Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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How healthcare workers respond to COVID-19: The role of vulnerability and social support in a close relationships defense mechanism☆

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ABSTRACT

Healthcare workers play a vital role in the fight against COVID-19. Based on Terror Management Theory (TMT), the present research examined whether a close relationships defense mechanism reduces anxiety among healthcare workers ($N = 729$) in China. Our results suggest that this defense mechanism, as indexed by relationship satisfaction, serves as an effective terror management source after exposure to reminders of death (MS; mortality salience). These findings extend TMT by identifying two moderating variables: vulnerability and social support. In a low objective vulnerability group, healthcare workers who subjectively believed themselves as less vulnerable to COVID-19 showed a stronger defense mechanism after a MS manipulation as compared to those who felt more vulnerable. Further, healthcare workers with higher levels of social support reported more relationship satisfaction. These findings have practical implications for guiding healthcare workers on how to buffer death-related anxiety and maintain their mental health in the fight against COVID-19.

1. Introduction

The COVID-19 pandemic quickly swept across the world in 2020, infecting more than 200 million people and was associated with more than 4 million deaths by August 2021 (World Health Organization, 2021). The highly infectious nature of the COVID-19 and absence of effective treatment at present has put healthcare workers under great mental pressure (e.g., Pappa et al., 2020; Zhang et al., 2020). Nurses, doctors, and others on the frontlines of the pandemic are facing a mental health crisis. In the present study, we applied Terror Management Theory (TMT, Greenberg et al., 1986) to investigate the anxiety-buffering effect of close relationships on healthcare workers' fear of death during the pandemic.

1.1. TMT and close relationships defense

Although the coronavirus is too small to be seen, daily updates in statistics of infection and death are a constant reminder of death. Many people believe that COVID-19 is life-threatening, and the fear of death affects individual's attitude and behavioral responses to the virus (Pyszczynski et al., 2020).

Terror Management Theory (TMT; Greenberg et al., 1986) posits that the awareness of personal inevitable death leads to a potential for existential anxiety. According to the anxiety-buffer hypothesis in TMT, self-esteem and cultural worldview defenses (Solomon et al., 1991) are distal defense mechanisms that individuals may use to buffer death-related anxiety. In this view, a self-esteem defense refers to obtaining a sense of personal value. In contrast, a worldview defense refers to constructing and maintaining something immortal to continue one's own values, such as those relating to religions, customs, or laws. Any threats to these anxiety-buffering defense mechanisms consequently heightens the accessibility of death-related thoughts (DTA, death-thought accessibility hypothesis, Pyszczynski et al., 2015). To deal with such unwanted death-related thoughts, individuals are thought to employ (or enhance) their self-esteem and worldview defenses when thoughts of mortality are salient (i.e., the mortality salience hypothesis).

To examine the impact of death awareness, researchers often use mortality salience (MS) in TMT experiments. Here, mortality awareness is primed by having individuals ruminate about their own death, thereby increasing death-related anxiety and the need for the above-

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mentioned anxiety-buffering defenses. Interestingly, prior findings suggest that, although MS increases the accessibility of death-related thoughts, it also enhances self-esteem striving behaviors and strengthens an individual's beliefs in their own cultural worldview (e.g., Castano et al., 2002; Mikulincer & Florian, 2000; Rosenblatt et al., 1989).

More recently, some researchers proposed another defense mechanism—close relationships (Mikulincer et al., 2003). Close relationships can alleviate primal fear associated with mortality by fostering a greater sense of symbolic immortality in two primary ways (Plusnin et al., 2018). First, close relationships provide a literal form of immortality regarding the continuation of one's genes, thoughts, and values, reducing the fear of being forgotten after one's biological death. Second, close relationships provide physical security and a way to feel part of a larger social entity (e.g., couples, family, group), allowing individuals to feel more connected with the world. Critically, close relationships are highly connected to self-esteem and worldview defenses. For instance, Mikulincer and colleagues (2000) demonstrated that individuals with secure attachment utilize intimacy resources when managing death-related anxiety, whereas individuals with insecure attachment utilize severe punishment toward any potential threats to strengthen their worldview because they lack intimacy resources. The buffering properties and priority of this "close relationships defense" highlight its important role in terror management.

Close relationships can reduce anxiety by establishing short-term, situation-based physical intimacy, or by establishing long-lasting, highly involved connections with significant others (Mikulincer et al., 2003). MS strengthens this close relationships defense mechanism by increasing attractiveness to intimate partners (e.g., Mikulincer et al., 2003), willingness to maintain social contact and interaction (e.g., Taubman-Ben-Ari et al., 2002), and the desire for intimacy in romantic relationships (e.g., Mikulincer & Florian, 2000). Moreover, MS increases positive connections with parents (e.g., Cox et al., 2008) and the willingness to become parents (Yaakobi et al., 2014).

1.2. TMT and real-world death threat

In recent years, researchers have begun to pay attention to the effect of real-world induced death-related thoughts from the perspective of TMT. For instance, thoughts about life-threatening diseases (e.g., AIDS and cancer) increase death thought accessibility (DTA, Arndt et al., 2007; Grover et al., 2010) in a similar manner to how MS increases DTA (e.g., Greenberg et al., 2001) in a typical TMT study. As an example, Grover et al. (2010) found that having thoughts related to AIDS increased DTA (study 1). Further, in a sample of conservative college students they found that participants reported more prejudicial attitudes toward the AIDS patients group to maintain their worldview after MS (study 2). Similar findings from other studies were also found in response to the threat of disease: during the swine flu outbreak in 2009, Americans were more defensive and identified more with their own nationalist values (Bélanger et al., 2013). And, within a few days after the Ebola outbreak in Dallas and Fort Worth (DFW), Texas, individuals displayed an increase in DTA and a stronger worldview defense (i.e., religious fundamentalism) when asked to answer two open-ended questions about Ebola (Ebola salience manipulation) (Arrowood et al., 2017). Such studies demonstrate that the threat of disease can lead to mortality awareness, and, more generally, that naturally occurring death reminders function similarly to laboratory research under the TMT framework (Arrowood et al., 2017).

In the current study, we wished to examine how healthcare workers respond to death-related anxiety caused by the COVID-19, with the overall aim of providing policymakers with suggestions on how to maintain healthcare workers' psychological health. This issue is especially important for healthcare workers fighting on the front line, who often have to be in direct contact with patients who may be infected with the virus. Given that COVID-19 is associated with mortality awareness, we hypothesize that close relationship satisfaction will increase after a COVID-19 salience manipulation (i.e., reminding participants of death awareness in the context of COVID19; Hypothesis 1).

1.3. The moderating role of vulnerability

As a force that cannot be ignored in the COVID-19 pandemic, healthcare workers have been actively fighting with the new virus. Nevertheless, the lack of personal protective equipment and workforce shortages have exposed healthcare workers to the risk of infection and death (Daly et al., 2020). Prior studies suggest that individuals who feel vulnerable to disease may experience higher anxiety and DTA, and, eventually, show greater defense mechanisms (Navarrete & Fessler, 2006; Pyszczynski et al., 2020).

The present study examines how subjective vulnerability reported nine months after the outbreak of the pandemic moderated healthcare workers' satisfaction with their close relationships, as a result of regulating the fear of death. This is an important question as the pandemic has lasted more than a year, leading healthcare workers to voice publicly that they are exhausted and have reached the breaking point multiple times. According to TMT, once death-related thoughts are on the fringes of consciousness, distal defenses are activated to buffer death anxiety and ultimately, may lead to lower perceived vulnerability to disease.

In addition, the objective likelihood of infection (i.e., objective vulnerability) may play a vital role in terror management. A study showed that German emergency room doctors reported a stronger defense of their nationalist values as a reaction to more frequent death reminders (Jonas et al., unpublished data, 2007; as cited in Arndt et al., 2009). Therefore, we expect that for healthcare workers who are exposed to highly-infected environments (high objective vulnerability), they may experience higher death-related anxiety and respond with a stronger defensive response as a result of a closer association with the virus and death. Taken together, it might be that individuals who work in an objectively highly infectious environment (i.e., high objective vulnerability), but believe that they are unlikely to be infected (i.e., low subjective vulnerability), are capable of successfully using a close relationships defense to buffer death-related anxiety. That is, the adjustment should be successful. Further, we hypothesize that, following MS, close relationship satisfaction will increase more among healthcare workers who believe they are lowly vulnerable (low subjective vulnerability, Hypothesis 2a), especially those who work in a highly-infectious environment (high objective vulnerability, Hypothesis 2b).

1.4. The moderating role of social support

Prior studies on the defense mechanism of close relationships show that intimacy can relieve death anxiety (see review, Plusnin et al., 2018). In fact, self-esteem and worldview defenses essentially represent adaptive efforts to establish or maintain social connectedness with others in the face of existential threat (Navarrete et al., 2004). When people feel threatened, they prefer to seek social support and the support systems that provide them with the deepest psychological security. Further, Cicirelli (2002) indicated that greater social resources are associated with more buffering effects for death-related anxiety and a lower fear of dying. One study showed that AIDS patients with more family support have less fear of death (Catania et al., 1992). In short, social support is an important component of a close relationships defense in response to mortality. People may defend themselves against terror by trusting and relying on the support and love from those close to them (Taubman-Ben-Ari et al., 2002). A study on nursing has emphasized that it is important to ensure nurses have adequate social support to cope with patient death (Kent et al., 2012).

Therefore, we speculate that social support is a moderator in a close relationships defense mechanism. Individuals tend to derive and rely on social support during times of stress, particularly those who have a history of positive close relationships (e.g., Fraley & Shaver, 1998).

Whether they can obtain social support is critical for their ability to adopt a close relationships defense mechanism. Consistently, studies on the moderating role of attachment style on a close relationships defense (e.g., Anglin, 2014; Mikulincer & Florian, 2000) have shown that individuals who possess a secure attachment style actively seek support to respond to death-related anxiety after MS with a close relationships defense mechanism rather than through the other two types of defenses. We predict that individuals with higher levels of social support will increase their relationship satisfaction to buffer death-related anxiety after MS (Hypothesis 3).

1.5. The present research

In summary, the present study has two main purposes. First, we wish to explore whether a close relationships defense mechanism reduces anxiety among healthcare workers after a COVID-19 salience manipulation. It is novel and meaningful to test whether close relationships reduce death anxiety among health care workers during the COVID-19 pandemic. Second, we wish to explore the moderating role of vulnerability and social support. Based on prior research (e.g., Anglin, 2014), close relationship satisfaction is often an index of a close relationships defense mechanism.

In general, MS manipulations have been used to examine the effect of mortality salience. A meta-analysis (Burke et al., 2010) summarized common forms of MS manipulations: (a) standard essay questions; (b) subliminal prime; (c) survey questions about death; (d) other (video, film, slide show, etc.). In our study, a questionnaire about death was adapted to fit the context of the COVID-19 pandemic and it was used as a MS manipulation. The simplicity of this questionnaire enabled us to recruit more healthcare workers to participate in our online survey. In doing so, our findings may contribute to the TMT literature by examining how TMT helps us to understand how individuals employ a close relationships defense mechanism in response to real-world induced death-related threats. Further, findings from this work may contribute to maintaining the mental health of healthcare workers in the fight against COVID-19. By understanding how healthcare workers use close relationships as a defense against death-related anxiety in the context of COVID-19, government and medical institutions may develop more effective methods to assist them.

2. Method

2.1. Participants and design

We acquired data from an online survey administered among healthcare workers, which took place between October 14 and October 24, 2020. A total of 1347 Chinese healthcare workers completed the questionnaire. Two questions served as the attention check. An example of the attention check question is “To indicate that you read this question carefully, please mark the fourth rating”. We excluded data from 618 participants who failed the attention check. This left a final sample of 729 (of whom 201 identified as doctors, 290 as nurses and 138 as neither). There were 565 women and 164 men. Participants ranged in age from 21 to 90 (median = 32.54) years.

We employed a one-factor within-subjects study design. Close relationship satisfaction served as the dependent variable. We measured this variable twice: before the MS manipulation and after the manipulation. To reduce practice effects, we used two different scales of relationship satisfaction. Specifically, we used the Relationship Assessment Scale as the pre-manipulation test of close relationship satisfaction and the Quality of Relationship Index as the post-manipulation test. The correlational and factor analyses seemed to indicate psychometric equivalence of the two scales (interrelation: $r = 0.65$, $p < .001$; more details can be seen in Supplemental Materials 1). Social support and vulnerability served as moderating variables.

2.2. Measures and procedure

All participants first completed a 12-item Perceived Social Support Scale (PSSS, Blumenthal et al., 1987) ranging from 1(*strongly disagree*) to 5 (*strongly agree*), $\alpha = 0.96$. Participants then responded to a 7-item Relationship Assessment Scale (Vaughn & Matyastik Baier, 1999; $\alpha = 0.86$) as a pretest of close relationship satisfaction. Participants rated all of these items on a 5-point Likert scale.

Next, as a mortality salience manipulation, participants were asked to complete a 15-item questionnaire adapted from the Death Anxiety Scale (T-DAS; Templer & Donald, 1970), $\alpha = 0.84$. We focused on the impact of COVID-19 on healthcare workers, so we added the context of COVID-19 to the T-DAS items (e.g., “I am very much afraid to die from COVID-19”). Following the manipulation, there was a 5-minute filler questionnaire as the delay task.

Subsequently, the post-test of close relationship satisfaction was measured by a 6-item Quality of Relationship Index (QRI; Patrick et al., 2007), $\alpha = 0.98$. An example question from this index is “My relationship with my partner makes me happy”. Participants responded to these six items on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*).

Finally, participants responded to several demographic items regarding their gender, age, position, and marriage status. Additionally, we used one item to assess participants' subjective vulnerability to COVID-19 (i.e., the likelihood of infection; “It is possible that I may get infected with COVID-19”) on a 7-point scale. We also measured objective vulnerability. To do so, participants were asked whether they were exposed to (a) people in fixed-point (hotel) isolation (b) suspected patients with the COVID-19, and/or (c) patients diagnosed with COVID-19. Healthcare workers who indicated that they were not exposed to any of these conditions were classified as “low” in objective vulnerability. In contrast, those who were exposed to any of these conditions were classified as “high” in objective vulnerability. All measurements completed by participants can be found in Supplemental Materials 3.

3. Results

First, we ranked participants' reported likelihood of infection and then chose the highest 27% as high subjective vulnerability group ($N = 197$), the middle 46% as mid subjective vulnerability group ($N = 335$) and the lowest 27% as low subjective vulnerability group ($N = 197$), respectively. We then conducted a 2 (mortality salience: before MS vs. after MS, within-subjects) × 2 (objective vulnerability: low vs. high, between-subjects) × 3 (subjective vulnerability: low vs. mid vs. high, between-subjects) three-way repeated-measures ANOVA. Close relationship satisfaction measured by the two relationship scales before and after MS manipulation served as the outcome variables. As these two relationship scales varied from one another (5-point Likert scales for pretests vs. 7-point Likert scales for posttests), we converted both tests into the same level of scale to analyze the difference before and after MS (more details see Supplementary Material 1).

Our results indicate that the main effect of MS on relationship satisfaction was significant, $F(1, 723) = 41.58$, $p < .001$, $\eta_p^2 = 0.054$, 95%CI [0.13, 0.24]. Consistent with Hypothesis 1, after the MS manipulation the score of close relationship satisfaction ($M = 4.16$, $SD = 0.82$) was significantly higher than the pre-manipulation score ($M = 3.99$, $SD = 0.64$). The results also indicate a significant main effect of subjective vulnerability, $F(2, 723) = 5.65$, $p = .004$, $\eta_p^2 = 0.015$. A Bonferroni post hoc test revealed that participants in the low subjective vulnerability group reported more relationship satisfaction ($M = 4.25$, $SD = 0.70$) than those in the mid subjective vulnerability group ($M = 3.99$, $SD = 0.76$), $p = .003$, 95%CI [0.06, 0.39]. The satisfaction between low and high, mid and high vulnerability groups was not significantly different, $p > .05$. However, the main effect of objective vulnerability was marginally non-significant, $F(1, 723) = 3.30$, $p = .07$, $\eta_p^2 = 0.005$.

Our results also indicate a significant interaction effect between subjective vulnerability and objective vulnerability, $F(2, 723) = 3.64$, p

= .027, η_p^2 = 0.01. Follow-up simple effect analyses (see Table 1) showed that, for those who subjectively perceived high vulnerability, individuals with high-objective vulnerability reported higher satisfaction than those with low-objective vulnerability both before MS ($F(1, 723) = 6.39$, $p = .012$) and after MS ($F(1, 723) = 8.26$, $p = .004$). However, for those who subjectively perceived low and mid vulnerability, there were no significant difference between low and high objective vulnerability groups, $p > .05$.

Additionally, simple effect analyses showed that, for those who worked in high-infected environment (i.e., high-objective vulnerability), their perceived relationship satisfaction after MS were significantly higher than before MS irrespective of subjective vulnerability (low subjective vulnerability group: $F(1, 723) = 4.61$, $p = .032$; mid subjective vulnerability group: $F(1, 723) = 4.68$, $p = .031$; high subjective vulnerability group: $F(1, 723) = 4.85$, $p = .028$). For those who worked in low-infected environment (i.e., low-objective vulnerability), participants were more satisfied with close relationships after MS than before MS in low subjective vulnerability group ($F(1, 723) = 36.38$, $p < .001$) and in mid subjective vulnerability group ($F(1, 723) = 13.05$, $p < .001$). However, in low objective vulnerability group, there was no significant effect of MS for those of high subjective vulnerability, $F(1, 723) = 3.14$, $p = .076$ (see Table 2 and Fig. 1).

Finally, to determine if social support moderated close relationship satisfaction after MS (i.e., Hypothesis 3), 729 participants were grouped into three sub-groups according to their social support in an analogous manner to our analyses on subjective vulnerability. The top and bottom 27% were coded as high and low social support and the middle 46% was coded as mid social support. We conducted a mixed ANOVA. Our results indicated a significant main effect of MS, such that participants were more satisfied with close relationships after MS, $F(1, 726) = 42.41$, $p < .001$, $\eta_p^2 = 0.055$, 95%CI [0.11, 0.20] (after MS: $M = 4.16$, $SD = 0.82$, vs. before MS: $M = 3.99$, $SD = 0.64$). Our results also indicated a significant main effect of social support, $F(2, 726) = 188.90$, $p < .001$, $\eta_p^2 = 0.342$, 95%CI [0.11, 0.20], such that participants with high levels of social support ($M = 4.56$, $SD = 0.56$) were more satisfied with relationships than those low in social support ($M = 3.51$, $SD = 0.78$) and those mid in social support ($M = 4.12$, $SD = 0.57$). There was a significant difference between low and mid social support groups, $ps < 0.001$.

Critically, our results indicated a significant MS × social support interaction, $F(2, 726) = 17.11$, $p < .001$, $\eta_p^2 = 0.045$. As shown in Fig. 2, simple effect analyses of MS revealed that in the middle and high social support groups, perceived relationship satisfaction mean scores after MS ($M_{high\ social\ support} = 4.68$, $SD_{high\ social\ support} = 0.60$; $M_{mid\ social\ support} = 4.25$, $SD_{mid\ social\ supportt} = 0.61$) were significantly higher than before MS ($M_{high\ social\ support} = 4.43$, $SD_{high\ social\ support} = 0.49$; $M_{mid\ social\ support} = 3.99$, $SD_{mid\ social\ support} = 0.51$), $F(1, 726) = 60.25$ and 30.80, $p < .001$, $\eta_p^2 = 0.077$ and 0.041, 95%CIs [0.29, 0.33] and [0.16, 0.33] before and after MS respectively. However, for individuals with low level of social support, there was no significant effect of MS (after MS: $M = 3.49$, $SD = 0.89$ vs. Before MS: $M = 3.53$, $SD = 0.65$), $F(1, 726) = 1.071$, $p = .30$.

4. Discussion

The present study showed that when faced with COVID-19 salience, healthcare workers' close relationships defense mechanism (i.e., relationship satisfaction) was enhanced. Individuals with higher levels of social support reported increased satisfaction in intimacy, which meant a more effective close relationships defense. Vulnerability also had moderating effect. For individuals who subjectively think themselves less vulnerable, they showed a stronger defense after MS as compared to those who felt more vulnerable. Further, individuals with low objective vulnerability and high subjective vulnerability (i.e., worked in the environment with low probability of infection but believed they were highly vulnerable) did not respond with a defensive reaction.

Consistent with previous studies (Arndt et al., 2007; Pyszczynski et al., 1999), our results show that mortality salience effects seem to be ineffective for healthcare workers with low objective and high subjective vulnerability. These healthcare workers may respond to death-related threats by suppression (Pyszczynski et al., 2020) rather than by distal defense. They "will not" or "cannot" use the defense mechanism after the outbreak. This is also reflected in the pretest results wherein relationship satisfaction in the high subjective vulnerability group was significantly lower than low subjective vulnerability group for those who worked in a low-infected environment (i.e., low objective vulnerability, see Supplementary Material 2).

The current work holds importance given the perspective of TMT. First, our research focused on the defense mechanism of terror management caused by the COVID-19 and replicated prior studies demonstrating that the threat of disease can lead to defense responses (Arndt et al., 2007; Bélanger et al., 2013). Further, we extend these findings by showing that COVID-19 salience enhances a close relationships defense mechanism. Second, the participants in this study are healthcare workers. Compared to samples of university students (e.g., Arrowood et al., 2017) or patients (e.g., Grover et al., 2010) recruited in previous studies, healthcare workers during the COVID-19 pandemic are exposed far more frequently to death. Thus, there is an urgent need to understand

Table 1
Objective vulnerability group's close relationship satisfaction before and after Mortality Salience (MS) for three subjective vulnerability groups.

	M	*SD*	*F*	*df1*	*df2*	*p*	η_p^2	95% CI
Low subjective vulnerability								
Before MS								
High objective vulnerability	4.10	0.55	0.01	1	723	0.90	<0.001	[−0.22, 0.19]
Low objective vulnerability	4.11	0.64						
After MS								
High objective vulnerability	4.29	0.87	0.93	1	723	0.34	0.001	[−0.39, 0.13]
Low objective vulnerability	4.42	0.71						
Mid subjective vulnerability								
Before MS								
High objective vulnerability	3.96	0.59	0.41	1	723	0.52	0.001	[−0.10, 0.21]
Low objective vulnerability	3.90	0.67						
After MS								
High objective vulnerability	4.11	0.80	0.30	1	723	0.58	<0.001	[−0.14, 0.26]
Low objective vulnerability	4.05	0.87						
High subjective vulnerability								
Before MS								
High objective vulnerability	4.20	0.52	6.40	1	723	0.012	0.009	[0.06, 0.49]
Low objective vulnerability	3.92	0.63						
After MS								
High objective vulnerability	4.41	0.69	8.26	1	723	0.004	0.011	[0.12, 0.97]
Low objective vulnerability	4.01	0.81						

Table 2
Mortality Salience (MS) effect on close relationship satisfaction within three subjective vulnerability groups for objective vulnerability groups.

	M	*SD*	*F*	*df1*	*df2*	*p*	η_p^2	95% CI
High objective vulnerability								
Low subjective vulnerability								
Before MS	4.10	0.55	4.61	1	723	0.032	0.006	[−0.38, −0.02]
After MS	4.30	0.87						
Mid subjective vulnerability								
Before MS	3.96	0.59	4.68	1	723	0.031	0.006	[−0.29, −0.01]
After MS	4.11	0.80						
High subjective vulnerability								
Before MS	4.20	0.52	4.85	1	723	0.028	0.007	[−0.41, −0.02]
After MS	4.41	0.69						
Low objective vulnerability								
Low subjective vulnerability								
Before MS	4.11	0.64	36.38	1	723	<0.001	0.048	[−0.41, −0.21]
After MS	4.42	0.71						
Mid subjective vulnerability								
Before MS	3.91	0.67	13.05	1	723	<0.001	0.018	[−0.22, −0.07]
After MS	4.05	0.87						
High subjective vulnerability								
Before MS	3.92	0.63	3.14	1	723	0.076	0.004	[−0.19, 0.01]
After MS	4.01	0.81						

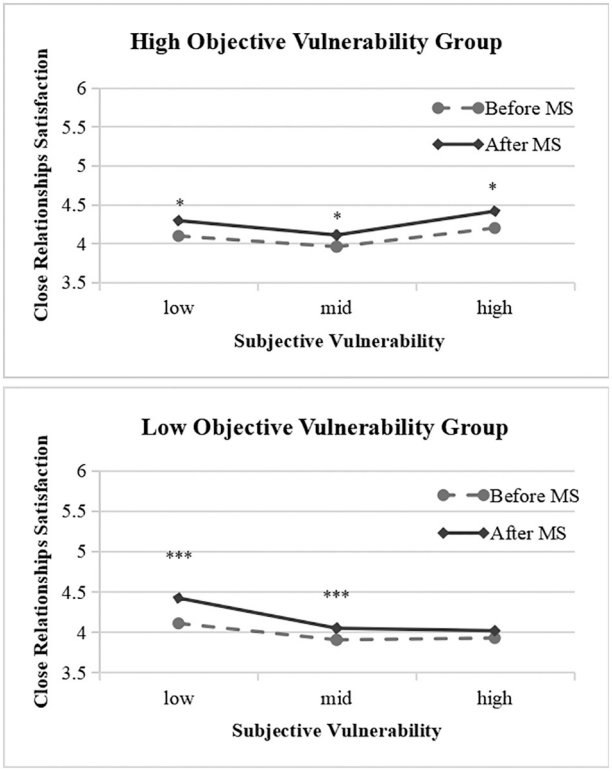

Fig. 1. MS effect on relationship satisfaction of Low, Mid and High Subjective Vulnerability Group. Note. *$p < .05$, ***$p < .001$.

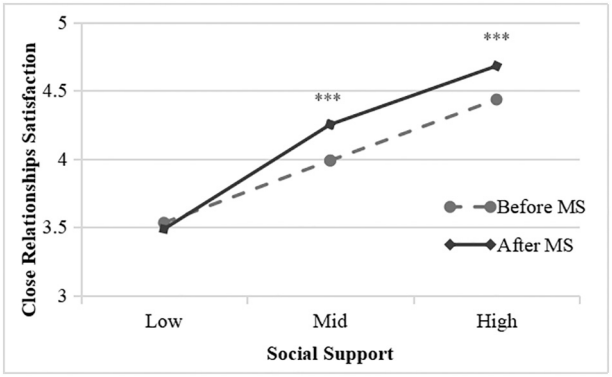

Fig. 2. MS effect on relationship satisfaction of Low, Mid and High Social Support Group. *Note.* ***$p < .001$.

how these individuals respond psychologically to the death threat rooted in the disease. The results highlight that a close relationships defense mechanism plays an effective role in buffering death-related anxiety for healthcare workers.

Additionally, this work contributes to the field by expanding our understanding of the role of two moderators (i.e., vulnerability and social support) in terror management. Given the context of the COVID-19 pandemic, objective and subjective vulnerability are unique factors derived from real-world situations. Objective vulnerability reflects the infectious risk in the environment where healthcare workers work, and subjective vulnerability manifests their risk perception of COVID-19 infection. Social support reflects a personal social-resource system that healthcare workers possess at present. Compared with an attachment that is endowed and cultivated from childhood, social support can be continuously replenished from close relationships, which has great practical value in maintaining mental health. The moderating effects of vulnerability and social support could therefore help identify potential populations with mental problems and provide effective assistance for them to deal with continuous death-related anxiety induced by COVID-19.

Although the study was consistent within the TMT framework, there were a few limitations. First, we collected data through a large survey and used a within-subjects design to explore the mortality salience effect rather than using a typical TMT approach of employing traditional MS manipulations and including a control group. In addition, two different scales of relationship satisfaction were used to examine the MS effect in our study. Thus, future replication studies may benefit from adopting a between-subject design and using same scales to measure the dependent variables. Second, there is no baseline measure of close relationship satisfaction before the COVID-19 pandemic. Thus, more evidence is needed to investigate this effect in the context of the pandemic in the future. Third, we obtained data nine months after the widespread outbreak of the pandemic in China. It is important to explore the impact of vulnerability in terror management not only during an outbreak but also at ground zero, because subjective vulnerability is affected by some situational factors (Wen et al., 2020).

The COVID-19 pandemic reminds humans of their vulnerability and personal mortality, especially for healthcare workers who have been

fighting with the virus and being exposed to death on a consistent basis. We believe that, despite some limitations, the present study shows how healthcare workers respond to death-related anxiety induced by COVID-19 within the TMT framework. As TMT predicts, our findings suggest that close relationships serve as an effective terror management source. Moreover, our findings illustrate the moderating effects of vulnerability and social support on managing death-related anxiety. This line of research highlights the importance of consistently paying attention to healthcare workers' mental health. Providing social support in various ways deserves practical application, whether during the current pandemic or in similar situations that may occur in the future.

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CRediT authorship contribution statement

Yunjiao Chen: conceptualization, methodology, formal analysis, data curation, writing - original draft, writing - Review & Editing, visualization.

Xuyun Tan: conceptualization, investigation, data collection, project administration.

Cai Xing: conceptualization, methodology, writing - Review & Editing, supervision, project administration.

Jiaren Zheng: investigation, data collection.

Declaration of competing interest

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work presented in the manuscript.

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