



Daily Positive Support and Perceived Stress During COVID-19 Outbreak: The Role of Daily Gratitude Within Couples

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Abstract

Coronavirus disease 2019 (COVID-19) has induced stress and anxiety. According to past studies, positive support within married couples reduces stress during diseases and disasters, but their mechanisms are unclear. To address this gap and help individuals better cope with COVID-19-related psychological distress, this study examined the relationships among daily positive support, daily gratitude, and daily stress within married couples. In this 14-day daily diary study, 54 heterosexually married couples ($N=108$) aged 28 to 71 years participated. After reporting their demographic information at the start of the study, they reported their perceived positive support from their partner, daily stress, and feelings of gratitude at the end of each day of the study for 14 consecutive days. Using a *multivariate outcome, multilevel cross-classification*, we found that daily positive support was negatively associated with daily stress, mediated by daily feelings of gratitude. On a day when a person reported more perceived positive support than others, this person also reported a higher level of feelings of gratitude and a lower level of stress, regardless of age. We found only an actor effect, no partner effect. These findings show how greater daily positive support is linked to greater daily feelings of gratitude, which in turn is linked to less daily stress during an emergent public health crisis.

Keywords Positive support · Marital relationship · Gratitude · Life span · COVID-19

1 Introduction

Coronavirus disease 2019 (COVID-19) has killed many people and caused enormous psychological distress, yielding higher levels of anxiety and stress (Qiu et al., 2020). Stress is a detrimental factor that decreases mental, physical, and cognitive well-being across the

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life span. When individuals experience stressful events such as COVID-19, social support, especially from marital partners, may serve a protective role, increasing positive affect and decreasing negative affect (Maisel & Gable, 2009; Pasupathi et al., 1999; Stanley & Markman, 2020). For example, Kowal and et al.' (2020) study of 26 countries and regions showed that married people reported better well-being than single people did during the pandemic. Lamarche (2020) found that people who felt more socially connected with significant others perceived COVID-19 precautions as more important and were more likely to prioritize collective interests over individual interests.

Pietromonaco and Overall (2020) extended the *vulnerability-stress-adaptation* model (Karney & Bradbury, 1995) to the COVID-19 pandemic, positing that this pandemic created various external stressors, such as perceived isolation and job loss. Adaptive dyadic relationship processes, such as responsive support from a partner, and positive affect, may buffer against the external stressors caused by the pandemic (Pietromonaco & Overall, 2020). In particular, Pietromonaco and Overall posit eliciting gratitude to be an effective method to nurture relationship growth and promote individual well-being. However, no published study has directly tested this idea within the COVID-19 pandemic. In addition, individuals who perceived more support from their family members reported better well-being during the COVID-19 pandemic (Losada-Baltar et al., 2020). However, few studies have examined the mechanism(s) underlying the relationship between family support and well-being during the COVID-19 pandemic. Little is known about how perceived positive support from one's marital partner affects their stress during COVID-19. In this 14-day daily diary study of couples during the peak outbreak of COVID-19 in China, we tested whether a person who perceived more positive support from a partner reported greater feelings of gratitude and hence, less stress.

1.1 Perceived Positive Support from Partner and Well-Being

The *transactional stress theory* (Lazarus & Folkman, 1984) posits that social support influences the cognitive appraisal of stressful situations. More social support than otherwise often elicits better coping strategies and therefore promotes healthier and more positive outcomes (Lazarus & Folkman, 1984). Studies have consistently yielded such findings for both general daily stress (Debrot et al., 2018) and high-stress life periods (e.g., life-threatening diseases, Sormanti & Kayser, 2000; pregnancy, Rini et al., 2006). Among cardiac patients (Holahan et al., 1997), HIV-positive patients (Weaver et al., 2005), and patients undergoing cancer surgery (Luszczynska et al., 2005), those receiving more positive support from a partner than others coped more actively. Among cancer patients, those who perceived more support from partners than others, reported more self-efficacy, which was linked to better coping (Schwarzer & Knoll, 2007). Positive support from partners enhanced coping mutuality for women with cancer, which helped them better cope with it (Sormanti & Kayser, 2000).

Similarly, among pregnant women, those with more partner support than others had lower levels of stress, depression symptoms, and posttraumatic stress disorder (PTSD) symptoms (River et al., 2020). Additionally, mothers who had more partner support than other mothers had less stress or depression (Brock et al., 2014). Moreover, women who perceived more partner support during pregnancy than others had less emotional distress postpartum, and their newly-born infants showed less distress towards novel stimuli (Stapleton et al., 2012).

After Meuwly et al. (2012) experimentally induced stress among heterosexual couples, those with more positive support from partners recovered from stress more quickly (indexed by a lower level of cortisol 45 min after the manipulation); women generally recovered faster than men did. Although many studies have shown a positive link between perceived support from partners and individual well-being, few studies have examined its mechanisms, especially from the perspective of affective experiences such as gratitude.

The vulnerability-stress-adaptation model (Karney & Bradbury, 1995) proposed that during stressful periods, positive interactions between partners are important to maintain their well-being and relationship quality. Because of the COVID-19 pandemic's tremendous impact on psychological well-being, this postulation might apply (Pietromonaco & Overall, 2020). Likewise, greater perceived family support enhanced individuals' well-being during the pandemic; those who perceived more support from family members reported less stress and better well-being (Losada-Baltar et al., 2020; Schmid et al., 2020).

1.2 The Relationship Between Perceived Positive Support and Gratitude

Gratitude is defined as a positive affective state that individuals experience when they perceive that they received benefits (Emmons & McCullough, 2004). McCullough et al. (2002) identified three levels of gratitude: a personal trait, an emotion, and a fluctuating daily feeling. Gratitude as a personal trait is one's general tendency to recognize one's benefits from others. Gratitude as an emotion is the desire to ignite reciprocal exchange. Last, gratitude can be viewed as a daily feeling. In this study, we focus on the role of gratitude as a daily feeling.

Perceiving the benefactor to be responsive to one's wishes and needs can elicit this feeling of gratitude (Algoe, 2012). After receiving a favor from others, individuals reported greater gratitude (Tsang, 2007). This effect also occurred when study participants were asked to imagine that a friend had helped them or when they were asked to recall such a past experience (Tsang, 2007). In the context of couple relationships, positive interactions within couples were associated with feelings of gratitude for both recipients and benefactors in a 14-day daily diary study (Algoe et al., 2010).

1.3 The Relationship Between Gratitude and Perceived Stress

People who feel gratitude more often have better well-being and perceive less stress both in general (e.g., Lee et al., 2018; Nezlek et al., 2019) and during the COVID-19 pandemic (Jiang, 2020). Individuals who feel more gratitude than others have better mental and physical health, including lower suicidal ideation (Kleiman et al., 2013), posttraumatic stress (among earthquake survivors in Indonesia, Lies et al., 2014), better sleep quality (Wood et al., 2009), and less stress (Lee et al., 2018; Nezlek et al., 2019), which in turn increase life satisfaction (Yildirim & Alanazi, 2018). Furthermore, an intervention promoting daily feelings of gratitude and grateful reflection improved daily well-being and reduced daily stress (O'Leary & Dockray, 2015). On days in which daily diary study participants felt more gratitude during the COVID-19 pandemic, they reported more positive affect, less perceived stress, and better subjective health (Jiang, 2020).

Gratitude also promotes closer romantic relationships among couples. According to *find-remind-and-bind theory* (Algoe, 2012), people feeling more gratitude than others more readily establish and maintain reciprocal relationships, as well as higher quality ones. Furthermore, expressions of gratitude towards partners increased their feelings of receiving

care ("cared for"), which weakened the negative links of insecure attachment (e.g., attachment avoidance) with both commitment and relationship satisfaction (Park et al., 2019). People who feel more gratitude also feel more connectedness, satisfaction, and commitment in their relationship (Algoe et al., 2010; Gordon et al., 2011, 2012). In a 14-day daily diary study, people feeling gratitude one day felt more connection and greater satisfaction with their relationships the next day (Algoe et al., 2010). Furthermore, perceived positive interaction (e.g., responsiveness) increased feelings of gratitude and further increased relationship maintenance behaviors (Kubacka et al., 2011). Compared to couples who were asked to talk with each other about their experiences for a month, participants who expressed their gratitude to each other for a month reported better personal and relational well-being (Algoe & Zhaoyang, 2016).

1.4 COVID-19 and the Present Study

We studied stress in Chinese couples from February to March 2020, during the peak period of the COVID-19 outbreak in China. During this time, the Chinese government ordered a home quarantine to reduce interpersonal contact. As a result, family support became more valuable, so understanding positive support from partners and well-being under such stress is critical. As multiple waves of COVID-19 have struck many countries (e.g., South Korea, Germany, etc.), understanding how positive support within couples affects stress can inform interventions during such waves. Thus, we tested whether daily perceived positive support, daily feelings of gratitude and daily stress are linked via a 14-day daily diary study of a life-span sample of married couples. We hypothesized that perceived positive support from partner would be negatively associated with a level of stress, and that such relationship would be mediated by feelings of gratitude. Specifically, a higher level of perceived positive support would be positively associated with the level of gratitude feeling, which will be negatively associated with perceived stress during the pandemic. For taking into account the interdependence of the partners, both, actor and partner effects will be tested. An individual's feelings and perceptions were more immediate than those of one's partner, and feelings of gratitude were not always expressed, so we expected a significant actor effect and a nonsignificant partner effect.

2 Method

2.1 Participants

We recruited 54 pairs of heterosexually married couples aged 28 to 71 years ($N=108$; $M=50.99$ years, $SD=6.39$ years; males: $M=51.37$, $SD=6.10$; females: $M=50.24$, $SD=6.53$) to participate in this 14-day daily diary study ($N_{\text{daily assessment}}=1466^1$). Participants were recruited from 40 cities in mainland China that were 178 km to 2796 km away from Wuhan ($M=861.47$ km, $SD=429.96$ km). All participants were recruited by sending advertisements to students using the mass mailing system of a university. Students were asked to participate and to recruit other married couples. Participants were required to (1)

¹ Since removing data of the couples who did not complete 14 assessments did not change the main patterns of results, we kept all the data in data analysis.

be aged 18 years or above; (2) be mainland Chinese; (3) live in mainland China during the 14-day study period; and (4) live together with their spouses. Table S1 presents the demographic characteristics of the sample.

The statistical power of the sample differed across levels. For $\alpha=0.05$ (type I error tolerance), the statistical power (a) exceeded 0.99 for the 1,466 daily responses at an effect size of $d=0.1$ (Cohen's d ; Cohen et al., 2003), (b) was 0.89 for the 108 participants at an effect size of 0.3 and (c) was 0.86 for the 54 couples at an effect size of 0.4 (Konstantopoulos, 2008). The empirical variances at each level were substantial (couple: 44%; person: 38%; time: 18%). See Table S1 in the online Supplementary Materials for a detailed description of the sample.

2.2 Procedure

Our study involved two phases. In phase 1, participants completed a consent form and a questionnaire regarding their demographic information. Phase 2 began the day after phase 1 and lasted for 14 consecutive days. In phase 2, participants received daily reminder text messages between 4–6 pm to complete the daily assessment by the end of the day. Online questionnaires were administered via <https://www.wenjuan.com/> collected participant responses. After completing the pretest and all daily questionnaires, participants received a supermarket coupon valued at approximately US\$26 as compensation. All procedures were approved by the Human Research Ethics Committee at our university.

2.3 Measures

Well-established scales were used to measure the key variables in our study. All measures were forward-translated into Chinese and backward-translated (Brislin, 1980).

2.3.1 Demographic Information

The questionnaire in phase 1 included questions on age, gender (0 = male; 1 = female), education level (secondary school graduate, college graduate, masters or above [vs. did not graduate from secondary school]), job status (full-time job vs. not), religiosity (vs. not), and having at least one child (vs. not) of both wife and husband. We used the education level and job status of each person in a couple to create a couple socioeconomic status (SES) index. As closer proximity to the location of the first confirmed COVID-19 case in Wuhan might affect participant views, we have also collected distances from the respondent's city to Wuhan.

Daily Perceived Stress (from Perceived Stress Scale, PSS, Cohen et al., 2014) has two subscales: (a) COVID-19 stress (3 items; between-person reliability estimate = 0.99; within-person reliability estimate = 0.81; Cranford et al., 2006; e.g., "I have felt that I was unable to control the important things in my life because of COVID-19 today") and (b) general life stress (2 items; between-person reliability estimate = 0.98; within-person reliability estimate = 0.60 Cranford et al., 2006; e.g., "I have felt troubles were piling up so high that I could not deal with them"). Its Likert-type scale ranged from 1 (never) to 5 (very often).

Daily Perceived Positive Support (from Positive and Negative Social Exchanges Scale, Newsom et al., 2005) has 4 items (between-person reliability estimate = 0.97; within-person reliability estimate = 0.93 using the methods in Cranford et al., 2006; e.g., "Today, my

Table 1 Statistics strategies to address each analytic difficulty

Analytic difficulty	Statistics strategy
<i>Data set</i>	
Missing data (01??10011)	Markov Chain Monte Carlo multiple imputation
Measurement errors on surveys	Factor analysis
<i>Outcome variables</i>	
Nested data	Multilevel analysis
Differences across time	Multilevel cross-classification
Similar adjacent days (t_3-t_4)	Q-statistics
Multiple outcomes (Y_1, Y_2, \dots)	Multivariate outcome multilevel analysis
<i>Explanatory variables</i>	
Indirect, multi-level, mediation effects	Multilevel <i>M-test</i>
Cross-level interactions (person \times couple)	Random effects model
Many hypotheses' false positives	Two-stage linear step-up procedure
Compare effect sizes ($\beta_1 > \beta_2?$)	Lagrange multiplier tests
Consistency of results across data sets (robustness)	Separate multilevel, single outcome models Analyses of subsets of the data Original (not estimated) data

partner is responsive to my need"). Its Likert-type scale ranged from 1 (not true at all) to 7 (completely true).

Daily Feeling of Gratitude (Fredrickson et al., 2003). Participants were asked to indicate the frequency with which they had felt gratitude in general that day on a Likert-type scale ranging from 1 (never) to 5 (all the time).

Daily Subjective Health (World Values Survey, Wave 6) was assessed by the question "How would you rate your current health status today?" Its Likert-type scale ranged from 1 (perfect) to 6 (very bad).

Interaction Time and Relationship Satisfaction with Family Members (Newsom et al., 2005). On five items, participants indicated the amount of time (in hours) that they interacted with family members, including partners, grandparents, parents, children, and grandchildren. Participants also rated their satisfaction with their family members on five corresponding items on a Likert-type scale from 1 (very negative) to 7 (very positive).

Information on the *ordinal day* of the quarantine of 14-days *and day of week* (Monday, Tuesday, ... Sunday) was obtained from the online questionnaire platform.

Daily COVID-19 information included the numbers of *new confirmed cases*, *new deaths* and *new suspected cases* in mainland China. This information was collected from the reported daily news of Xinhua News Agency during the data collection period.

3 Data Analysis

3.1 Analytic Issues and Statistics Strategies

Suitable analyses of these data must address issues involving data, outcomes, and explanatory variables (see Table 1). Data issues include missing data and survey measurement error. As missing data can bias results, reduce estimation efficiency, and

complicate data analyses, we estimated the missing data with *Markov chain Monte Carlo multiple imputation* (Peugh & Enders, 2004) via *Lisrel 10.1* ([a] single-chain, [b] EM posterior mode initial estimates, [c] Jeffreys priors, [d] 500 imputations, [e] 200 burn-in iterations, [f] 100 iterations; Joreskog & Sorbom, 2018). To reduce survey measurement error, we used multiple questions for each construct to create a precise index via *factor analyses* (Joreskog & Sorbom, 2018).

Outcome issues include differences across groups or times, and multiple outcomes. As responses by the same person within the same couple living in the same city likely resemble one another more than responses by different people across couples or cities (*nested data*), an ordinary least squares regression can underestimate the *standard errors*, so we used a *multilevel analysis* (Goldstein, 2011). As ignoring similarities among adjacent days (*serial correlation* of residuals) can bias the results, the *Q-statistic* tests responses by individuals on adjacent days (if needed, we model it; Ljung & Box, 1978). We modeled time through a *multilevel cross-classification* (Goldstein, 2011). Multiple outcomes can have *correlated residuals* that underestimate standard errors, which we addressed via a *multivariate outcome multilevel analysis* (Goldstein, 2011).

Explanatory variable issues include mediation effects, cross-level interactions, many hypotheses' false positives, effect size comparisons, and robustness. As single-level mediation tests on nested data can bias results, a *multilevel M-test* was used (MacKinnon et al., 2004). With nested data, incorrectly modeling interaction effects across levels can bias the results, so we used a *random effects* model (Goldstein, 2011). We also test for (and model) *cross-level moderation* with structural variables (e.g., gender). As testing many hypotheses increases the possibility of a *false positive* (not significant in reality but a significant statistics result), we reduced the likelihood of false positives via the *two-stage linear step-up procedure*, which outperformed 13 other methods in computer simulations (Benjamini et al., 2006). When testing whether the effect sizes of explanatory variables differ, we used *Lagrange multiplier tests* which apply to the entire data set and show greater statistical power than Wald or likelihood ratio tests for small deviations from the null hypothesis (Bertsekas, 2014). Last, we tested whether the results remained stable despite minor changes in the data or analyses (*robustness*, Kennedy, 2008) by modeling each outcome variable separately, testing data subsets, and repeating the analyses for the original, un-estimated data.

3.2 Factor Analyses

We tested the internal validity of the survey items from their measurements on perceived stress, and minimized their measurement errors with *multilevel confirmatory factor analyses* (*ML-CFA* on LISREL 10.1 for 4 factor models: single, multiple, hierarchical, nested) to yield unbiased *Bartlett factor scores* (Joreskog & Sorbom, 2018). To assess fit, we used the comparative fit index (CFI), Tucker–Lewis index (TLI), standardized root mean square residual (SRMR) and root mean square error approximation (RMSEA; Hu & Bentler, 1999). The fit thresholds were: good (CFI and TLI > 0.95; SRMR < 0.08; RMSEA < 0.06), moderate (0.90 < CFI and TLI < 0.95; 0.08 < SRMR < 0.10; 0.06 < RMSEA < 0.10), and poor (CFI and TLI < 0.90; SRMR > 0.10; RMSEA > 0.10).

3.3 Explanatory Model

We modeled daily survey responses from each person within a couple in a city with a *multivariate outcome, multilevel cross-classification* (Goldstein, 2011).

$$\mathbf{Stress}_{t(ijk)} = \beta_0 + e_{t(ijk)} + f_{ijk} + g_{jk} + h_k \quad (1)$$

Stress (perceived) at time t by individual i in couple j in province k has a grand mean intercept β_0 , with unexplained components (*residuals*) at the day-, individual-, couple-, and province-levels ($e_{t(ijk)}$, f_{ijk} , g_{jk} , h_k).

Explanatory variables were entered in sequential sets to estimate the variance explained by each set and to test for mediation effects (Kennedy, 2008). Structural variables (e.g., demographics) can influence malleable process variables (e.g., perceived positive support, feeling of gratitude), so the former was entered before the latter. Also, the quantity of time spent together can influence perceived relationship satisfaction. Hence, the explanatory variables were entered in this order: demographics, partner demographics, day, number of confirmed cases during the COVID-19 quarantine, interaction time with family (partner, parents, children, grandparents, and grandchildren), relationship satisfaction with family (partner, parents, children, grandparents, and grandchildren), subjective health, perceived positive support, and gratitude.

$$\begin{aligned} \mathbf{Stress}_{t(ijk)} = & \beta + e_{t(ijk)} + f_{ijk} + g_{jk} + h_k + \beta_{ijk} \mathbf{Demographics}_{ijk} + \beta_{t(ijk)} \mathbf{Day}_{t(ijk)} \\ & + \beta_{t(ijk)} \mathbf{COVID-19}_{t(ijk)} + \beta_{t(ijk)} \mathbf{Interaction_Time}_{t(ijk)} \\ & + \beta_{t(ijk)} \mathbf{Relationship_Satisfaction}_{t(ijk)} + \beta_{t(ijk)} \mathbf{Perceptions}_{t(ijk)} \end{aligned} \quad (2)$$

First, we entered the individual's **Demographics** (*gender, age, SES, religion, marital length, child status, and distance from Wuhan*). A *nested hypothesis test* (χ^2 log likelihood) indicates whether each set of explanatory variables is significant (Kennedy, 2008).

Then, we entered the partner's demographics (e.g., partner's age), without *female* (our data only include heterosexual couples) and without distances from Wuhan (same for each couple). Next, we entered **Day** (ordinal day in quarantine, ordinal day in quarantine², Monday, Tuesday, Thursday, Friday, Saturday, Sunday [vs. baseline of Wednesday]). Then, we added the **COVID-19** numbers of confirmed new cases, suspected new cases, and new deaths. We followed with **Interaction Time** and then **Relationship Satisfaction** with family members for each day in quarantine (parents, children, grandparents, and grandchildren and relationship satisfaction with partner, parents, children, grandparents, and grandchildren). Then, we added the daily **Perceptions** (subjective health, positive support, gratitude).

As variables in vectors later entered into the model might mediate the link between variables in vectors entered earlier and the outcomes, we performed multilevel mediation tests on each such combination of significant variables (explanatory variable \rightarrow mediator \rightarrow outcome; variable in earlier vector \rightarrow variable in later vector \rightarrow stress [self or partner]; MacKinnon et al., 2004) before conducting a multilevel path analysis (Goldstein, 2011). The *total effect* (TE) of an explanatory variable on the outcome is the sum of its direct effects and all of its indirect effects (Kennedy, 2008). Unless otherwise noted, all effects are total effects. We also analyzed the residuals for influential outliers and performed robustness tests.

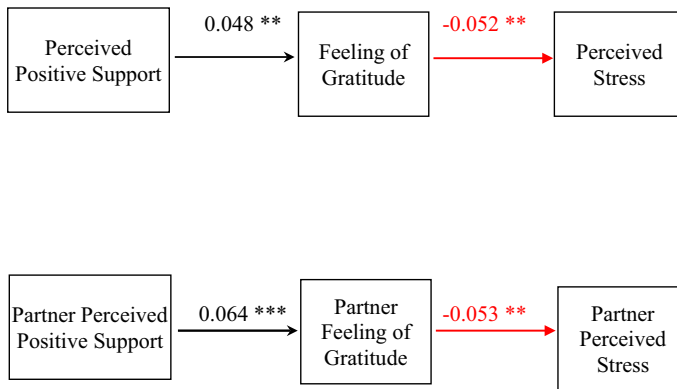


Fig. 1 Daily feeling of gratitude as mediator of the relationship between perceived positive support and stress in actors and partners. Black arrows indicate positive links. Red arrows indicate negative links. Thicker arrows indicate larger effect sizes. (Color figure online)

4 Results

4.1 Factor analysis

The ML-CFA for the stress variables showed a good fit for a single factor (CFI=0.979; TLI=0.948; RMSEA=0.035; SRMR=0.029 within couples and=0.029 between couples; $\chi^2[8]=23$, $p=0.004$; and poor fits for other factor structures; results available upon request). The first eigenvalue accounted for 75% of the variance within couples and 48% of the variance across couples. The reliability coefficient was 0.807 within couples and 0.992 across couples (Cronbach's $\alpha=0.832$). Factor loadings of stress variables are reported in the Online Supplementary Materials.

4.2 Explanatory Model

For all outcomes, most of the variance was at the couple level (45% for both individual perceived stress and partner perceived stress), somewhat less at the person level (35%), and even less across time (20%). These outcomes showed no significant differences across provinces.

4.3 Actor's Perceived Stress

Individuals' perceived positive support and feelings of gratitude were both linked to individual perceived stress. Participants perceiving more positive support from their partners reported less stress on the same day ($-0.002=0.048 \times -0.052$ from the multiplicative product of the parameters along the top path of the structural equation model in Fig. 1, top). This relationship was mediated by feeling of gratitude on that day (mediation test: $z=2.028$, $p=0.042$). Participants feeling more gratitude reported less stress on the same day (-0.052 ; see Fig. 1, top). These results, with the other controlled explanatory

variables, accounted for approximately 10% of the variance in individual perceived stress each day. These reported results focus on the primary variables of interest. For the full results, see Table S4 in the Online Supplementary Materials.

4.4 Partner's Perceived Stress

Likewise, partners' perceived positive support and feelings of gratitude were both linked to partners' perceived stress. Partners who reported more positive support than other partners reported less stress on the same day (-0.003 ; from 0.064×-0.053 ; see Fig. 1, bottom). This relationship was mediated by feeling of gratitude on the day (mediation test: $z=2.006$, $p=0.044$). Partners reporting more feelings of gratitude reported less stress on the same day (-0.053). These results, with the other controlled explanatory variables, accounted for approximately 11% of the variance in partner perceived stress each day.

All other explanatory variables were not significant. Analyses of residuals showed no unusual outliers. Robustness tests yielded similar results.

5 Discussion

Our 14-day daily diary study of married couples during a COVID-19 quarantine showed that individuals who perceived more positive support from their partners felt more gratitude (mediator), and thus reported less stress. These results suggest that after perceiving positive support from a partner, a person feels more gratitude (perhaps for the partner), which reduces the person's stress, though not the partner's stress. Partners who perceived more positive support felt more gratitude, and so reported less stress. Also, the results showed only same-day effects and no time-lagged effects from earlier days.

Note that we examined participants' subjective feelings of gratitude, not gratitude expression; a person who feels gratitude for a partner does not always express it to the partner. Individuals who more often express gratitude (e.g., saying "thank you") to their partner than others do report higher relationship quality (Park et al., 2019). As researchers have not tested whether expressing gratitude improves well-being during high-stress events such as pandemics, future studies can address this question.

Other mechanisms in addition to gratitude might underlie the link between perceived positive support from a partner and stress. For instance, perceived positive support might increase general positive affect or increase active coping strategies (Holahan et al., 1997; Schwarzer & Knoll, 2007), either of which in turn might reduce stressful feelings. Future studies can clarify these relationships.

In addition to identifying a mechanism, our findings suggest that future studies examine whether an intervention that enhances positive support and feelings of gratitude reduce stress during a COVID-19 outbreak or other high-stress situations. Specifically, future studies can examine whether social media or practitioners who emphasize positive support in families and promote feelings of gratitude help them reduce stress or other negative affective states during COVID-19.

The partner effects were not significant in this study. These findings may suggest that gratitude might only affect one's own emotional states, not those of a partner, during high-stress situations such as a pandemic. Previous studies that found both actor and partner effects in studies on couple relationships focused on behaviors (e.g., Bloch et al., 2014) or subjective evaluations of the relationship (Algoe et al., 2010) as outcomes. Compared

to behaviors, emotional states are more subjective and more difficult to observe (Gross, 1998). Also, relationship quality was not related to perceived stress in this study.

In addition, the nonsignificant partner effect may be due to the fact that we focused on feelings of gratitude, but not gratitude expression (e.g., Kleiman et al., 2013). As noted above, feeling gratitude differs from expressing gratitude to a partner, so a partner might not detect a person's gratitude feelings without their overt expression. Future studies should consider the role of gratitude expression in reducing stress of the partners.

Also, the small sample size of this study, especially at the couple level reduces statistical power and hence reduces our confidence in nonsignificant results (Kennedy, 2008). As suggested in our limitations sections, future studies with larger sample sizes might detect a partner effect in the actor partner interdependence model with mediation effects.

We found significant cross-sectional effects but no time-lagged effects. Most past studies of positive support and stress were based on one-off surveys or laboratory experiments. Only a few studies have used a daily diary study. These studies demonstrated a cross-sectional effect but not a time-lagged effect (e.g., Li & Fung, 2013). Unlike the salient positive support that participants report in a laboratory discussion (e.g., Pasupathi et al., 1999), the extent of positive interactions within couples changed within and across days in this diary study, so today's positive behavior might not influence tomorrow's individual stress.

A number of studies have examined couple relationships during the COVID-19 pandemic. For instance, Panzeri et al. (2020) examined changes in sexuality and quality of couple relationships during the COVID-19 lockdown (Panzeri et al., 2020). Günther-Bel et al. (2020) examined relational improvement and deterioration. Sahebi (2020) highlights the importance of clinical supervision of couples and family therapy during the pandemic. Although these findings have provided important information about couple relationships during the pandemic, they did not directly address how daily interaction influences well-being of each individual. Our findings suggested that positive daily interactions between couples could buffer stress during the COVID-19 pandemic and be protective for individuals' well-being; thus, these findings have several implications. First, past studies showed that positive interactions within couples improve both individual and relational well-being (e.g., Ditzen et al., 2008; Vittengl & Holt, 1998), so we extended this research by providing evidence that feelings of gratitude operates as a mechanism to mediate the relationship between positive interaction and well-being. This result raises the possibility of a successful intervention that further increases a person's gratitude for partner's positive interactions to reduce the person's stress and enhance the person's well-being. Future intervention studies can test this idea.

Second, the current proposed intervention strategies for promoting individual well-being during the pandemic have focused on individuals. The findings of our studies, however, show the importance of support from romantic partners on individuals' well-being during this stressful period. The findings of our study may have the potential to be developed into interventions to promote well-being during the COVID-19 pandemic from the perspectives of inducing positive interactions between couples. In addition, policy-makers and practitioners in different countries have spent much effort organizing counseling services to promote individual well-being. The findings of our study suggest that support from family members, especially romantic partners, can help individuals maintain well-being during the pandemic. Policymakers and practitioners might consider testing whether interventions that improve family support, especially support from romantic partners, enhance health and well-being.

Our study has five limitations: changes across time, small sample size, survey, construct measure, and generalizability beyond the location of data collection. First, the severity of

COVID-19 changed substantially from the February to March 2020 time period of this study, so participants did not experience the same external COVID-19 conditions (which we controlled for with COVID-19 variables such as new daily infections). Ideally, all participants would begin future studies at the same time. Also, this study tested whether today's behavior affects tomorrow's stress; future studies can test fine-grained sequences of moment-to-moment behaviors and stresses.

Second, we have 1466 daily survey responses and 108 participants, but only 54 couples from mainland China were included in this study. The smaller sample size at the couple-level yields less statistical power, so we have less confidences in nonsignificant effects at the couple-level (though we retain full confidence in all significant effects at all levels and have more confidence in nonsignificant effects at the daily response and participant levels). Future studies can use larger, diverse samples with more participants from different countries.

Third, using the daily diary method, our longitudinal data showed only significant links within the same day, not across days. Experimental designs can further clarify the causal mechanisms. For instance, participants in the experimental condition could be asked to write down positive support from the partner and focus on the feeling of gratitude in daily interactions (unlike participants in the control condition). Such designs can clarify the causal mechanism of gratitude for the link between perceived positive support and stress.

Fourth, our study measured reported gratitude as a general daily mood (McCullough et al., 2002), but did not directly examine whether the feelings of gratitude was caused by partner's positive support. Future studies can specify the target of the gratitude feeling and further clarify this question.

Fifth, our study was conducted in China during home quarantine, so whether our findings generalize to other countries is an open question. Unlike many other countries, the Chinese government imposed a strict home quarantine order, so these couples might have spent more time interacting with each other than those in other countries without a strict home quarantine. Although we controlled for daily interaction hours in our data collection, we do not know whether being forced to stay at home causes different interaction patterns within couples. Future studies can collect data from other countries to determine whether our findings generalize across countries.

In this 14-day daily diary study of married couples during the peak COVID-19 outbreak in China, more daily perceived positive support was linked to greater daily feelings of gratitude (mediator), which in turn was linked to lower levels of daily stress. This study sheds light on the important roles of providing positive support to family and feelings of gratitude on reducing stress during the COVID-19 outbreak.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10902-021-00387-0>.

Declarations

Conflict of interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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