Guardianship from being present: the moderation of mindfulness in the longitudinal relationship of loneliness to quality of life and mental health problems among the oldest old

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Abstract
Since the pace of population aging is getting faster than in the past, the population aging has been a serious social concern. The Quality of life (QOL) of the older adults, especially the oldest old, and their mental health problems need more public attention, for the purpose of enhancing their late well-being. Therefore, the current study aims to investigate the longitudinal relationship between loneliness to quality of life and mental health problems, considering the moderation effect of mindfulness among the oldest old. A total of 457 Chinese oldest-old completed questionnaires measuring mindfulness, loneliness, QOL, and mental health problems at baseline, and completed QOL and mental health problems again at six-month follow-up. Results showed that the longitudinal positive association between loneliness and mental health problems was significant ($r = .401$, $p < .01$). Nevertheless, loneliness was positively correlated with QOL ($r = .242$, $p < .01$). Additionally, mindfulness significantly moderated the association between loneliness and mental health problems. Specifically, higher mindfulness was associated with a weaker longitudinal relationship between loneliness and mental health problems. However, mindfulness did not moderate the relationship between loneliness and QOL. These findings indicated that loneliness can be a risk factor of mental health problems, and mindfulness can buffer the adverse effect of loneliness on mental health problems among the oldest old. Limitations and implications were discussed.

Keywords Mindfulness · Loneliness · Quality of life · Mental health · Longitudinal · The oldest old

It is projected that in the next 30 years, the 60-year-old elderly will double and those who are 80 years old will triple, while the population of other age groups will decrease at the same time (World Health Organization (WHO), 2021). The population-aging problem is especially severe in China. Over the last 40 years, China's demographic structure has transited from a mature population to one that is declining and old (Lu & Liu, 2019). Except for the social problems population aging brings about, the well-being of the aged people needs further attention (Bloom et al., 2011).

According to the previous study, the old tend to suffer from chronic disease, physical disabilities, mental illness, and other co-morbidities (Boutayeb & Boutayeb, 2005). Among the senior population, the oldest old (those who are 80 + years old) are more vulnerable to developing physical and mental health issues (Cimarolli et al., 2018; Lee et al., 2018; Smith et al., 2002), and the proportion of this group is also expanding. Based on the calculation of the United Nations Population Division (2002), the average annual growth of the oldest old is almost twice as high as the growth rate of younger old (Gwozdz & Sousa-Poza, 2010). Therefore, the well-being of the oldest old has gradually become public health concern (Steptoe et al., 2015), and it's essential to pay particular attention to their health, both physically and mentally (Shrivastava et al., 2013).

Quality of life (QOL) is one of the most widely used indicators of the health status of older adults in life. QOL assesses how an individual feels about their current station in life, referring to social and psychological indicators (Felce & Perry, 1995). On the other hand, mental issues,

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such as depression, anxiety, and stress, have been witnessed as extremely prevalent among older adults —— more than one-fifth of adults aged 60 years old and above experience a mental disorder (WHO, 2021), while the oldest old are more vulnerable to these problems than younger ones (Jeon & Dunkle, 2009; Luppa et al., 2012). According to a study conducted by Qin et al. (2018), using a nationally representative Chinese dataset, the prevalence of depressive symptoms among individuals older than 75 was over one-third. Therefore, in order to improve the oldest old's well-being, it's very important to find out the impact factors of QOL and the trigger of mental health problems.

Researchers have recognized the critical role played by loneliness due to its considerable association with QOL (Hajek & König, 2021) and mental health problems (Gerino et al., 2017). Loneliness, which may relate to missing an intimate or close emotional relationship and a loss of sense of social connectedness, has an adverse effect on the old's QOL through mechanisms such as dissatisfying belonging needs and aggravating biological stress processes (Beridze et al., 2020; Tan et al., 2020). Researchers also found that loneliness was significantly associated with depression and anxiety (Diehl et al., 2018; Erzen & Çikrikci, 2018). An explanation is that loneliness is related to an individual's negative cognitive style, which leads to an adverse and pessimistic explanation of incidents in life (Campagne, 2019). Thus, in the process of aging, which involves higher chances of missing intimate family members and social contacts, the old tend to feel lonely, and consequently accumulate physical and mental health problems (Southwick et al., 2005).

However, not all studies supported that loneliness predicted low levels of QOL or psychological well-being. For example, in the research of older adults from Northern and Southern Europe conducted by Beridze et al. (2020), there was no significant association between loneliness and QOL in the Sweden or Spain sample. Therefore, there may be some potential factors that can buffer the adverse effect of loneliness, which can be beneficial for the oldest old to protect themselves from being seriously affected by loneliness, the main target of the current study is to identify a moderator in relating loneliness to both QOL and mental health problems in this special population.

According to the model of the Loneliness Regulatory Loop, loneliness sets off unconscious hypervigilance for social threats and causes individuals to attend to negative social stimuli in social encounters, which further leads to individual's negative social-interaction expectations and consequently social separation from others, accompanying by perceived social isolation (Hawkley & Cacioppo, 2010). Since the implicit alert toward social threats has a strong effect on perceptions, cognitions, and behaviors, in order to alleviate the aforementioned negative impacts of loneliness, it's important to diminish automatic cognitive

processing that individuals are unconsciously paying too much attention to negative social threats and information (Hawkley & Cacioppo, 2010). Several attempts have been made to support that mindfulness, characterized as the ability to the purposeful attend to the present moment with a nonjudgmental attitude (Kabat-Zinn, 2003), contributes to better awareness (i.e., monitoring) of social interactions and individuals' emotional reactions with an open and nonreactive attitude (i.e., acceptance), thus reducing the negative perceptions and interpretations of social threat (Lindsay et al., 2019). Moreover, mindfulness allows for more flexible cognitive and behavioral responses (Sipe & Eisendrath, 2012), which decreases maladaptive thought patterns about social interactions and promoting social connectivity (Lindsay et al., 2019). Consistently, research showed that mindfulness can reduce individuals' feelings of loneliness (Creswell et al., 2012; Dodds et al., 2015; Lindsay et al., 2019; Mascaro et al., 2018; Zhang et al., 2018). However, it still remains unclear whether mindfulness can also effectively alleviate the adverse effect of loneliness among the oldest old. Therefore, we examined mindfulness as a potential moderating factor that could buffer the self-reinforcing loneliness loop and thus reduce the impact of loneliness.

Moreover, evidence showed that mindfulness may also function as a protective determinant of QOL and psychological well-being. A growing body of literature has recognized that mindfulness-based interventions (MBIs), such as mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), are associated with various positive outcomes related to QOL, such as psychological well-beings and life satisfaction (Baer et al., 2012; Neff, 2003; Yang et al., 2016). MBIs are also helpful to cultivate self-compassion (Berking et al., 2010; Hayes et al., 2004) which is an important mechanism for enhancing QOL (Trombka et al., 2021). In addition, mindfulness is found to be associated with fewer mental health problems (Bergmann et al., 2021). A higher level of mindfulness promotes more self-insight and the ability to refrain from judging oneself (Jansen et al., 2020), so mindful individuals can differentiate between their experience and self-concept (Böge et al., 2020), further reducing mental health problems. It is also well established from a variety of studies that mindfulness negatively associated with mental health problems (Grossman et al., 2004; Hofmann & Gómez, 2017; Williams, 2008). Considering that mindfulness potentially breaks the maladaptive loneliness regulatory loop, and therefore prevents the deterioration of QOL and exacerbation of mental health problems, it is reasonable to propose that mindfulness can moderate the association of loneliness to QOL and mental health problems.

The current study

Prior studies have examined the relationship between loneliness, mindfulness, QOL, and mental health problems (e.g., depression, anxiety, and stress). However, most of them are cross-sectional designs and none of them were conducted among the population of the oldest old (Lee et al., 2018). The current study adopted longitudinal research methods to explore the moderating role of mindfulness in the association of loneliness to both QOL and mental health problems among the Chinese oldest old.

We hypothesized that: (1) loneliness at baseline negatively predicts QOL and positively predicted mental health problems at six-month follow-up. (2) mindfulness moderates the negative association between loneliness and QOL, as well as the positive association between loneliness and mental health problems. To be specific, higher mindfulness at baseline is associated with a weaker negative relationship between loneliness and QOL as well as a weaker positive relationship between loneliness and mental health problems.

Method

Participants and procedures

Participants in the current study were senior citizens over 80 years old from different communities in Nanjing, China. A total of 548 participants aging from 60 to 101 were invited and completed the questionnaires at Time 1 and 494 of them completed the follow-up assessment 6 months later (T2). Those who dropped out at T2 were all hospitalized due to significant impairment in functioning or passed away. There were no significant differences in terms of the involved variables (loneliness, mindfulness, DASS, and QOL) as well as demographic information (gender and age) between those who dropped out and not ($ps > 0.05$). Excluding invalid answers of 37 participants, 457 valid questionnaires were left (53.60% were female; $M_{age}= 85.00$, $SD = 7.99$). Among all the subjects, 55.8% were in poor physical condition, and 60.8% of them were widowed. As for living conditions, 28.9% lived alone, 30.1% lived with their spouses, 7.3% lived with their spouses and children, 32.6% lived with their children, and 1.1% lived with and were cared by professional caregivers. In terms of cultural level, 14% had primary school education, 30.4% had junior high school education, 37.7% had senior high school education, 17.2% had college education, and 0.7% didn't report their education levels.

The protocol of this study was reviewed and approved by the ethical committee of the authors' university. All participants signed written informed consent in the current study. Trained social workers were assigned to visit every participant at home. With the help of social workers, senior participants completed the questionnaires. Loneliness, mindfulness, QOL, and mental health problems were measured at baseline. After 6 months, QOL and mental health problems were measured again. It should be noted that the research was conducted during the COVID-19 epidemic (Data at T1 was collected in September 2020 and T2 in Mar 2021). However, the epidemic was effectively controlled and there were basically no confirmed COVID-19 infected cases during the assessment period. Therefore, social workers can successfully visit the participants and help them finish the questionnaires. Both assessments were conducted under the supervision of the researchers.

Measures

University of California Los Angeles loneliness scale (ULS-8)

ULS-8 was used to assess loneliness in the current study at baseline. This scale was developed by Hays and DiMatteo (1987), and the Chinese version was adapted by Wu et al. (2018). The scale includes 8 items rated on a 4-point scale (1, never; 4, always). Questions 3 and 6 of the necessary items are scored in reverse and then all items are added together to get a total score. A higher score indicates a higher level of loneliness. The Cronbach's α of this scale in this study was 0.884.

Mindful Attention Awareness Scale (MAAS)

Mindful Attention Awareness Scale (MAAS) was used to assess mindfulness at baseline. The MASS was developed by Brown and Ryan (2003), consisting of 15 items. The Chinese version was revised by Deng et al. (2012). The items are scored on a 6-point Likert scale from 1 (almost always) to 6 (rarely) (note that higher scores indicate less frequency) and each item describes a situation of mindlessness. Therefore, higher scores indicate higher levels of mindfulness. In this sample, the scale demonstrated good internal consistency ($\alpha = 0.924$).

The MOS item short form health survey (SF-36)

The QOL was measured by the MOS 36-item short-form health survey (SF-36) developed by McHorney et al. (1993). The Chinese version of the scale was revised by Li et al. (2002). The scale consists of 36 items, with different ratings from each subscale. The scale includes 8 subscales: physical functioning (PF), role physical (RP), role emotional (RE), vitality (VT), bodily pain (BP), social functioning (SF), mental health (MH), and general health (GH). When

calculating the total scores of QoL, items 1, 4(1), 4(2), 4(3), 4(4), 5(1), 5(2), 5(3), 9(1), 9(4), 9(8), 10(2), and 10(4) are scored in reverse and then all items are added together to get a total score. Only the total score should be reversed, and the original dimension score should not be reversed. The total score of the scale was converted to a hundred-mark scale, ranging from 1 to100 points. A higher total score indicates a higher level of quality of life. The scale demonstrated good internal consistency (T1: $\alpha = 0.952$; T2: $\alpha = 0.926$).

Depression Anxiety and Stress Scale (DASS)

DASS is a well-known self-report instrument developed by Lovibond and Lovibond (1995) to assess the level of depression, anxiety, and stress. The Chinese version of the scale was revised by Gong et al. (2010). Each subscale consists of 7 items rated on a 4-point scale (0 = extremely disagree; 3 = extremely agree). Some of the necessary items are scored in reverse and then all items are added together to get a total score. Higher scores indicate higher levels of mental health problems. The Cronbach's αs of the scale in the current study were 0.900 and 0.867 at T1 and T2, respectively.

Data analysis

A total of 4.79% of the data was missing. Means, standard deviations (SD), Cronbach alpha coefficients of all measures, and Pearson's correlations of the variables used in the current study were computed by SPSS 26.0. Multiple regressions were both applied to evaluate the hypothesized moderation effect for statistical significance. In multiple regressions, the independent variable and moderator were z-standardized to minimize multi-collinearity with the interaction terms in the model. Simple slopes were then computed to obtain the specific moderation effect.

Results

Common method bias test

We used Harman's single-factor test to find out whether the common method bias existed. The outcome showed that there were 30 factors accounting for the variance in the variables, while the total variance extracted by one factor is 19.04%, indicating there's no significant common method bias in this data.

Descriptive statistics and correlation coefficients

The means, standard deviations among all variables related, and the correlation matrix are reported in Table 1. The correlation analysis showed a significant positive correlation between loneliness at T1 and DASS at T2 ($r = .401$, $p < .01$). However, loneliness at T1 significantly positively correlated with QOL at T2 ($r = .242$, $p < .01$). Besides, mindfulness at T1 was significantly negatively correlated to DASS at T2 ($r = -.124$, $p < .01$), and positively correlated with QOL at T2 ($r = .347$, $p < .01$). Nevertheless, mindfulness was not significantly correlated to loneliness ($r = .047$, $p > .05$).

Moderation analysis

We adopted three steps of regressions (Baron & Kenny, 1986) to test the moderating role of mindfulness in the longitudinal relationship of loneliness to QOL and DASS. Gender, age, and each outcome variable at T1 were entered into the regression as control variables in step 1. In step 2 we put the independent viable (loneliness) and the potential moderation (mindfulness) into the regression. In step 3, the interaction (loneliness X mindfulness) was entered.

Table 2 shows the results of the moderating analysis. There was a significant interaction between loneliness and mindfulness in predicting the total score of DASS ($\Delta R^2 = 0.016$, $R^2 = 0.262$, $\beta = -0.164$, $p < .01$). Additionally, the moderating effects were also significant when outcome variables were the two subscales of DASS, anxiety ($\Delta R^2 = 0.024$, $R^2 = 0.194$, $\beta = -0.199$, $p < .01$) and depression ($\Delta R^2 = 0.012$, $R^2 = 0.331$, $\beta = -0.141$, $p < .01$). Simple slopes analysis was further conducted to show the direction of the moderation (see Fig. 1). Results indicated that among participants with lower mindfulness, loneliness at baseline negatively predicted the total score of DASS ($B = 0.025$, $SE = 0.011$, $p = .022$), While this longitudinal association became insignificant among participants with higher mindfulness ($B = 0.012$, $SE = 0.012$, $p = .327$). As to the two dimensions of DASS, the results of simple slopes analysis also presented in Fig. 1 revealed that the longitudinal relationships between loneliness and anxiety and depression were higher among participants low in mindfulness (anxiety: $B = 0.029$, $SE = 0.190$, $p = .876$; depression: $B = 0.025$, $SE = 0.010$, $p = .019$), than those among participants high in mindfulness (anxiety: $B = 0.010$, $SE = 0.190$, $p = .956$; depression: $B = 0.013$, $SE = 0.011$, $p = .242$).

However, the results showed no significance of the interaction between loneliness and mindfulness in predicting QOL ($\Delta R^2 = 0.003$, $R^2 = 0.341$, $\beta = 0.070$, $p > .05$) or its subscales ($ps > 0.05$).

Discussion

For the first time, the current study applied a longitudinal design to investigate the associations among loneliness, mindfulness, quality of life (QOL), and mental health problems in the oldest old in China. Especially, controlling for

Table 1 Descriptive statistics and correlations

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Loneliness_T1	12.792	4.780															
2 Mindfulness_T1	81.196	7.830	0.047														
3 Stress_T2	1.250	0.254	.280**	−.157**													
4 Anxiety_T2	1.315	0.282	.321**	−.115*	.635**												
5 Depression_T2	1.146	0.238	.494**	−0.058	.711**	.793**											
6 DASS_T2	1.237	0.232	.401**	−0.124**	.866**	.908**	.923**										
7 PF_T2	20.783	5.350	.378**	.346**	−.211**	−0.089	0.073	−0.088									
8 RP_T2	6.503	1.740	−.348**	−0.341**	.144**	−0.013	−.118*	0.007	−.718**								
9 RE_T2	4.343	1.283	−0.014	−0.248**	.271**	.177**	.197**	.238**	−.429**	.525**							
10 VT_T2	18.902	2.655	−.105*	.166**	−.272**	−.226**	−.226**	−.268**	.296**	−.201**	−.492**						
11 BP_T2	4.626	1.962	−.355**	−0.317**	.146**	0.003	−.114*	0.015	−.761**	.739**	.496**	−0.330**					
12 SF_T2	7.991	1.743	.260**	.358**	−.216**	−.156**	−0.012	−.146**	.691**	−.601**	−.453**	.407**	−.821**				
13 MH_T2	21.825	2.130	−.288**	0.05	−.374**	−.288**	−.387**	−.385**	0.074	0.012	−.311**	.696**	−.105*	.147**			
14 GH_T2	14.845	3.238	.203**	.175**	−.218**	−0.068	−0.014	−.112*	.541**	−.512**	−.455**	.424**	−.625**	.631**	.205**		
15 QOL_T2	101.855	14.804	.242**	.347**	−.311**	−.161**	−0.061	−.200**	.848**	−.739**	−.655**	.637**	−.845**	.819**	.396**	.775**	

T1, baseline; T2, six-month follow-up

DASS, the total score of the Depression, Anxiety, and Stress scale; *QOL*, quality of life; *PF*, physical functioning; *RP*, role-physical; *RE*, role-emotional; *BP*, body pain; *VT*, vitality; *SF*, social functioning; *MH*, mental health; *GH*, general health

**p < .01

*p < .05

Table 2 The moderation analyses

	DASS_T2	Stress_T2	Anxiety_T2	Depression_T2	QOL_T2	PF_T2	RP_T2	RE_T2	BP_T2	VT_T2	SF_T2	MH_T2	GH_T2
step1													
Gender	0.028	0.042	0.030	0.016	0.089*	0.050	-0.077	-0.078	-0.055	0.095*	0.020	0.019	0.064
Age	0.063	0.159**	0.050	0.005	-0.397**	-0.517**	0.427**	0.252**	0.489**	-0.045	-0.475**	0.140**	-0.249**
Outcome variable at T1	0.372***	0.221**	0.285**	0.469**	0.242**	0.190**	0.223**	0.134**	0.063	-0.232**	0.144**	0.286**	0.159**
step2													
Loneliness_T1	0.377***	0.326**	0.335**	0.383**	0.176**	0.229**	-0.199**	0.057	-0.275**	-0.082	0.189**	0.205**	0.161*
Mindfulness_T1	0.067	-0.009	0.055	0.098*	0.041	0.037	-0.094*	-0.110*	-0.075**	0.075	0.081**	-0.196**	-0.008
step3													
Loneliness_T1 x Mindfulness_T1	-0.164**	-0.076	-0.199**	-0.141**	0.070	0.023	-0.068	-0.047	-0.081	0.041	0.066	0.058	0.024
ΔR^2	0.016	0.004	0.024	0.012	0.003	0.000	0.003	0.001	0.004	0.001	0.003	0.002	0.000
Adjusted R^2	0.262	0.155	0.194	0.331	0.341	0.463	0.379	0.109	0.330	0.067	0.315	0.115	0.137

T1, baseline; T2, six-month follow-up

DASS, the total score of the Depression, Anxiety, and Stress scale; *QOL*, quality of life; *PF*, physical functioning; *RP*, role-physical; *RE*, role-emotional; *BP*, body pain; *VT*, vitality; *SF*, social functioning; *MH*, mental health; *GH*, general health

**$p < .01$

*$p < .05$

age, gender, QOL, and mental health problems at baseline, the study set out to assess the predicting role of loneliness in QOL and mental health problems 6 months later as well as estimate the moderation of mindfulness in the relationship of loneliness to both QOL and mental health problems among the oldest old.

In line with previous studies (Diehl et al., 2018; Erzen & Çikrikci, 2018; Hajek & König, 2021), results in the current study showed that loneliness at baseline was positively correlated with mental health problems six months later. It can be inferred that mental health problems, especially among the oldest old, can gradually aggravate due to the negative cognitive processing toward life caused by loneliness (Campagne, 2019).

However, loneliness was positively correlated with QOL six months later, which is not consistent with some of the previous findings (Beridze et al., 2020; Tan et al., 2020). One reason may be that loneliness also includes positive elements such as solitude (Tornstam, 1990), which may be beneficial for older adults (Adams et al., 2004; Cacioppo & Patrick, 2008; Long & Averill, 2003). Another reason may reside in the special sample in the current study. Previous findings of the negative association between loneliness and QOL were mostly conducted in the "general old population" (Arslantas et al., 2015; Gerino et al., 2017; Jakobsson & Hallberg, 2005) in which a large proportion of them was above 60 years but under 80 years. Research has indicated that loneliness can increase the mortality of the elders (Luo et al., 2012; Rico-Uribe et al., 2018; Tilvis et al., 2011). Therefore, it is possible that many old adults with poor capacity to deal with the adverse impact of loneliness are unlikely to survive to very late life. However, in the current study, the mean age of the participants was about 85 years old. Those oldest old may have passed the "selection" through the negative effect of loneliness by learning how to get on well with loneliness. In this case, loneliness can even be functional to achieve a sense of control and autonomy in their lonely life, which may be beneficial to promoting QOL. In addition, the current study was conducted in a Chinese sample. Part of Chinese traditional culture emphasizes the importance of being alone to pursue a higher spiritual level (Averill & Sundararajan, 2014), which may also contribute to the positive effect of loneliness. However, it should be noted that those possible explanations are just conjectures, and thus future studies are encouraged to further examine the association between loneliness and QOL among the oldest old Chinese samples and bring insight into it.

To investigate the moderation effect of mindfulness on the relationship between loneliness and QOL as well as that between loneliness and mental health problems, we conducted a hierarchical multiple regression, particularly regarding every dimension of dependent variables as
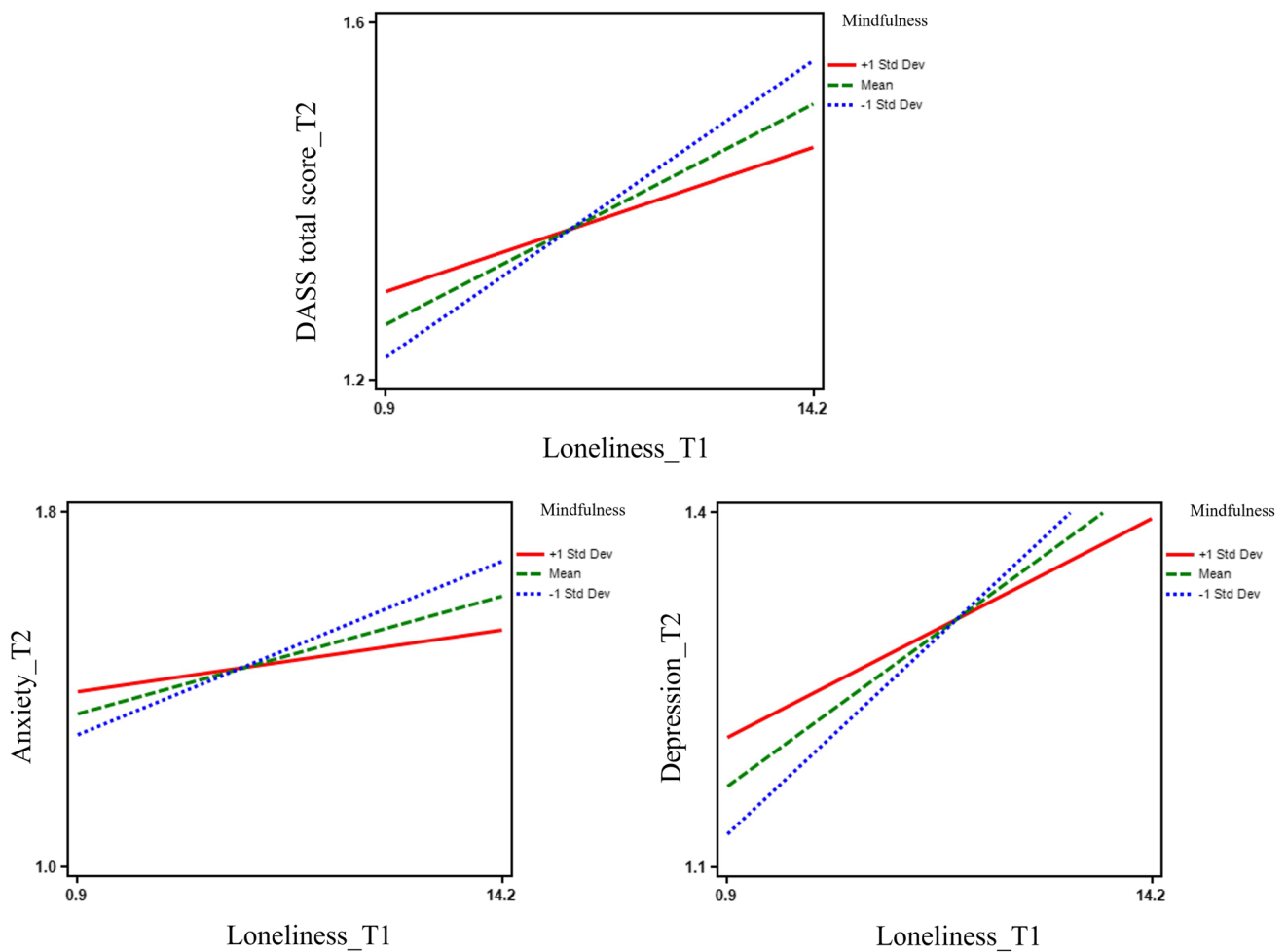
Fig. 1 Simple slope results of the moderation role of mindfulness

the outcome variable. The results in Table 2 showed that high levels of mindfulness weaken the positive association between loneliness and mental health problems, specifically anxiety and depression. As two basic components of mindfulness, awareness and acceptance play important roles in breaking the vicious circle according to the Loneliness Model (Hawkley & Cacioppo, 2010), thus reducing the adverse impact of loneliness. Also, evidence has found that mindfulness is associated with enhanced cognitive flexibility and better interpersonal relationship (Cásedas et al., 2020; Garland et al., 2010; Quinn-Nilas, 2020; Skoranski et al., 2019), which can help to avoid automatic cognitive bias toward social threats and enhance social connectivity, and thus reducing individuals' feelings of social isolation. Moreover, non-judgment attitude and self-insight, which are embedded in mindful cognitive processing, function as protectors for individuals to diminish mental health problems (Bergmann et al., 2021; Böge et al., 2020). Hence, mindful older adults tend to behave in an adaptive thought pattern and act flexibly and openly (Sipe & Eisendrath, 2012),

which helps them to jump out of the self-reinforcing loneliness loop (Hawkley & Cacioppo, 2010), alleviating adverse social, cognitive, and biological reactions to loneliness, and decrease the risk of mental health problems.

Another unanticipated result was that mindfulness did not moderate the relationship between loneliness and QOL or its subscales. An explanation may be that mindfulness functions through the mental process mechanisms to construct emotional and cognitive traits (Robins et al., 2014). As to physical or biological features, sometimes mindfulness might show no significant improvement in physical well-being (Geiger et al., 2016). Some alternative moderators, other than mindfulness, may be taken into account in future research.,

To sum up, the current study found that the oldest old with more feelings of loneliness are likely exposed to severer mental health problems and that mindfulness can serve as a moderator buffering this association. Given it was quite difficult to collect longitudinal data from the oldest old sample, results of our study should be implied focusing on this

group. The oldest old should be appropriately emphasized and trained among them to improve their psychological well-being. Communities can introduce professional workers to teach mindfulness exercises to increase their levels of mindfulness (Carmody & Baer, 2008). Since previous research has shown primary positive effects of mindfulness training for the elderly (Perez-Blasco et al., 2016), developing simple and useful ways of mindfulness practice is potentially beneficial for the well-being of the oldest old. Considering the findings of moderation role of mindfulness in the current study, teaching and guiding mindfulness practice among the elderly who live alone might be more helpful. Also, adequate company and care from family and society should be arranged to alleviate their loneliness and their negative emotions.

The present study still has some limitations. Firstly, there were only two time points of measurement, and the 6-month time span was not that long. Future studies may increase the time points to conduct the measurements and adjust the time span period accordingly. Besides, all variables were measured by self-report questionnaires. Future studies are encouraged to add some objective indexes obtained from other sources such as archival data.

Declarations

Competing interest The authors report there are no competing interests to declare.

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