation matrix of Spearman's correlation coefficients

Variable	1	2	3	4	5
1. Fear of COVID-19	1				
2. Social participation	-0.130**	1			
3. Loneliness	0.458**	-0.313**	1		
4. Anxiety	0.514**	-0.305** (0.000)	0.612**	1	
5. Depression	-0.354**	-0.487**	0.628**	0.561**	1

COVID-19=coronavirus disease 2019. \*\* $p < .01$

### Correlations Among Study Variables

Significant associations between study variables are presented in Table 3. Fear of COVID-19 showed a negative correlation with social participation ( $r = -.13$ ,  $p < .05$ ) and positive correlations with loneliness ( $r = .46$ ,  $p < .05$ ), anxiety ( $r = .51$ ,  $p < .05$ ), and depression ( $r = -.35$ ,  $p < .05$ ). Social participation was negatively associated with loneliness ( $r = -.31$ ,  $p < .05$ ), anxiety ( $r = -.31$ ,  $p < .05$ ), and depression ( $r = -.49$ ,  $p < .05$ ). Loneliness was positively related to adverse psychological health outcomes of anxiety ( $r = .61$ ,  $p < .05$ ) and depression ( $r = .63$ ,  $p < .05$ ).

### Testing the Serial Mediation Model

The multiple regression analysis showed that fear of COVID-19 negatively predicted social participation ( $\beta = -0.153$ ,  $p < .01$ ). If fear of COVID-19 ( $\beta = 0.336$ ,  $p < .001$ ) and social participation ( $\beta = -0.173$ ,  $p < .001$ ) were both taken as predictors, their effects on loneliness were significant. When fear of COVID-19 (anxiety:  $\beta = 0.160$ ,  $p < .001$ ; depression:  $\beta = 0.052$ ,  $p < .05$ ), social participation (anxiety:  $\beta = -0.059$ ,  $p < .001$ ; depression:  $\beta = -0.159$ ,  $p < .001$ ), and loneliness (anxiety:  $\beta = 0.296$ ,  $p < .001$ ; depression:  $\beta = 0.356$ ,  $p < .001$ ) were taken as predictors simultaneously, their effects on anxiety and depression were significant. The confounding variables (e.g., age, sex, living arrangement, household income) did not affect the significance of the serial mediation effects of social participation and loneliness, as well as the direct and total effects of the models (Table 4).

As shown in Table 5, analyses of total indirect effects indicated that social participation and loneliness served a partial mediating function in the relation between fear of COVID-19 and anxiety (Effect=0.116, 95%CI (0.088, 0.046)). The mediating effect accounted for 42% of the total effect (Effect=0.276, 95%CI (0.236, 0.317)). Meanwhile, when tested separately, three mediating paths were significant: the indirect effects of fear of COVID-19 on anxiety through social participation (Effect=0.009, 95%CI (0.002, 0.019)), accounting for 7.8% of the total indirect effect; the indirect effects of fear of COVID-19 on anxiety through loneliness (Effect=0.010, 95%CI (0.075, 0.126)), accounting for 86.2% of the total indirect effect; and the indirect effects of fear of COVID-19 on anxiety through social



**Table 4** Regression analysis of the model ( $N=508$ )

Independent variables	Fit index			$\beta$	$t$
	$R$	$R^2$	$F$		
Dependent variable: social participation					
Fear of COVID-19	0.130	0.017	8.632	-0.153	2.938**
Age				-0.245	-5.761***
Sex				0.009	0.256
Living with family				0.007	0.763
Household income				0.127	3.601***
Dependent variable: loneliness					
Fear of COVID-19	0.525	0.275	95.823	0.336	11.117***
Social participation				-0.173	6.74***
Age				-0.103	-2.655**
Sex				-0.006	-0.207
Living with family				-0.004	-2.485*
Household income				0.107	3.838***
Dependent variable: anxiety					
Fear of COVID-19	0.678	0.459	142.548	0.160	8.067***
Social participation				-0.059	3.770***
Loneliness				0.296	11.316***
Age				0.018	0.706
Sex				0.004	1.060
Living with family				0.425	1.758
Household income				0.102	2.291*
Dependent variable: depression					
Fear of COVID-19	0.704	0.495	164.576	0.052	2.524*
Social participation				-0.159	9.703***
Loneliness				0.356	13.074***
Age				0.212	5.038
Sex				0.010	1.372
Living with family				0.211	1.238
Household income				0.106	2.420*

COVID-19=coronavirus disease 2019; \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$

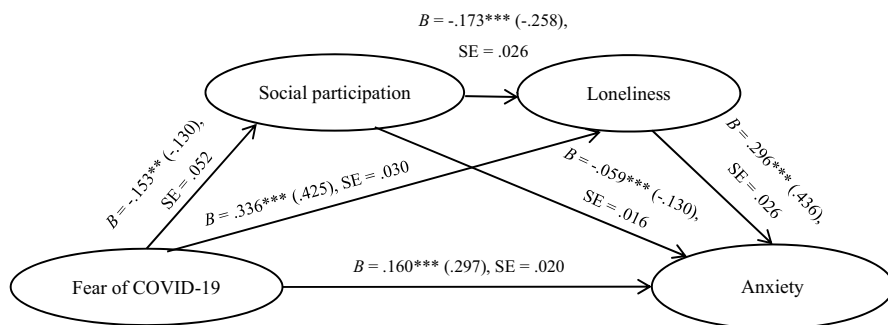
participation then loneliness (Effect=0.008, 95%CI (0.002, 0.016)), accounting for 6.9% of the total indirect effect.

The findings in Table 5 also indicated that social participation and loneliness served a partial mediating function in the relation between fear of COVID-19 and depression (Effect=0.153, 95%CI (0.115, 0.194)). The mediating effect accounted for 72.3% of the total effect (Effect=0.206, 95%CI (0.158, 0.253)). Meanwhile, when tested separately, three mediating paths were significant: the indirect effects of fear of COVID-19 on depression through social participation (Effect=0.024, 95%CI (0.005, 0.046)), accounting for 15.7% of the total indirect

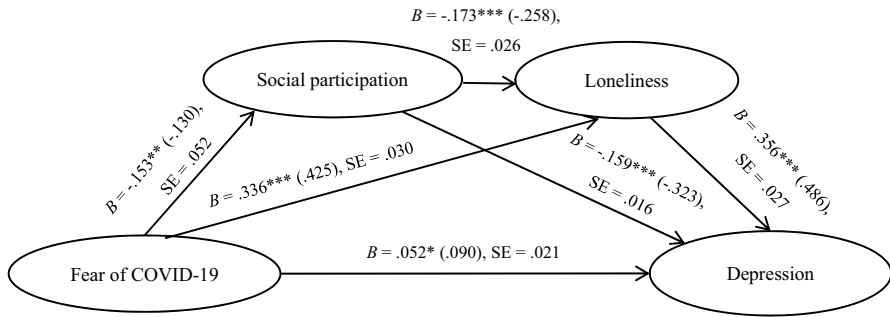
**Table 5** The mediating effect test of fear of COVID-19 and adverse psychological health outcomes between social participation and loneliness

Analyses	Effect value	Effect size	95% confidence interval interval
<b>Anxiety model</b>			
Total effect	0.276		(0.236, 0.317)
Direct effect	0.160	58.0%	(0.121, 0.199)
Total indirect effect	0.116	42.0%	(0.088, 0.046)
<i>Indirect path 1:</i>	0.009	7.8%	(0.002, 0.019)
Fear of COVID-19→social participation→anxiety			
<i>Indirect path 2:</i>	0.010	86.2%	(0.075, 0.126)
Fear of COVID-19→loneliness→anxiety			
<i>Indirect path 3:</i>	0.008	6.9%	(0.002, 0.016)
Fear of COVID-19→social participation→loneliness→a nxiety			
<b>Depression model</b>			
Total effect	0.206		(0.158, 0.253)
Direct effect	0.052	25.2%	(0.012, 0.093)
Total indirect effect	0.153	72.3%	(0.115, 0.194)
<i>Indirect path 1:</i>	0.024	15.7%	(0.005, 0.046)
Fear of COVID-19→social participation→depression			
<i>Indirect path 2:</i>	0.120	78.4%	(0.093, 0.148)
Fear of COVID-19→loneliness→depression			
<i>Indirect path 3:</i>	0.009	5.9%	(0.002, 0.019)
Fear of COVID-19→social participation→loneliness→de pression			

COVID-19=coronavirus disease 2019



**Fig. 2** Regression coefficients for the association between fear of COVID-19 and anxiety as mediated by social participation and loneliness. Note. COVID-19=coronavirus disease 2019. Unstandardized coefficients and standard error (SE) are displayed. Standardized coefficients are mentioned in parentheses next to unstandardized coefficients.  $*p < .05$ ,  $**p < .01$ ,  $***p < .001$



**Fig. 3** Regression coefficients for the association between fear of COVID-19 and depression as mediated by social participation and loneliness. Note. COVID-19=coronavirus disease 2019. Unstandardized coefficients and SE are displayed. Standardized coefficients are mentioned in parentheses next to unstandardized coefficients. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

effect; the indirect effects of fear of COVID-19 on depression through loneliness (Effect = 0.120, 95% CI (0.093, 0.148)), accounting for 78.4% of the total indirect effect; and the indirect effects of fear of COVID-19 on depression through social participation then loneliness (Effect = 0.009, 95% CI (0.002, 0.019)), accounting for 5.9% of the total indirect effect. Figures 2 and 3 illustrate the serial mediation models, with solid lines denoting significant paths and arrows indicating their direction. The figures also report unstandardized coefficients, standard errors (SE), and standardized coefficients.

## Discussion

The mean levels of fear of COVID-19, social participation, loneliness, and two types of adverse psychological health outcomes (depression and anxiety) were estimated. The findings indicated that Chinese older adults had a comparable level of fear regarding the pandemic ( $M = 19.40$ ) to that reported in previous studies (Mistry et al., 2021:  $M = 19.4$ ; Savci et al., 2021:  $M = 19.1$ ), albeit slightly higher than the general population's average fear level (Luo et al., 2021:  $M = 18.5$ ). There has been scarce research on the average social participation level among older adults during the pandemic, and our results enrich the current knowledge on this aspect. Furthermore, this study investigated the mean loneliness level among Chinese older adults, revealing a significant increase in their loneliness score ( $M = 16.85$ ) after the policy change in comparison to prior studies with Chinese older adults (Liu et al., 2022b:  $M = 12.82$ ; Niu et al., 2020:  $M = 15.6$ ; Wu et al., 2010:  $M = 4.02$ ). Similarly, the mean levels of anxiety ( $M = 8.02$ ) and depression ( $M = 8.98$ ) among older adults in this study were worse compared to those in previous research results (Lam et al., 2010: anxiety was  $M = 4.8$ ; depression was  $M = 4.4$ ; Song 2020: anxiety was  $M = 6.98$ ; depression was  $M = 8.36$ ). These findings confirmed the negative health impacts of pandemic policy relaxation on

Chinese older adults and highlighted the need for greater attention to their negative psychological health risks.

The study's results demonstrated that fear, social participation, and loneliness were predictors of negative psychological health outcomes in the COVID-19 outbreak context. Furthermore, they suggested that social participation and loneliness had a serial-mediating effect on the relationship between pandemic fear and adverse psychological health outcomes, with both variables exhibiting a partial mediation role in both models. These findings suggested that fear had a direct impact on adverse psychological health outcomes, and when social participation and loneliness were taken into account, these variables also influenced the relationship between fear and adverse psychological health outcomes. As fear increased, social participation decreased and loneliness increased, leading to more severe depression and anxiety. While the effect of fear on depression and anxiety weakened at this point, their relationship remained significant. The study results supported the notion that fear should be the primary target since it consistently and crucially impacted psychological health in Chinese older adults during the pandemic, whether or not other factors were considered. Moreover, the findings clarified the underlying mechanism by which fear during the COVID-19 outbreak led to psychological health damage among older adults in China. They demonstrated that increasing social participation and eliminating loneliness could help improve their psychological health. Therefore, the impact of social participation and loneliness on negative emotional health among older adults during the pandemic period should be taken seriously.

It is noteworthy that while this study was innovative in conducting a mediation analysis on the relationship between social participation, loneliness, fear, and adverse psychological health outcomes, it remains unclear whether other explanatory variables may influence this relationship. For instance, previous research has shown that fear of COVID-19 among older adults may alter their resilience level and sleep patterns, which can further impact their quality of life (Savci et al., 2021). Additionally, scholars have suggested that social support and family function can affect loneliness among this population (Wu et al., 2010), and that resilience and perceived stress are associated with loneliness, anxiety, and depression among Chinese elderly migrants (Wang et al., 2022). Based on these findings, we are curious to know whether these variables have the potential to affect the relationship between fear and adverse psychological health outcomes through mediating or moderating effects. Therefore, further modeling analysis of this topic will provide a deeper, more systematic, and comprehensive understanding of the physical and mental health status of Chinese older adults during the COVID-19 outbreak.

The results of this study have important empirical implications for understanding the quality of life of older adults during the COVID-19 pandemic. First, they provided valuable insights into the impact of the pandemic on different cultural groups and enriched the research data on Asian populations in this regard. Second, the study highlighted the prevalence of fear of COVID-19 among older adults, with slightly higher levels than the general population. Fear can lead to social isolation and reduced social participation, negatively affecting individuals' well-being. Moreover, the study found a significant increase in loneliness levels among older adults during the pandemic, which has been linked to negative health outcomes, such as

depression and anxiety, and can negatively impact their quality of life. In addition, this study contributed to the research literature on the relationship between fear and different social functioning and psychological health outcomes in the COVID-19 outbreak context, which has been poorly discussed in previous research. This study was also among the first to identify the mechanism underlying the observed relationship between fear of COVID-19 and negative psychological health outcomes in Chinese older adults, via the inclusion of social participation and loneliness as serial mediators.

This study has several practical implications for policymakers, practitioners, and researchers. It highlights that policies aimed at reducing the spread of COVID-19, such as social distancing, can lead to social isolation and decreased social participation among older adults. Policymakers need to balance the need to protect vulnerable populations with the need to promote social participation and prevent loneliness. One potential solution is to promote technology-based communication and support programs to maintain social connections while limiting in-person interactions.

Additionally, this study highlighted the importance of addressing fear among older adults during the pandemic. Disseminating information on ways to prevent COVID-19 infection, providing access to fever-reducing medication, and educating individuals on how to access medical care if infected could be effective in reducing fear. Reducing loneliness is another crucial intervention target. Practitioners and healthcare professionals need to identify and provide support to individuals who could be experiencing loneliness. Support groups, telehealth programs, and counseling services can be implemented to help mitigate the negative effects of loneliness on mental health. This study also provides insights into the underlying mechanisms by which fear of COVID-19 leads to adverse psychological health outcomes among older adults. Understanding the cognitive appraisal and coping mechanisms of older adults can inform interventions and policies aimed at reducing fear and promoting well-being. The Protection Motivation Theory provides a relevant framework for understanding how older adults respond to threats and risks, and policymakers and practitioners can use this framework to develop targeted interventions.

Despite its contributions, this study has some limitations that should be noted. First, due to the cross-sectional nature of the study, it was not possible to conduct periodic follow-ups on the mental health of elderly individuals in China during the pandemic, nor was it possible to conduct more comprehensive intervention research on these health concerns. Second, the use of convenience sampling in this study may limit the generalizability of the findings and increase the risk of producing biased data. Future research should aim to conduct longitudinal tracking and analysis on the fear of COVID-19, social participation, loneliness, and adverse psychological health outcomes among Chinese older adults to provide a more in-depth understanding of the health dynamics of this population. Random systematic sampling methods should be employed in future research to improve the representativeness of the sample. In addition, although this study tested demographic variables as confounders, future studies should consider examining additional potential confounding factors such as resilience, sleep patterns, family function, social support, and stress in multi-variable models.

Moreover, the findings of this study highlight the need to investigate the effectiveness of multi-modal interventions in reducing fear and its related adverse psychological health outcomes among older adults during the COVID-19 pandemic. Existing intervention recommendations for treating depression, anxiety, and promoting social participation primarily focus on managing single symptoms, with little attention paid to symptom clusters. Therefore, comprehensive and integrated interventions that target multiple symptoms may be more effective in improving the quality of life of older adults during the pandemic. Such interventions could include a combination of psychological interventions, social support, physical activity, and health education, tailored to the specific needs of older adults. Further research is necessary to evaluate the effectiveness of these interventions and identify the most appropriate strategies for promoting well-being among this population.

## Conclusion

In summary, this study analyzed the relationship between fear of COVID-19, social participation, loneliness, and adverse psychological health outcomes among Chinese older adults after restriction policies were relaxed. This study highlighted the negative effects of fear, social isolation, and loneliness on mental and emotional health and suggested potential interventions to mitigate these effects. Policymakers, practitioners, and researchers must continue addressing the unique challenges older adults face during the pandemic and develop solutions to support their well-being.

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**Data Availability** For original data, please contact the corresponding author. Ethical approval does not cover making data openly accessible.

## Declarations

**Competing Interests** The authors report no competing interests.

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