

# Daily interventions and assessments: The effect of online self-compassion meditation on psychological health

Yanjuan Li<sup>1</sup> | Yueqin Hu<sup>2</sup> | Wanting Yang<sup>1</sup> | Yuyin Wang<sup>1</sup> 

<sup>1</sup>Sun Yat-sen University, Guangzhou, China

<sup>2</sup>Texas State University, San Marcos, TX, USA

## Correspondence

Yuyin Wang, Department of Psychology, Sun Yat-sen University, Guangzhou, Guangdong, China.  
Email: wangyuy2@mail.sysu.edu.cn

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## Abstract

Traditional self-compassion-based interventions have been shown to be beneficial for improving psychological health. With the development of technology, online interventions accessible via smart phones start to emerge. The current study aimed to use daily assessments to investigate the effect of online daily self-compassion interventions and its improvement pattern. Sixty-five employees were recruited and completed a 4-week study. The first week was the control period; the second week and the third week were the intervention period and the fourth week was the follow-up period. Online self-compassion meditation significantly improved daily self-compassion and reduced perceived stress and emotional exhaustion, with varied changing patterns. Daily self-compassion and perceived stress did not change in the control period, then started to increase/decline with time during the intervention period, and remained stable in the follow-up period. Daily emotional exhaustion declined with time in the control period and remained stable in the intervention and follow-up period. The intervention effects did not differ for individuals with different levels of trait self-compassion. This study shows that daily online self-compassion meditation is effective and reveals how it works. Future studies can apply this method to examine the effectiveness of other daily online interventions.

**KEYWORDS**

daily assessments, daily interventions, self-compassion, stress

**INTRODUCTION**

Self-compassion-related interventions have been developed to assist individuals in improving psychological health. Some known interventions include mindful self-compassion (MSC; Neff & Germer, 2013) and compassion-focused therapy (CFT; Gilbert, 2014), in which training is mainly based on meditation. A formal program of these traditional interventions usually lasts for more than 8 weeks, including around 2-h training sessions weekly and at least 45 min of home practice daily (Eriksson et al., 2018). A few meta-analytic studies exclusively reviewed self-compassion-related interventions and found that these interventions significantly increased self-compassion while reducing anxiety, depression, and psychological distress (Kirby et al., 2017; Wilson et al., 2019).

With the development of technology, an increasing number of smart phone apps that are blended with meditation interventions have shown up in the market, such as Headspace, Calm, Mindbody, and Now. It has been demonstrated that principles of acceptance and self-compassion can be learned through online meditations via smart phone, leading to decreased perceived stress and psychological distress (Jayawardene et al., 2017; Linardon, 2020). Meanwhile, these interventions are more convenient and cost-effective (Economides et al., 2018).

Compared with traditional forms of interventions, online interventions are especially suitable for employees. First, most employees have strict working time and they also need to balance work and family, which places additional difficulties for them to attend the formal programs (e.g. MSC, CFT). By contrast, online interventions are accessible 24/7 to employees in their own environment. Second, emotional exhaustion and high stress are prevalent in employees (Norlund et al., 2015). Therefore, it is helpful for employees to learn self-help strategies to alleviate daily pressure and promote general health. Finally, daily interventions are cost-effective and do not necessarily require the involvement of a therapist (Eriksson et al., 2018). Therefore, it is of great importance to examine the effect of online meditation interventions among employees given that this form of intervention may be the most accessible and realistic solution for them.

Previous studies have demonstrated that self-compassion is associated with lower stress and less emotional exhaustion at the between-person level (Atkinson et al., 2017; Homan & Sirois, 2017). In other words, individuals high in self-compassion are more likely to have less stress and emotional exhaustion than individuals low in self-compassion. Recently, one study also revealed that self-compassion is associated with stress at the within-person level (Li et al., 2020). That is, on days when a person treats him or herself more self-compassionately than usual, he or she experiences less stress. However, how the effects of online self-compassion intervention on daily stress and daily emotional exhaustion are produced remain unknown.

These questions would be examined with a study design that uses daily assessments. Compared with pre- and post-tests, daily assessments could closely examine the effects of online daily interventions on varied outcomes given the following advantages (Lischetzke et al., 2015). First, daily assessment enables us to examine the within-person relationship between intervention target (e.g. self-compassion) and intervention outcomes (e.g. stress) and therefore is closer to causal inference than traditional pre- and post-design (Bolger & Laurenceau, 2013). Second, the situational conditions may bias the result in a traditional design (i.e. pre- and post-tests), but is not an issue in daily assessment design for that each individual is followed for a period of time, and the within-person variation of one variable should be associated with the within-person variation of another (Bolger & Laurenceau,

2013). In addition, compared with pre- and post-tests, daily assessments can capture the whole process of change, thus demonstrate how the effects are produced (Lischetzke et al., 2015), and therapists can be more aware of what can be expected at each stage of intervention. Moreover, if daily assessment is combined with individual trait measures, we can also examine the intervention effect among different groups and therefore be able to answer questions such as who benefit more from the intervention (Lischetzke et al., 2015).

To our knowledge, a few studies have used daily assessments to examine the effects of self-compassion-related or mindfulness-related interventions, but with different data-analytic strategies. Generally speaking, there are three kinds of analysis strategies. The first kind focuses on the overall changes of daily-assessed variables after the interventions, without revealing how the changes were produced (e.g. Hülshager et al., 2013). The second kind is using generalized additive models to picture the changing trajectories of the outcome variables (e.g. Congard et al., 2019, 2020), though by employing this rather complex analytic method, it is hard to do straightforward numerical comparison between the intervention group and the control group (McKeown & Sneddon, 2014). The third kind is more in line with the one Lischetzke et al. (2015) proposed, using multilevel regression models to investigate the intervention effects and reveal the changing trend of the intervention outcomes (e.g. Jazaieri et al., 2018; Pogrebtsova et al., 2018).

Compared with the former two kinds of analytical strategies, the last kind is more informative, comprehensible, and user-friendly. In light of their data-analytical plan, we proposed a four-step procedure for research design that combines daily assessments and daily interventions: the first step is analyzing the within-person relationship between the intervention target (e.g. self-compassion) and the intervention outcomes (e.g. stress); the second step is investigating whether the intervention target changes significantly after the intervention (i.e. manipulation check); the third step is examining whether the intervention outcomes have been improved in the expected direction and revealing the improvement pattern; the last step is examining whether the intervention effect is moderated by individual differences in rather stable characteristics or situational factors.

Therefore, the current study aimed to use the four analytic steps to investigate (1) the within-person relationships between self-compassion and perceived stress and emotional exhaustion, (2) whether daily interventions on self-compassion could simultaneously improve self-compassion, perceived stress and emotional exhaustion, (3) if could, how would be the improvements pattern, and (4) whether individuals with different levels of trait self-compassion benefited differently from the daily intervention. Correspondingly, it was hypothesised that (1) self-compassion was negatively associated with emotional exhaustion and perceived stress at the within-person level; (2) compared with the control period, self-compassion, perceived stress, and emotional exhaustion were significantly improved in the intervention and/or follow-up period, while the examination of the last two research questions was exploratory.

## METHODS

### Study design

The current study used a within-subject design, gathering daily records from employees for four consecutive weeks (28 days), in which the first week was the control period, the second and the third week were the intervention periods, and the last week was the follow-up period (see Figure 1). The daily assessments for the 28 days were identical. Power analysis was conducted to estimate an appropriate sample size prior to data collection. Given 28 diaries per participant and an intra-class

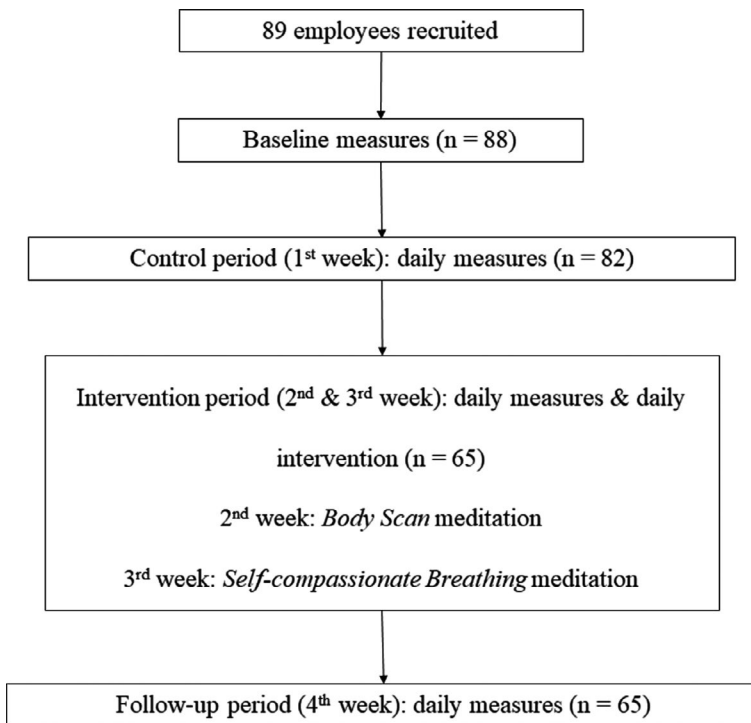


FIGURE 1 Flowchart of the study

correlation of .60, power analysis suggested that a sample size of 52 is adequate to detect a medium effect size of  $r = .30$  (Diggle et al., 2002, pp. 26–31). Taking account of an estimate of attrition rate of 30 per cent based on a previous review (Nam & Toneatto, 2016), the current study planned to recruit at least 74 participants. The Human Subject Review Boards of the Department of Psychology of Sun Yat-sen University granted approval to the study.

## Participants

Using the method of snowball sampling via social networking, participants were recruited from various organisations, such as Internet companies and schools. Inclusion criteria included the following: (1) currently employed; (2) 18 years of age or older; (3) voluntary participation. Exclusion criteria included the following: (1) no access to the Internet; (2) inadequate proficiency in Chinese; (3) previous participation in meditation program longer than 8 weeks; and (4) with mental disorder diagnosis or severe physical problems.

Eighty-nine employees were recruited. The average age of the recruited sample was 35.65 ( $SD = 6.19$ ). Among them, 62.1 per cent were females; 86.2 per cent were married, 9.2 per cent were single, and 4.6 per cent divorced; and 20.7 per cent were research and development personnel, 27.6 per cent were managerial personnel, 8.0 per cent were teachers, and 43.7 per cent had other jobs. Education levels were as follows: 14.9 per cent without a bachelor's degree, 58.6 per cent bachelor's degree, 24.1 per cent master's degree, and 2.3 per cent doctor's degree. The average subjective

socioeconomic status was 5.79 ( $SD = 1.12$ , potential range = [1, 10], actual range = [3, 8]), indicating that the perceived socioeconomic status of the current sample was slightly above average.

## Procedures

After being recruited, participants received a description of the study and were asked to provide the informed consent. Then, they completed baseline measures including demographic information and measure of trait self-compassion. The 28 dairy study started on the following Monday after the participant finished their baseline measures. Each evening, participants needed to complete one diary questionnaire on a data collection website (sojump<sup>®</sup>; <https://www.wjx.cn>). Since the first week was the control period, participants only needed to finish dairy questionnaire. In the intervention period, participants needed to meditate following guidance and complete dairy questionnaire. Besides, they were also asked to report whether they performed the meditation or not during the past 24 h (yes or no) every morning. In the follow-up week, participants completed dairy questionnaires only. At the end of the study, all participants were debriefed about the study and were rewarded with a book named *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*.

## Measures

Data collection consisted of baseline measures and daily measures. Baseline measures included demographic information and measure of trait self-compassion. Daily measures included daily self-compassion, perceived stress, and emotional exhaustion. Omega was calculated as an indicator of the within-person reliability for each daily measure using multilevel confirmatory factor analysis (Bolger & Laurenceau, 2013, pp. 138–139; Shrout & Lane, 2012, pp. 302–320).

## Demographics

Demographic information included age, gender, marriage status, education level, job, and subjective socioeconomic status. Subjective socioeconomic status was measured by the MacArthur Scales of Social Subjective Status (Singhmanoux et al., 2003), which is a self-anchoring scale in the form of a 10-rung ladder. The higher up participants put themselves on the ladder, the higher they rate their subjective socioeconomic status.

## Trait self-compassion

Trait self-compassion was assessed with the 26-item Self-Compassion Scale (SCS; Neff, 2003). The SCS assesses the three main components of self-compassion and their negative counterparts, that is, self-kindness (self-judgment), common humanity (isolation), and mindfulness (over-identification). All items are prefaced with the statement “how I typically act toward myself during difficult times” and respondents indicate how often they behave in the described way using response options ranging from 1 (*Almost Never*) to 5 (*Almost Always*). Total scores across the 26 items defined each participant's level of self-compassion. The possible range of the total SCS is 26–130. In the current study, Cronbach's  $\alpha$  was .901.

## Daily self-compassion

Daily self-compassion was assessed with the 6-item Daily Self-compassion Scale (DSCS; Li et al., 2020). Participants were asked to respond based on how they treat themselves during difficult times of that day using a scale from 1 (*almost never*) to 5 (*almost always*). A sample item is “Today, when I saw aspects of myself that I didn't like, I got down on myself.” The potential range of the total DSCS is 6–30. The omega was .886.

## Perceived stress

Perceived stress was measured using the Short Form Perceived Stress Scale (PSS-4), which describes life stress in terms of how much one felt that things were not in control (Leung et al., 2010). Participants answered the questions based on their experience of that day and responded options ranged from 0 (*Never*) to 4 (*Very Often*). A sample item is “Today, how often have you felt confident about your ability to handle your personal problems?” The potential range of PSS-4 is 0–16. The omega was .794.

## Emotional exhaustion

Emotional exhaustion was measured using the Emotional Exhaustion subscale of Maslach Burnout Inventory-General Survey (MBI-GS; Schaufeli et al., 1996, pp. 19–26). Emotional exhaustion is identified through five items such as “I feel burned out from my work.” Participants were instructed to complete the scale based on their experience of that day. All items are scored on a seven-point scale, from 0 (*Completely Disagree*) to 6 (*Completely Agree*). The potential range of the total emotional exhaustion score is 0–30. The omega was .849.

## Intervention

In the intervention period, participants were first instructed to read materials that introduced the concept of self-compassion and the two intervention materials they would receive. *Body Scan* was delivered on the second week while *Self-compassionate Breathing* was delivered on the third week. These two guided meditation materials were adapted from the guided meditations posted on the website *Self-compassion.org* by Dr. Kristin Neff. The *Body Scan* was used to help individuals to be more mindful toward their physical and psychological status, which is also one of the components of self-compassion (Neff, 2003). The *Self-compassionate Breathing* was used to help individuals foster a compassionate attitude toward themselves. These two meditations are commonly used in self-compassion trainings.

## Data analyses

We conducted main analyses using multilevel modeling with restricted maximum likelihood using HLM 7 (Raudenbush et al., 2011). Multilevel modeling was appropriate in the current study since the data had a hierarchical structure where days/periods (level 1; within-person) were nested within participants (level 2; between-person; Lischetzke et al., 2015). The manipulation check of online

self-compassion meditation and the effects of online self-compassion meditation on perceived stress and emotional exhaustion were analyzed in two ways. First, we examined how daily self-compassion, perceived stress, and emotional exhaustion changed with time in each period. Weekly cyclic trend was controlled by including the binary variable *WK* (weekdays vs. weekend) as a level-1 predictor (see Equations 1 and 2). Second, we compared levels of these variables in the control period (study days 1–7) to those in the intervention period (study day 8–21) and the follow-up period (study day 22–28) (see Equations 3 and 4). Besides, if we want to examine whether trait self-compassion moderated the intervention effects, we included trait self-compassion as a level-2 predictor in Equations (2) and (4), then conducted the above analyses again.

a. To examine the change with time in each period

Level-1:

$$Y_{ij}^a = \beta_{0j}^a + \beta_{1j}^a \text{Time}_{ij} + \beta_{2j}^a \text{WK}_{ij} + \varepsilon_{ij}^a \quad (1)$$

Level-2:

$$\begin{aligned} \beta_{0j}^a &= \gamma_{00}^a + \mu_{0j}^a \\ \beta_{1j}^a &= \gamma_{10}^a + \mu_{1j}^a \\ \beta_{2j}^a &= \gamma_{20}^a + \mu_{2j}^a \end{aligned} \quad (2)$$

*Note.* *WK* = Weekdays or weekend.  $Y_{ij}^a$  = individual  $j$ 's dependent variables on day  $i$ ;  $\gamma_{00}^a$  = the outcome level at Time 0;  $\gamma_{10}^a$  = the change in the outcome per day;  $\gamma_{20}^a$  = the difference between weekdays and weekend. To examine the moderating effect of trait self-compassion,  $\beta_{1j}^a$  in Equation (2) is updated to  $\beta_{1j}^a = \gamma_{10}^a + \gamma_{11}^a \text{SC}_j + \mu_{1j}^a$  where  $\gamma_{11}^a$  = the interaction between time and trait self-compassion.

b. To examine the difference between three periods

Level-1:

$$Y_{ij}^b = \beta_{0j}^b + \beta_{1j}^b \text{PERIOD}_{ij} + \varepsilon_{ij}^b \quad (3)$$

Level-2:

$$\begin{aligned} \beta_{0j}^b &= \gamma_{00}^b + \mu_{0j}^b \\ \beta_{1j}^b &= \gamma_{10}^b + \mu_{1j}^b \end{aligned} \quad (4)$$

*Note.* *PERIOD* is the dummy variable for the control/intervention period or the control/follow-up or the intervention/follow-up period, depends on which two periods are being compared;  $\gamma_{00}^b$  = mean score of the control period across individuals;  $\gamma_{10}^b$  = mean control/intervention difference (intervention minus control score), or control/follow-up difference (follow-up minus control score), or intervention/follow-up (follow-up minus intervention score)/across individuals. To examine the moderating effect of trait self-compassion,  $\beta_{1j}^b$  in Equation (4) is updated to  $\beta_{1j}^b = \gamma_{10}^b + \gamma_{11}^b \text{TSC}_j + \mu_{1j}^b$  where  $\gamma_{11}^b$  = the interaction between period and trait self-compassion.

## RESULTS

### Preliminary analyses

Among the 89 employees who were recruited, one did not complete the baseline measures, six dropped out during the control period, and three dropped out during the intervention period. Six participants reported doing the meditation less than 7 times during the intervention period, and eight participants received different intervention materials due to the experimenter's mistake. Therefore, 65 participants were included in the following analyses (See Figure 1). The average age of the final sample was 35.65 ( $SD = 6.19$ ), among whom 63.1 per cent were females. No differences were found in any of the demographic characteristics and trait self-compassion at baseline between the excluded participants and the remaining participants (all  $p$  values  $> .05$ ). On average, 26.43 daily records ( $SD = 2.35$ ) were gathered per person: 6.85 ( $SD = 0.44$ ), 13.23 ( $SD = 1.31$ ) and 6.35 ( $SD = 1.04$ ) daily records for control, intervention, and follow-up period, respectively. On average, individuals performed 11.14 times ( $SD = 1.78$ ) meditation, with *body scan* 5.17 times ( $SD = 1.49$ ) and *self-compassionate breathing* 5.97 times ( $SD = 1.10$ ). The descriptive statistics for each day are presented in Table S1.

Intra-class coefficient (ICC) was calculated for each measure. As shown in Table 1, daily self-compassion, perceived stress, and emotional exhaustion displayed an ICC of .766, .489, and .627 respectively, indicating that at least 23 per cent ( $1 - .766$ ) of the variance of each variable lay within persons. Therefore, there was sufficient within- and between-person variation in the data to estimate a multilevel model.

### Correlations between study variables during the control period

Daily data collected during control period were used to examine the correlations between study variables. As depicted in Table 1, both at the within- and between-person level, self-compassion was significantly and negatively correlated to perceived stress and emotional exhaustion. The one-day lagged relationships were also examined using multilevel regression. Results indicated that T day's self-compassion could significantly predict T+1 day's perceived stress ( $B = -.240$ ,  $SE = .043$ ,  $t = -5.550$ ,  $p < .001$ ) and emotional exhaustion ( $B = -.252$ ,  $SE = .089$ ,  $t = -2.816$ ,  $p = .005$ ).

### Manipulation check of daily self-compassion intervention

Daily self-compassion did not change with time during the control period ( $\gamma_{10}^a = -0.033$ ,  $p = .689$ ). During the intervention period, from the day 8 (Monday) to day 21 (Sunday), daily self-compassion

TABLE 1 Correlations between study variables and ICCs during the control period

|                          | ICC  | 1      | 2      | 3      | 4      |
|--------------------------|------|--------|--------|--------|--------|
| 1. Trait self-compassion |      |        |        |        |        |
| 2. Daily self-compassion | .766 | .193*  |        | -.181* | -.052* |
| 3. Perceived stress      | .489 | -.087* | -.375* |        | .153*  |
| 4. Emotional exhaustion  | .627 | -.187* | -.377* | .300*  |        |

Note: Within-person correlations are above the diagonal and between-person correlations are below the diagonal.  $n = 82$ .

Abbreviation: ICC, intra-class coefficient.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

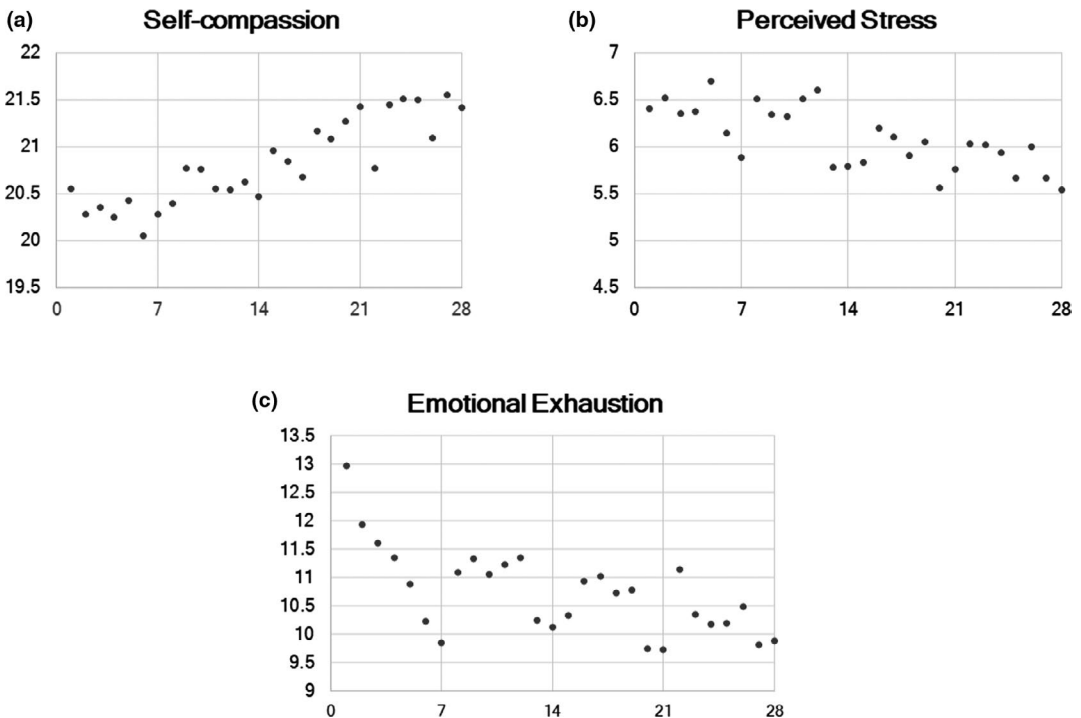


increased significantly with time ( $\gamma_{10}^a = 0.062, p = .027$ ). And the average level of self-compassion during the intervention period was significantly higher than that of the control period ( $\gamma_{10}^b = 0.537, p = .014$ ). During the follow-up period, daily self-compassion remained did not change with time ( $\gamma_{10}^a = 0.042, p = .376$ ) and the average self-compassion level was significantly higher than that in the control period ( $\gamma_{10}^b = 1.014, p = .004$ ) and in the intervention period ( $\gamma_{10}^b = 0.477, p = .014$ ); see Figure 2A, Tables 2 and 3.

## The effects of online self-compassion meditation

During the control period, perceived stress did not change with time ( $\gamma_{10}^a = 0.034, p = .639$ ). During the intervention period, perceived stress reduced significantly with time ( $\gamma_{10}^a = -0.043, p = .024$ ). On average, compared with the control period, perceived stress decreased in the intervention period, though not significant ( $\gamma_{10}^b = .246, p = .116$ ). During the follow-up period, perceived stress did not change with time ( $\gamma_{10}^a = -0.041, p = .524$ ) and was significantly lower than perceived stress both in the control period ( $\gamma_{10}^b = -0.537, p = .007$ ) and in the intervention period ( $\gamma_{10}^b = -0.294, p = .006$ ) on average (see Figure 2B, Tables 2 and 3).

During the control period, from Monday to Sunday, emotional exhaustion significantly reduced with time ( $\gamma_{10}^a = -0.468, p < .001$ ). During the intervention period, from the day 8 (Monday) to day 21 (Sunday), emotional exhaustion did not change significantly with time ( $\gamma_{10}^a = -0.054, p = .208$ ). On average, compared with the control period, emotional exhaustion decreased marginally significant in the intervention period ( $\gamma_{10}^b = -0.624, p = .065$ ). Similarly, during the follow-up period,



**FIGURE 2** The change with time of each variables. Each dot represents the mean score of all participants on a given day

TABLE 2 Multilevel models describing change over time in each period

| Outcome variable      | Period              | Fixed (with robust SE) |                 |        | Random |         |              |        |
|-----------------------|---------------------|------------------------|-----------------|--------|--------|---------|--------------|--------|
|                       |                     | Coef.                  | Est.            | SE     | t      | Coef.   | SD           |        |
| Daily self-compassion | Control period      | Intercept              | $\gamma_{00}^a$ | 20.426 | .415   | 49.171* | $\mu_{0j}^a$ | 3.207* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.033 | .082   | -.402   | $\mu_{1j}^a$ | 0.506* |
|                       | Intervention period | Intercept              | $\gamma_{00}^a$ | 20.453 | .403   | 50.788* | $\mu_{0j}^a$ | 3.198* |
|                       |                     | Time                   | $\gamma_{10}^a$ | 0.062  | .027   | 2.279*  | $\mu_{1j}^a$ | 0.196* |
|                       | Follow-up period    | Intercept              | $\gamma_{00}^a$ | 21.143 | .455   | 46.443* | $\mu_{0j}^a$ | 3.576* |
|                       |                     | Time                   | $\gamma_{10}^a$ | 0.042  | .047   | .892    | $\mu_{1j}^a$ | 0.125  |
| Perceived stress      | Control period      | Intercept              | $\gamma_{00}^a$ | 6.408  | .268   | 23.895* | $\mu_{0j}^a$ | 1.807* |
|                       |                     | Time                   | $\gamma_{10}^a$ | 0.034  | .073   | .471    | $\mu_{1j}^a$ | 0.323* |
|                       | Intervention period | Intercept              | $\gamma_{00}^a$ | 6.497  | .250   | 26.014* | $\mu_{0j}^a$ | 1.877* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.043 | .019   | -2.307* | $\mu_{1j}^a$ | 0.103* |
|                       | Follow-up period    | Intercept              | $\gamma_{00}^a$ | 6.031  | .268   | 22.537* | $\mu_{0j}^a$ | 1.918* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.041 | .064   | -.641   | $\mu_{1j}^a$ | 0.301* |
| Emotional exhaustion  | Control period      | Intercept              | $\gamma_{00}^a$ | 12.732 | .626   | 20.353* | $\mu_{0j}^a$ | 4.728* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.468 | .106   | -4.401* | $\mu_{1j}^a$ | 0.487  |
|                       | Intervention period | Intercept              | $\gamma_{00}^a$ | 11.274 | .686   | 16.445* | $\mu_{0j}^a$ | 5.422* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.054 | .042   | -1.273  | $\mu_{1j}^a$ | 0.289* |
|                       | Follow-up period    | Intercept              | $\gamma_{00}^a$ | 10.646 | .697   | 15.272* | $\mu_{0j}^a$ | 5.429* |
|                       |                     | Time                   | $\gamma_{10}^a$ | -0.095 | .103   | -.915   | $\mu_{1j}^a$ | 0.582* |

Note: To simplify the table, only reported estimates of coefficients of interests were reported.

Abbreviations: Coef., coefficient; Est., estimate; SD, standard deviation; SE, standard error.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

TABLE 3 Multilevel models comparing the average level of different periods

|                         | Fixed (with robust SE) |        |      |                     | Random       |                    |
|-------------------------|------------------------|--------|------|---------------------|--------------|--------------------|
|                         | Coef.                  | Est.   | SE   | <i>t</i>            | Coef.        | SD                 |
| Daily self-compassion   |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 20.302 | .387 | 52.492 <sup>†</sup> | $\mu_{0j}^b$ | 3.088 <sup>†</sup> |
| PERIOD <sub>IP-CP</sub> | $\gamma_{10}^b$        | 0.537  | .211 | 2.545 <sup>†</sup>  | $\mu_{1j}^b$ | 1.556 <sup>†</sup> |
| PERIOD <sub>FU-CP</sub> | $\gamma_{10}^b$        | 1.014  | .340 | 2.984 <sup>†</sup>  | $\mu_{1j}^b$ | 2.628 <sup>†</sup> |
| Perceived stress        |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 6.356  | .225 | 28.253 <sup>†</sup> | $\mu_{0j}^b$ | 1.725 <sup>†</sup> |
| PERIOD <sub>IP-CP</sub> | $\gamma_{10}^b$        | -0.246 | .154 | -1.594              | $\mu_{1j}^b$ | 1.007 <sup>†</sup> |
| PERIOD <sub>FU-CP</sub> | $\gamma_{10}^b$        | -0.537 | .192 | -2.798 <sup>†</sup> | $\mu_{1j}^b$ | 1.292 <sup>†</sup> |
| Emotional exhaustion    |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 11.307 | .580 | 19.466 <sup>†</sup> | $\mu_{0j}^b$ | 4.594 <sup>†</sup> |
| PERIOD <sub>IP-CP</sub> | $\gamma_{10}^b$        | -0.624 | .333 | -1.875 <sup>†</sup> | $\mu_{1j}^b$ | 2.353 <sup>†</sup> |
| PERIOD <sub>FU-CP</sub> | $\gamma_{10}^b$        | -1.080 | .476 | -2.270 <sup>†</sup> | $\mu_{1j}^b$ | 3.537 <sup>†</sup> |
| Daily self-compassion   |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 20.839 | .388 | 53.690 <sup>†</sup> | $\mu_{0j}^b$ | 3.125 <sup>†</sup> |
| PERIOD <sub>FU-IP</sub> | $\gamma_{10}^b$        | 0.477  | .182 | 2.617 <sup>†</sup>  | $\mu_{1j}^b$ | 1.282 <sup>†</sup> |
| Perceived stress        |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 6.110  | .219 | 27.917 <sup>†</sup> | $\mu_{0j}^b$ | 1.724 <sup>†</sup> |
| PERIOD <sub>FU-IP</sub> | $\gamma_{10}^b$        | -0.294 | .103 | -2.823 <sup>†</sup> | $\mu_{1j}^b$ | 0.355              |
| Emotional exhaustion    |                        |        |      |                     |              |                    |
| Intercept               | $\gamma_{00}^b$        | 10.683 | .570 | 18.740 <sup>†</sup> | $\mu_{0j}^b$ | 4.566 <sup>†</sup> |
| PERIOD <sub>FU-IP</sub> | $\gamma_{10}^b$        | -0.456 | .272 | -1.677              | $\mu_{1j}^b$ | 1.737 <sup>†</sup> |

Note: Because when we compared the control/intervention score difference and the control/follow-up score difference, the dummy coding for control period was 0, which means the intercept ( $\gamma_{00}^b$ ) was the same, we put the result together to simplify the table.

Abbreviations: CP, control period; FU, follow-up period; IP, intervention period.

<sup>†</sup> $p < .07$ ; \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

emotional exhaustion did not significantly change with time ( $\gamma_{10}^a = -0.095$ ,  $p = .354$ ). However, emotional exhaustion decreased significantly in the follow-up period compared with the control period ( $\gamma_{10}^b = 1.080$ ,  $p = .027$ ; see Figure 2C, Tables 2 and 3).

## The moderating effects of trait self-compassion

To examine the moderating effects of trait self-compassion on the intervention effects, we included trait self-compassion as a level-2 predictor in Equations (2) and (4). Results showed that trait self-compassion did not moderate the effect of time and the effect of periods on daily self-compassion, perceived stress, and emotional exhaustion (all  $p$  values  $> .05$ ). Therefore, both people high in trait self-compassion and people low in trait self-compassion benefited equally from daily self-compassion intervention.

## DISCUSSION

The current study used a daily assessment design to closely examine the effects of self-compassion-related online daily meditation on employees' perceived stress and emotional exhaustion. The daily assessment revealed more information about the intervention effects than research using traditional pre- and post-tests.

The results from multilevel modeling comparing the average level of different periods provided similar findings with traditional pre- and post-tests and further supported that self-compassion-related meditation could increase self-compassion and decrease perceived stress and emotional exhaustion, which were consistent with previous studies using pre- and post-test (Eriksson et al., 2018). The current study revealed more findings that the intervention effect on self-compassion showed up in the intervention period, while the significant effect on the outcome variables appeared in the follow-up period. These findings implied that the intervention effect on the outcome variables had a delayed pattern.

The daily assessment design provided additional opportunity to closely examine the improvement patterns over time, which were not able to be examined in the traditional design. Through multilevel modeling examining change over time in each period, the results showed that self-compassion and perceived stress changed with time in the intervention period. These results could show us an accumulating improvement pattern of meditation practice. Besides, although in the follow-up period, the level of self-compassion and the other two variables did not change with time, the average level of them showed significant improvement compared with the control period. This indicated that it may exist an aggregation effect of daily meditation practice.

Surprising improvement pattern showed in daily emotional exhaustion. Although consistent with expectation, the average level of emotional exhaustion reduced after intervention, the changing pattern over time was different from perceived stress. It significantly reduced with time in the control period, but not in the intervention and follow-up period. The tentative explanation of this result may be that the online self-compassion meditation might inhibit the increase of emotional exhaustion in the beginning of a week. There has been one study investigated the weekly pattern of incivility and vigor, which showed that incivility decreased from Monday to Friday while vigor increased (Nicholson & Griffin, 2017). Although to our knowledge, there has no study directly examining the pattern of emotional exhaustion, it could be possible that it could be high in the beginning of the week facing a long week work. The self-compassion meditation could buffer this detrimental effect and finally reduce the average level of emotional exhaustion during the intervention period. However, this explanation needs control group or more pure assessment weeks to further verify it.

Another possible explanation for the unexpected changing pattern of daily emotional exhaustion is monitoring one's self-compassion, stress, or emotion might be an effective intervention to reduce emotional exhaustion. Thus, attending the study significantly reduced emotional exhaustion and reached ceiling effect after the first week, which may explain why the improvement only happened during the control period. Yet further studies are needed to clarify the observed effect. If such "monitoring-as-an-intervention effect" does exist, more specific intervention targeting at emotional exhaustion is needed for a further decrease.

The interaction between trait self-compassion and period/time was examined and no interaction was detected. This result suggests that individuals who are generally high and low in self-compassion can be equally benefit from online self-compassion meditation. Another study also found that baseline self-compassion-related traits (i.e. fear of self-compassion) did not moderate the effect of a brief online self-compassion intervention on trait anxiety (Stevenson et al., 2019). It seems like

online self-compassion intervention is equally suitable for individuals with different levels of self-compassion-related traits.

The within-person relationships between self-compassion and intervention outcomes were also examined using the measures in the control period. The results indicated that when an individual was more self-compassionate toward him- or herself on a given day, he or she was less likely to perceive a lot of stress and be emotionally exhausted on that day and on the next day. These findings were in line with the results of previous cross-sectional and longitudinal studies (Allen & Leary, 2010; Atkinson et al., 2017; Li et al., 2020).

As shown from the above discussion, it is beneficial to use daily assessments to examine the effects of daily interventions. Using multilevel regression analyses, we can investigate whether the intervention is effective and how the improvement pattern is (Lischetzke et al., 2015). Compared with commonly used pre- and post-tests in examining the effectiveness of online meditations (Eriksson et al., 2018), the current assessment and analytical method provide more information, especially for variables that fluctuate over time. To our knowledge, the current study is one of the few studies that used daily assessments to investigate the effects of online daily meditation intervention. In this post-COVID-19 world, there is an increased reliance on online meditation interventions. Strong empirical support for these interventions is of great need. With the convenience of collecting daily data on APPs, researchers could use this daily assessment method and analytical procedure to investigate the effectiveness of online meditation training programs on preventing psychopathological symptoms and improving mental health.

However, some limitations of the current study should be addressed. First of all, no control group was designed in this study. All participants went through the intervention, so we can hardly draw a casual conclusion that the observed changes were a result of intervention. Other interfere possibilities could not be excluded, including the effect of time, the monitoring effect of study variables. Yet including a control period moved us one step closer to casual inference and eliminate other interferences. Future study can include a control group who monitors their self-compassion and other variables throughout the whole course of the study. Second, the current study did not examine the amount of practices that we needed to produce a significant change. Future study can develop other analytical strategies to investigate this question. Third, the global levels of perceived stress and emotional exhaustion at baseline and post-intervention were not collected. These data would be valuable to further investigate the intervention effect. Last, the current study examined two common kinds of self-compassion meditations as an example, cautions should be taken when generalizing our findings to other meditation practices (e.g. Loving-Kindness Meditation; Neff & Germer, 2013), and each practice should be closely examined before it is delivered to a large population.

## CONCLUSION

The current study used daily assessments to investigate the effects of daily self-compassion meditation on employees' psychological health. Results showed that daily self-compassion negatively correlated with daily perceived stress and emotional exhaustion at the within-person level, and daily self-compassion meditation could improve employees' self-compassion, while reducing their perceived stress and emotional exhaustion, but with varied improving patterns. In addition, this intervention is equally suitable for individuals with different levels of self-compassion. This study illustrated how to use daily assessments to investigate the effects of daily interventions.

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## CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## ETHICAL APPROVAL

All procedures performed in the current study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study (i.e. day-level variables, person-level variables, and demographic information) are openly available in Open Science Framework at <https://doi.org/10.17605/OSF.IO/PQF6V> (file name = days.sav and persons.sav).

## ORCID

Yuyin Wang  <https://orcid.org/0000-0001-8977-4894>

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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