



Online Mindfulness-Based Intervention Program Improves Mental Health, Well-Being, and Productivity

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Abstract

Objectives This study aimed to evaluate the effectiveness of the Intervention program of Mindfulness and Compassion against COVID-19 (IMACOCO), an online mindfulness-based intervention (MBI), in enhancing mindfulness, mental health, well-being, and productivity among working individuals during the COVID-19 pandemic. Additionally, the study examined the program's efficacy in individuals directly impacted by the pandemic through a randomized controlled trial and pre-post program comparisons.

Method Three hundred working adults, including office workers, educators, and medical welfare workers, were randomly allocated to the intervention or waiting control group. An 8-week online MBI program, with pre-, interim (4 weeks), and post-program (8 weeks) evaluations, was conducted via the Internet; standardized questionnaires were used to assess mindfulness, psychological distress, life satisfaction, and productivity. After the initial 8-week program, the waiting control group participated in the same program and evaluation surveys for pre-post comparisons.

Results There were 99 participants in the intervention group and 111 in the control group. Significant increases in mindfulness (FFMQ) and life satisfaction (SWLS) as well as decrease in psychological distress (GHQ-12) were observed primarily in the intervention group (Cohen's $d = 0.18$ – 0.52). Furthermore, the pre-post comparisons with 168 participants demonstrated significant improvements in productivity (Cohen's $d = 0.26$), and stratified analysis revealed that participants affected by COVID-19 showed more pronounced benefits in mindfulness and life satisfaction than those who were unaffected.

Conclusions Implementing an online MBI program (IMACOCO) can be a potent strategy to reduce mental stress and enhance overall well-being and resilience, in a disaster-prone world.

Preregistration This study is not preregistered.

Keywords Mindfulness · Compassion · Well-being · Presenteeism · COVID-19

Mindfulness has been adopted in many therapeutic programs and also been introduced as a stress management strategy and workers' capacity development skill in numerous companies and is common among most modern leaders (Lomas et al., 2017; Parsons et al., 2022; Vonderlin et al., 2020).

The concept of mindfulness originates from Buddhist traditions; however, one reason for its worldwide popularity is that it has been established as a secular (non-religious) technique. Given its global popularity, mindfulness-based interventions (MBIs) have advanced exponentially in recent years (Creswell, 2017; Spijkerman et al., 2016). Standardized MBIs have been developed and proved effective in areas such as medication and prevention of mental disorders (Hofmann & Gómez, 2017). MBIs are typically based on 8-week sessions (similar to MBSR [Mindfulness-Based Stress Reduction] and MBCT [Mindfulness-Based Cognitive Therapy]) and are currently used in many types of interventions, including mindfulness meditation practice and principles in group setting approaches (Strauss et al., 2014; Tao et al., 2022; Williams et al., 2015).

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Mindfulness offers a silent mental state and promotes the ability to focus on the present while paying attention and maintaining awareness with a non-judgmental and curious willingness to accept one's thoughts, feelings, and sensations. This mindful mental status has five aspects: observation, description, awareness, non-judgment, and non-reactivity (Baer et al., 2008). It is possible to assess the mindful state using established questionnaires (Cebolla et al., 2012).

The global spread of the novel coronavirus disease 2019 (COVID-19) pandemic in 2020 increased concerns and anxiety about the risk of infection and the uncertain socioeconomic future. In addition, the work environment and lifestyles changed significantly (such as a shift to teleworking), reducing communication (Crocker et al., 2022; Furuya et al., 2022; Meira-Silva et al., 2022; Wang et al., 2023). Mehrsafari et al. (2021) reported that the COVID-19 pandemic negatively influenced mental health and life satisfaction. Therefore, effective measures were sought to alleviate these social anxieties (Mehrsafari et al., 2021).

Numerous studies have demonstrated that MBIs can help reduce anxiety and perceived stress, preventing mental disorders (such as depression) and increasing well-being, resilience, and compassion (Fulambarkar et al., 2022; Hofmann & Gómez, 2017; Malik & Annabi, 2022; Sist et al., 2022; Zhang et al., 2020). Mindfulness is an effective method recognized and applied globally as an evidence-based psychopractice. Therefore, MBIs can be effective for people affected by the COVID-19 pandemic (Liu et al., 2022).

In this study, we developed the Intervention program of Mindfulness and Compassion against COVID-19 (IMACOCO), an original MBI program, to reduce anxiety and stress and improve citizens' well-being and productivity. The acronym "IMACOCO" means "the present moment" in Japanese. The defining features of the IMACOCO are its accessibility as an online program and its elements of compassion in the basic mindfulness acquisition program.

Mindfulness, a practice of present-moment awareness without judgment, inherently includes compassion, fostering a deep understanding and desire to alleviate suffering in oneself and others. Although not explicitly designed to cultivate compassion, MBSR programs are associated with increased self-compassion (Jazaieri et al., 2013). Compassion extends this acceptance by showing genuine concern for alleviating suffering. Shapiro et al. (2005) examined the effects of mindfulness intervention on healthcare professionals and found that the program led to significant increases in self-reported empathy and compassion. Lilius et al. (2008) explored how compassion is manifested, facilitated, and obstructed in organizational contexts and emphasized the role of compassion at work.

This study primarily aimed to investigate the effectiveness of the IMACOCO on mindfulness, mental health, well-being, and productivity of working people. Additionally, we

investigated whether this MBI program was effective for people affected by the COVID-19 pandemic. We investigated the effectiveness of this MBI program using a randomized controlled trial, by comparisons with a waiting control group and pre- and post-program implementation evaluations.

Method

Participants

The participants comprised workers residing in Fukuoka City, Japan, and were recruited through public advertising. Recruitment and registration were conducted between August and September 2020 via websites. The participants included general office workers, educators, and medical welfare workers. Participation in the study was voluntary. Participants who were currently experiencing or undergoing treatment for severe anxiety or depression, mental illness, or any other serious mental or physical problem that could affect their ability to engage with the program were excluded. In total, 300 participants, aged 25–75 years, were enrolled in this study. There were 140 male participants, 159 female, and 1 other. The industry categories were general companies (171 participants), medical and welfare (80 participants), and education (49 participants). These participants were allocated to the intervention group and the waiting control group, with 150 individuals in each group.

Procedures

We conducted a randomized controlled trial with waiting controls for the first 8-week intervention program. The participants were randomized into two groups (A and B). Group A received the intervention in the first 8 weeks, with Group B being the waiting control group. In the first session, Groups A and B were simultaneously evaluated three times (pre- [T1], interim- [T2], and post-intervention [T3]) via the Internet.

After the initial 8-week intervention program, Group B (control group) completed the 8-week intervention program and participated in a survey (pre- [T3], interim- [T4], and post-intervention [T5]). In the comparison between Group A and Group B, T3 represents the data from the evaluation after the intervention. However, in the evaluation before and after the intervention for Group B, T3 was analyzed as the pre-intervention evaluation data. Therefore, a total of five surveys were conducted for Group B. This study design enabled us to compare the effectiveness of the first 8-week session for the intervention and control groups; the pre- and post-effectiveness was evaluated by integrating the survey data during the intervention for both groups.

IMACOCO is an 8-week program, with 2 hr allotted for the initial lesson, and a 1-hr lesson after 7 weeks (9 hr in total) as a formal online session. Weekly formal online lessons were conducted every Thursday evening. If a participant was absent from the live online lesson, they took the on-demand video lesson before the next lesson. The contents of the sessions were developed in accordance with the standardized MBSR, MBCT, and Search Inside Yourself methods, which were adopted for corporate employee training at Google Inc. The instructor was trained in mindfulness and compassion and certified as an official Search Inside Yourself instructor in the United States.

The participants in the control group were instructed to maintain an ordinary lifestyle and were not provided specific information about mindfulness during the first session. After the first 8-week waiting session and three surveys (pre-, interim-, post-), the control group participated in the second 8-week MBI session with three surveys (pre-, interim-, post-), as in the first session.

The basic IMACOCO weekly program was as follows:

1. Check-in meditation (10 min with guidance)
2. Learning mindfulness evidence and skills (PowerPoint presentation)
3. Mindfulness practice (breathing, observing thoughts, and body scan meditation)
4. Journaling (provide weekly themes)
5. Review and discussion (lively remarks from participants)

Measures

Before starting the first 8-week MBI session, pre-surveys were performed for Groups A and B. The interim survey was performed 4 weeks after starting the first 8-week session, and a post-survey was performed immediately after the end of the first 8-week session. After the post-survey, the second 8-week MBI session commenced for Group B as an intervention. Interim (4 weeks after starting the second 8-week session) and post (after the second 8-week session) surveys were performed for Group B (Fig. 1).

Basic attribute information was collected using an online questionnaire before the program started, including questions about whether the COVID-19 pandemic had a psychological, social, or occupational impact on the respondent. The major outcomes of the evaluation consisted of four aspects measured by each questionnaire.

Five Facet Mindfulness Questionnaire

The Japanese version of the Five Facet Mindfulness Questionnaire (FFMQ) was used to assess the mindful state of the participants' daily lives (Cebolla et al., 2012). The FFMQ

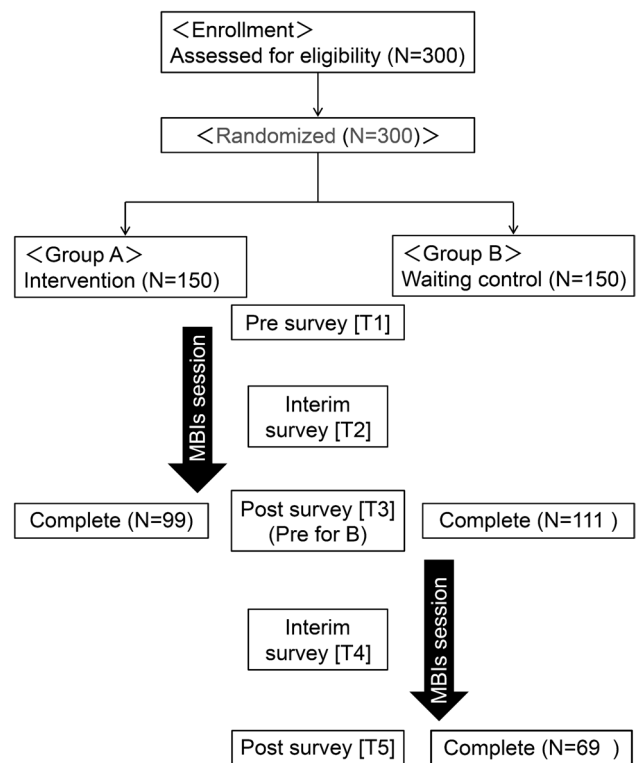


Fig. 1 Three hundred participants were randomly allocated to two groups: Group A ($n=150$) or B ($n=150$). In the first 8-week session, Group A received an MBI program while Group B served as the waiting control. Both groups were evaluated three times (pre-, interim, and post-survey) using the same questionnaires. Group B received the MBI intervention in the second 8-week session. In total, 99 participants in Group A and 111 participants in Group B completed all the evaluations in the first MBI session, while 69 participants in Group B completed all the evaluations in the second MBI session

measures five aspects of how respondents achieve a mindful state. It includes 39 items, divided into five categories (Observing, Describing, Acting With Awareness, Non-Judgment, and Non-Reactivity). Each item is evaluated using a 5-point evaluation range (1 = *never or very rarely*; 5 = *very frequently or always*). The total FFMQ scores range from 39 to 195. The Japanese version of the FFMQ showed sufficient reliability for the total scale (Cronbach's alpha = 0.80) and the 5 subscales (alpha-values = 0.67–0.85; Sugiura et al., 2012).

General Health Questionnaire-12

Psychological distress was measured using the General Health Questionnaire (GHQ-12). The GHQ-12 is the most frequently used screening tool for psychological distress (Goldberg et al., 1997). Each GHQ-12 item assesses an individual's experience of a particular symptom or behavior for a specified timeframe. Each item is rated on a 4-point scale (1 = *less than usual*; 2 = *no more than usual*; 3 = *rather more*

than usual; and 4 = *much more than usual*). It yields a total score of 12 based on the bimodal scoring method (0–0–1–1). A higher score indicates a greater degree of psychological distress. The Japanese version of the GHQ-12 showed excellent reliability (Cronbach's alpha = 0.83 for men and 0.85 for women; Doi & Minowa, 2003).

Satisfaction with Life Scale

The Satisfaction with Life Scale (SWLS) is a self-administered questionnaire that assesses life satisfaction using five short questions. Each item is scored on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The total scores range from 5 to 35, with higher scores indicating higher satisfaction (Diener et al., 1985). The SWLS also focuses on emotional well-being and individual euphoria. The SWLS has been reported to be reliable (Cronbach's alpha = 0.84; Yamanaka et al., 2021).

Presenteeism/Productivity

Presenteeism is a measure of productivity. Presenteeism was assessed using the single-item presenteeism question (SIPQ), which enquired about the average output capacity (0–100%). The SIPQ is a simple and valid assessment tool for presenteeism without being a burden on participants. The SIPQ was adapted from the standardized World Health Organization Health and Work Performance Questionnaire (WHO-HPQ) (Muramatsu et al., 2021).

Data Analyses

All data were analyzed based on the intention-to-treatment principle. Primary analysis was performed using the full analysis set. The balance of participants' characteristics by randomized assignment was evaluated by calculating the absolute standardized difference that was considered to be balanced if it was less than $1.96 \cdot \sqrt{(2/n)}$.

In the initial analysis, we compared Groups A (intervention) and B (waiting control) using data collected at three time points: T1, T2, and T3. Whereas, for the pre- and post-intervention comparison, we integrated and analyzed data from T1, T2, and T3 for Group A with T3, T4, and T5 for Group B. For comparisons between assigned groups of repeated-measures outcomes, linear mixed models that included intervention, dummy variables for time, intervention-by-time interactions as covariates, and the participants as a random effect were used. The covariance structure was a general (unstructured) covariance matrix. The results were reported as least square means with a 95% confidence interval at each time point. The repeated-measures outcomes were analyzed using linear mixed models that included dummy variables for time as a fixed effect and the

participants as a random effect. In addition, subgroup analysis based on "whether or not there was an impact of the novel coronavirus (COVID-19)" was conducted using the linear mixed model and interaction tests. The size of the intervention effects was reported as Cohen's *d* for between-group effects. Effect sizes were defined as small ($d=0.2$), medium ($d=0.5$), and large ($d=0.8$), consistent with Cohen's (1988) recommendations. The mixed-model analysis is used in longitudinal clinical trials for its inherent ability to handle missing values or dropouts (Chakraborty, 2009). In this study, we employed the characteristics of mixed-model analysis but did not conduct any data imputation (Solhaug et al., 2019).

Statistical significance was set at $p < 0.05$, and all *p*-values were two-tailed without multiplicity adjustment. All statistical analyses were performed using SPSS 24.0 for Windows (IBM Japan, Ltd., Tokyo, Japan).

Results

The full analysis set ultimately comprised 99 and 111 participants in the intervention and control groups, respectively. The dropout rate at T3 was 30% (i.e., 90 participants). Fisher's exact test revealed that baseline outcome measures focusing on gender and industry did not differ significantly between dropouts and completers at T3 (Supplementary Table S1).

The baseline characteristics of both groups were determined to be similar, as absolute standardized difference was found to be below the threshold, except for certain items (Table 1). The reliability of each questionnaire (Cronbach's alpha) in this study was as follows: FFMQ = 0.8580, GHQ-12 = 0.7930, and SWLS = 0.8985.

In both the control and intervention groups, participants primarily worked in general companies, followed by medical welfare and education-related industries. In addition, the number of participants who experienced the impact of COVID-19 was small.

Figure 2 shows the mean \pm standard error of mean (SEM) of the between-group comparison of the intervention effects on outcome measures. There was a significant increase in the total FFMQ score only in the intervention group after 8 weeks of the program (intervention group: 4.1 [2.4, 5.8], $p < 0.001$; control group: 1.1 [−0.5, 2.7], $p = 0.184$). There was also a significant between-group difference in the amount of change ($p = 0.012$, Cohen's $d = 0.35$). For the FFMQ subscales, only the intervention group showed a significant increase in Observing and Act With Awareness; however, a clear improvement was observed in the control group as well (Supplementary Table S2).

The GHQ-12 scores decreased significantly at 8 weeks in both the intervention and control groups (intervention group: −2.2 [−2.7, −1.6], $p < 0.001$; control group: −0.7

Table 1 Baseline characteristics of the intervention and control groups

Variables	Intervention Mean (\pm SD)	Control Mean (\pm SD)	ASD (%)
Age	42.28 (9.7) <i>n</i> (%)	42.26 (8.5) <i>n</i> (%)	0.2
Gender			
Male	42 (42.4%)	54 (48.6%)	12.5
Female	56 (56.6%)	57 (51.4%)	10.5
Other	1 (1.0%)	0	14.3
Industry			
General companies	48 (48.5%)	68 (61.3%)	25.9
Medical and welfare	30 (30.3%)	32 (28.8%)	3.7
Education	21 (21.2%)	11 (9.9%)	31.6
Marital status			
Cohabitant/married	63 (63.6%)	76 (68.5%)	10.2
Unmarried/single	36 (36.4%)	35 (31.5%)	10.2
Impact of the COVID-19 pandemic			
Affected	13 (13.1%)	29 (26.1%)	33.2
Unaffected	86 (86.9%)	82 (73.9%)	33.2

[-1.2, -0.2], $p=0.008$), but were higher in the intervention group than in the control group (4 weeks: $p=0.02$, Cohen's $d=0.32$; 8 weeks: $p<0.001$, Cohen's $d=0.52$). The total SWLS scores significantly increased in the intervention group after 4 and 8 weeks of intervention (changes after 4 weeks: 0.8 [0.1, 1.5], $p=0.032$ in the intervention group and 0.1 [-0.6, 0.8], $p=0.703$ in the control group; changes after 8 weeks: 1.7 [1.0, 2.4], $p<0.001$ in the intervention group and -0.1 [-0.8, 0.6], $p=0.879$ in the control group). There was also a significant between-group difference in the amount of change ($p=0.001$, Cohen's $d=0.47$; Supplementary Table S2).

There were significant improvements in the SIPQ after 8 weeks only in the intervention group (intervention group: 3.8 [0.5, 7.1], $p=0.026$; control group: -0.3 [-3.4, 2.9], $p=0.861$). However, the difference between the changes in both groups was not statistically significant, and only a trend was observed ($p=0.082$, Cohen's $d=0.24$).

Figure 3 shows the results of the pre- and post-intervention comparison of the intervention effect on outcome measures in the integrated data of the intervention period for both groups. There was a significant increase in the total FFMQ scores after 4 and 8 weeks of intervention (after 4 weeks: 2.2 [0.7, 3.7], $p=0.003$, Cohen's $d=0.23$; after 8 weeks: 5.3 [3.8, 6.7], $p<0.001$, Cohen's $d=0.54$). Regarding the FFMQ, the scores of only the Observing (after 4 weeks: $p=0.001$, Cohen's $d=0.25$; after 8 weeks: $p=0.000$, Cohen's $d=0.62$), Non-Reactivity (after 4 weeks: $p=0.016$, Cohen's $d=0.19$; after 8 weeks: $p=0.000$,

Cohen's $d=0.42$), and Describing (after 8 weeks: $p=0.001$, Cohen's $d=0.25$) subscales showed a significant increase. The GHQ-12 scores showed a significant decrease at 4 and 8 weeks (at 4 weeks: -1.2 [-1.7, -0.8], $p<0.001$, Cohen's $d=-0.47$; at 8 weeks: -1.8 [-2.2, -1.4], $p<0.001$, Cohen's $d=-0.66$). There was a significant increase in the total SWLS scores after 4 and 8 weeks (after 4 weeks: 0.6 [0.1, 1.1], $p=0.031$, Cohen's $d=0.17$; after 8 weeks: 1.3 [0.8, 1.9], $p<0.001$, Cohen's $d=0.37$). The productivity index also showed a significant improvement after 8 weeks (4.8 [2.1, 7.5], $p=0.001$, Cohen's $d=0.26$; Supplementary Table S3).

The results of the stratified analysis based on the presence or absence of being "affected by the COVID-19 pandemic" as a factor are shown in Supplementary Table S4.

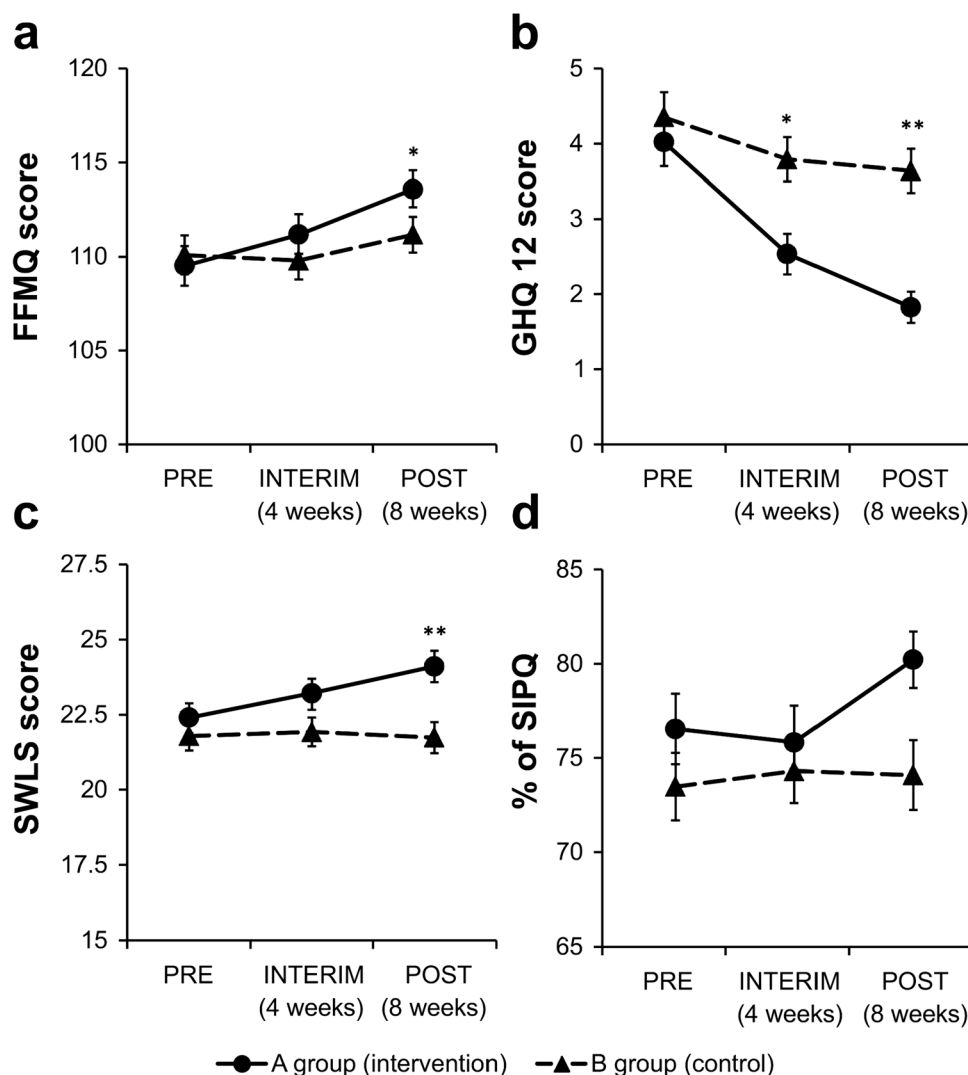
There was a significant improvement in the GHQ-12 scores in both the affected and unaffected groups compared to the control group. In contrast, significant improvements in the FFMQ and SWLS scores were detected only in the affected group (FFMQ: changes after 8 weeks in the affected vs. control group: $p=0.010$; SWLS: changes after 8 weeks in the affected vs. control group: $p=0.001$; FFMQ: changes after 8 weeks in the affected vs. control group: $p=0.010$; SWLS: changes after 8 weeks in the affected vs. control group: $p=0.001$).

Discussion

The present study revealed that the online MBI program IMACOCO promoted mindfulness state, reduced psychological distress, and improved well-being in the intervention group compared with the waiting control group. In addition, the pre- and post-intervention assessments showed that, although the effect sizes were small, this MBI program also led to improvement in productivity. Similar results have been reported in previous studies (Bajaj & Pande, 2016; Kong et al., 2014; Solhaug et al., 2019). However, our study demonstrated and confirmed these findings through a randomized controlled trial to be effective even for online programs during the COVID-19 pandemic.

Significant improvement was observed in the GHQ-12 scores, which measure mental health, at 4 and 8 weeks after the beginning of the intervention. A distinctive feature of this study is that evaluations were performed not only at the end of the program but also at the midpoint, 4 weeks after the intervention. The MBI program yielded relatively short-term effects on mental health, while it was less likely to show short-term effects on other measures, such as productivity evaluations owing to presenteeism. The effects on stress reduction and well-being enhancement were more significant after 8 weeks than after 4 weeks, indicating a time-response relationship. This suggests that conducting the

Fig. 2 Differences between the mean scores (\pm SEM) on the FFMQ (a), GHQ-12 (b), SWLS (c), and SIPQ (d) for the intervention and control groups. The data are presented as the mean \pm SEM. * $p < 0.05$ and ** $p < 0.01$ compared with the control group



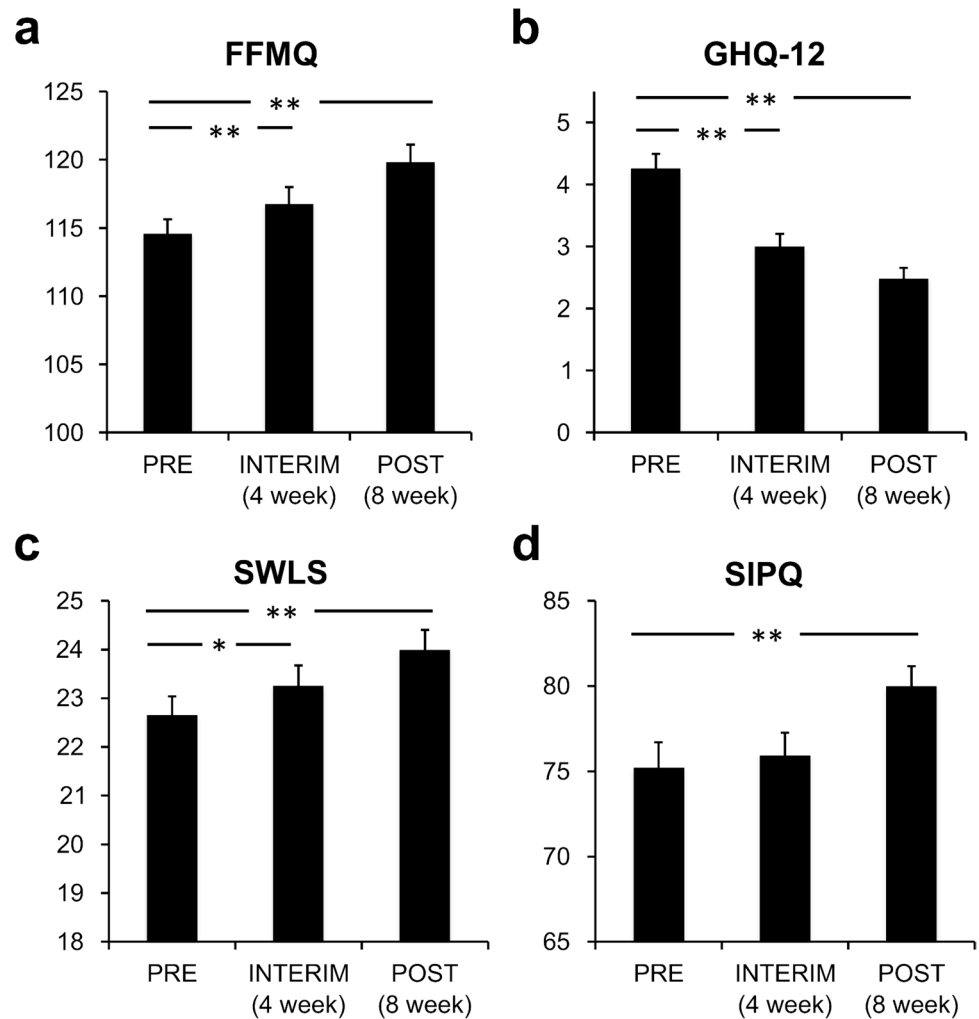
program for 8 weeks will likely solidify these benefits. The MBI program may have some effects even in the short term but is expected to have a definite effect if an 8-week-long program is implemented. Solhaug et al. (2019) reported that a MBSR program resulted in significantly improved mental distress scores, measured by the General Health Questionnaire (GHQ), compared to the control group. Notably, MBSR resulted in lasting effects on mental distress and coping mechanisms in medical and psychology students even 4 years after the intervention (Solhaug et al., 2019). It is believed that mindfulness can have an impact on reducing psychological stress relatively early and this effect may persist long-term.

In the mindfulness state evaluation using the FFMQ, the Observing and Acting With Awareness subcategories showed significant improvements in the intervention group. A previous study reported that scores on “observing” and “non-reactivity” improved after an 8-week mindfulness training program (Gracia Gozalo et al., 2019). Observing

tends to have a relatively early improvement effect. In this program, Acting With Awareness scores also showed improvement, and can therefore be expected to effectively relieve stress symptoms. According to the results of a meta-analysis, non-judgment and acting with awareness of the present moment are strongly correlated with symptoms of psychological distress (Carpenter et al., 2019). Thus, awareness is also believed to be related to reducing mental stress.

The present study was conducted during the COVID-19 pandemic that had a major impact on the health and social lives of citizens. Rossi et al. (2020) reported that 47% of Italian respondents showed moderate distress and 14% had severe symptoms owing to COVID-19-related effects. Mehrsavar et al. (2021) reported that the COVID-19 pandemic negatively influenced mental health and life satisfaction, as measured by the SWLS (Mehrsavar et al., 2021). Regarding well-being, life satisfaction was assessed using the SWLS in this study; a significant improvement in life satisfaction was found at 8 weeks after intervention (Kong et al., 2014).

Fig. 3 Changes in the mean scores on the FFMQ (a), GHQ-12 (b), SWLS (c), and SIPQ (d) for the integrated data of all participants ($n = 168$) during the intervention period. The data are presented as the mean \pm SEM. * $p < 0.05$ and ** $p < 0.01$ compared with pre-intervention (baseline)



Well-being, a primary component of life satisfaction, is related to psychological factors, particularly when adapting to unpredictable and difficult circumstances. Bajaj and Pande (2016) investigated the mediating role of resilience in the relationship between mindfulness and life satisfaction among undergraduate students in India. Resilience partially mediated the link between mindfulness and life satisfaction, highlighting the significance of resilience in the positive effects of mindfulness on well-being.

We also investigated the impact of the COVID-19 pandemic and analyzed the effects of mindfulness intervention. The GHQ-12 scores in both the affected and unaffected groups improved significantly compared to the control group. However, significant improvements in the FFMQ and SWLS scores were only observed in the affected group. These results indicate that the MBI program was effective in improving mental health, mindfulness, and well-being, particularly in participants affected by COVID-19.

Numerous mental health care measures and lifestyle modifications have been proposed to deal with mental and physical distress caused by COVID-19-related effects

(Walton et al., 2020), including MBI, which can be used online and be adapted to any industry and age group (El Morr et al., 2020), without the use of special techniques. As this program is delivered online, it can be easily implemented and offered to many people even during infectious disease pandemics when face-to-face implementation is difficult. The World Health Organization guidelines on mental health at work that aim to promote the implementation of evidence-based interventions for mental health were published in 2022, and mindfulness and cognitive-behavioral approaches were recommended as specific measures for individual interventions, even for health, humanitarian, and emergency workers, in addition to workers with emotional distress.

Presenteeism is the act of attending work when suffering from an illness, a topic that has garnered much attention in occupational medicine. Johns (2010) showed that presenteeism is correlated to the productivity of individual workers and the organization (Johns, 2010).

Workers' productivity, measured by the SIPQ, did not improve significantly in the waiting control group. In

contrast, significant improvement was observed in the pre- and post-intervention comparison. Previous studies reported an effect of mindfulness on presenteeism. Tang et al. (2019) explored the relationship between presenteeism and mindfulness among primary medical staff. The effect of mindfulness on presenteeism was mediated by self-efficacy, highlighting the importance of self-efficacy in mental health management strategies.

In the present study, the SIPQ was used to measure productivity at work. Our decision to use this measure was influenced by its simplicity, ease of administration, and prevalent use in preliminary studies. We acknowledge that the use of a single self-reported item may not fully encapsulate the multifaceted nature of presenteeism and the data may have varied widely; therefore, it may not show a statistically significant difference in the control group.

However, although the effect size is small and there are limitations to the research outcomes, this study indicates that engaging in mindfulness over the long term can improve presenteeism and contribute to increased productivity. The present findings indicate that an online MBI program is an effective method for decreasing mental stress and improving well-being and life satisfaction, even in a volatile and uncertain world where natural disasters and pandemics may occur.

Limitations and Future Directions

This study had certain limitations. As only the participants who submitted all the survey responses were included in the analysis, the number of valid samples was reduced. Detailed information on dropout, such as when and why each participant dropped out, was not collected, and therefore, it was not possible to analyze the factors influencing dropout.

We obtained valid answers by eliminating missing values through online surveys, and we repeatedly prompted participants to participate in the survey. However, participation was entirely voluntary, which could be the reason underlying the reduction in the effective sample rate.

Mindfulness training cultivates compassion, and the IMACOCO program constituted compassion content in the work session. Nevertheless, because the survey did not include an index for measuring compassion, changes in compassion could not be observed in this study. Future studies will evaluate IMACOCO to determine its effectiveness in cultivating compassion.

To assess the impact of COVID-19, respondents were only asked whether they experienced any psychological, social, or occupational impacts due to the pandemic. The survey did not include detailed questions regarding the level of isolation, lockdown status, anxiety, loneliness, depression, infection status, or financial concerns/instability resulting from the COVID-19 pandemic. Therefore, a detailed analysis of the correlations between the impact of the COVID-19

pandemic, the state of mindfulness, and mental health could not be performed.

Despite these limitations and future study challenges, this study demonstrated an online MBI program (IMACOCO) that effectively enhanced mindfulness, reduced psychological distress, and improved well-being and life satisfaction, particularly among those affected by the COVID-19 pandemic. Additionally, the results suggested an improvement in productivity over the long term. Implementing an online MBI program can be a potent strategy for reducing mental stress and enhancing overall well-being and resilience in a disaster-prone world.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s12671-024-02344-3>.

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Author Contribution Junya Ogino, Takashi Maruyama, Wakako Umene-Nakano, and Takashi Maeno: study design, conceptualization, and methodology. Takashi Maruyama and Wakako Umene-Nakano: data analysis; writing—original draft preparation. Takashi Maeno: supervision. Junya Ogino, Takashi Maruyama, Wakako Umene-Nakano, and Takashi Maeno: writing—reviewing and editing. All authors read and approved the final manuscript.

Data Availability The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics Approval This study was approved by the Ethics Committee for Medical Care and Research of KEIO University, Japan (Application No. SDM-2020-E021). The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed Consent All participants provided written informed consent.

Conflict of Interest The authors declare no competing interests.

Use of Artificial Intelligence The authors did not use any artificial intelligence tool to write the manuscript.

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References

- Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., Walsh, E., Duggan, D., & Williams, J. M. G. (2008). Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment, 15*(3), 329–342. <https://doi.org/10.1177/1073191107313003>
- Bajaj, B., & Pande, N. (2016). Mediating role of resilience in the impact of mindfulness on life satisfaction and affect as indices of subjective well-being. *Personality and Individual Differences, 93*, 63–67. <https://doi.org/10.1016/j.paid.2015.09.005>
- Carpenter, J. K., Conroy, K., Gomez, A. F., Curren, L. C., & Hofmann, S. G. (2019). The relationship between trait mindfulness and affective symptoms: A meta-analysis of the Five Facet Mindfulness Questionnaire (FFMQ). *Clinical Psychology Review, 74*, 101785. <https://doi.org/10.1016/j.cpr.2019.101785>
- Cebolla, A., García-Palacios, A., Soler, J., Guillen, V., Baños, R., & Botella, C. (2012). Psychometric properties of the Spanish validation of the Five Facets of Mindfulness Questionnaire (FFMQ). *The European Journal of Psychiatry, 26*(2). <https://doi.org/10.4321/S0213-61632012000200005>
- Chakraborty, H. (2009). *A mixed model approach for intent-to-treat analysis in longitudinal clinical trials with missing values*. RTI Press.
- Creswell, J. D. (2017). Mindfulness interventions. *Annual Review of Psychology, 68*(1), 491–516. <https://doi.org/10.1146/annurev-psych-042716-051139>
- Crocker, K. M., Gnat, I., Haywood, D., Butterfield, I., Bhat, R., Lalitha, A. R. N., Jenkins, Z. M., & Castle, D. J. (2022). The impact of COVID-19 on the mental health workforce: A rapid review. *International Journal of Mental Health Nursing, 32*(2), 420–445. <https://doi.org/10.1111/inm.13097>
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13
- Doi, Y., & Minowa, M. (2003). Factor structure of the 12-item General Health Questionnaire in the Japanese general adult population. *Psychiatry and Clinical Neurosciences, 57*(4), 379–383. <https://doi.org/10.1046/j.1440-1819.2003.01135.x>
- Fulambarkar, N., Seo, B., Testerman, A., Rees, M., Bausback, K., & Bunge, E. (2022). Review: Meta-analysis on mindfulness-based interventions for adolescents' stress, depression, and anxiety in school settings: A cautionary tale. *Child and Adolescent Mental Health, 28*(2), 307–317. <https://doi.org/10.1111/camh.12572>
- Furuya, Y., Nakazawa, S., Fukai, K., & Tatemichi, M. (2022). Health impacts with telework on workers: A scoping review before the COVID-19 pandemic. *Frontiers in Public Health, 10*, 981270. <https://doi.org/10.3389/fpubh.2022.981270>
- Goldberg, D. P., Gater, R., Sartorius, N., Ustun, T. B., Piccinelli, M., Gureje, O., & Rutter, C. (1997). The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychological Medicine, 27*(1), 191–197. <https://doi.org/10.1017/S0033291796004242>
- Gracia Gozalo, R. M., Ferrer Tarrés, J. M., Ayora Ayora, A., Alonso Herrero, M., Amutio Kareaga, A., & Ferrer Roca, R. (2019). Aplicación de un programa de mindfulness en profesionales de un servicio de medicina intensiva. Efecto sobre el burnout, la empatía y la autocompasión. *Medicina Intensiva, 43*(4), 207–216. <https://doi.org/10.1016/j.medin.2018.02.005>
- Hofmann, S. G., & Gómez, A. F. (2017). Mindfulness-based interventions for anxiety and depression. *Psychiatric Clinics of North America, 40*(4), 739–749. <https://doi.org/10.1016/j.psc.2017.08.008>
- Jazaieri, H., Jinpa, G. T., McGonigal, K., Rosenberg, E. L., Finkelstein, J., Simon-Thomas, E., Cullen, M., Doty, J. R., Gross, J. J., & Goldin, P. R. (2013). Enhancing compassion: A randomized controlled trial of a compassion cultivation training program. *Journal of Happiness Studies, 14*(4), 1113–1126. <https://doi.org/10.1007/s10902-012-9373-z>
- Johns, G. (2010). Presenteeism in the workplace: A review and research agenda. *Journal of Organizational Behavior, 31*(4), 519–542. <https://doi.org/10.1002/job.630>
- Kong, F., Wang, X., & Zhao, J. (2014). Dispositional mindfulness and life satisfaction: The role of core self-evaluations. *Personality and Individual Differences, 56*, 165–169. <https://doi.org/10.1016/j.paid.2013.09.002>
- Lilius, J. M., Worline, M. C., Maitlis, S., Kanov, J., Dutton, J. E., & Frost, P. (2008). The contours and consequences of compassion at work. *Journal of Organizational Behavior, 29*(2), 193–218. <https://doi.org/10.1002/job.508>
- Liu, X., Xu, Y., Xu, H., Jiang, L., Wang, T., Chen, C., Lee, A., & Zhu, P. (2022). Anxiety and sleep quality among front-line nurses treating first wave COVID-19 in China: The mediating role of mindfulness. *Archives of Psychiatric Nursing, 41*, 341–347. <https://doi.org/10.1016/j.apnu.2022.09.007>
- Lomas, T., Medina, J. C., Ivztan, I., Rupperecht, S., Hart, R., & Eiroa-Orosa, F. J. (2017). The impact of mindfulness on well-being and performance in the workplace: An inclusive systematic review of the empirical literature. *European Journal of Work and Organizational Psychology, 26*(4), 492–513. <https://doi.org/10.1080/1359432X.2017.1308924>
- Malik, H., & Annabi, C. A. (2022). The impact of mindfulness practice on physician burnout: A scoping review. *Frontiers in Psychology, 13*, 956651. <https://doi.org/10.3389/fpsyg.2022.956651>
- Mehrsafar, A. H., Moghadam Zadeh, A., Gazerani, P., Jaenes Sanchez, J. C., Nejat, M., Rajabian Tabesh, M., & Abolhasani, M. (2021). Mental health status, life satisfaction, and mood state of elite athletes during the COVID-19 pandemic: A follow-up study in the phases of home confinement, reopening, and semi-lockdown condition. *Frontiers in Psychology, 12*, 630414. <https://doi.org/10.3389/fpsyg.2021.630414>
- Meira-Silva, V. S. T., Freire, A. C. T. N., Zinezzi, D. P., Ribeiro, F. C. R., Coutinho, G. D., Lima, I. M. B., Crispi, I. C., Porto, J. D., Silva, L. G. P., Miranda, L. H. A., Zurita, M. G., Belerique, V. H. R., & Bandoli, Y. T. (2022). Burnout syndrome in healthcare workers during the COVID-19 pandemic: A systematic review. *Revista Brasileira de Medicina do Trabalho, 20*(1), 122–131. <https://doi.org/10.47626/1679-4435-2022-849>
- El Morr, C., Ritvo, P., Ahmad, F., & Moineddin, R. (2020). Effectiveness of an 8-week web-based mindfulness virtual community intervention for university students on symptoms of stress, anxiety, and depression: Randomized controlled trial. *JMIR Mental Health, 7*(7), e18595. <https://doi.org/10.2196/18595>
- Muramatsu, K., Nakao, K., Ide, H., & Furui, Y. (2021). Testing the construct validity and responsiveness of the single-item presenteeism question. *Journal of Occupational & Environmental Medicine, 63*(4), e187–e196. <https://doi.org/10.1097/JOM.0000000000002158>
- Parsons, D., Gardner, P., Parry, S., & Smart, S. (2022). Mindfulness-based approaches for managing stress, anxiety and depression for health students in tertiary education: A scoping review. *Mindfulness, 13*(1), 1–16. <https://doi.org/10.1007/s12671-021-01740-3>
- Rossi, R., Soggi, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., Di Marco, A., Rossi, A., Siracusano, A., & Di Lorezno, G. (2020). COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Frontiers in Psychiatry, 11*, 790. <https://doi.org/10.3389/fpsyg.2020.00790>
- Shapiro, S. L., Astin, J. A., Bishop, S. R., & Cordova, M. (2005). Mindfulness-based stress reduction for health care professionals: Results from a randomized trial. *International Journal of Stress*

- Management*, 12(2), 164–176. <https://doi.org/10.1037/1072-5245.12.2.164>
- Sist, L., Savadori, S., Grandi, A., Martoni, M., Baiocchi, E., Lombardo, C., & Colombo, L. (2022). Self-care for nurses and midwives: Findings from a scoping review. *Healthcare*, 10(12), 2473. <https://doi.org/10.3390/healthcare10122473>
- Solhaug, I., de Vibe, M., Friborg, O., Sørli, T., Tyssen, R., Bjørndal, A., & Rosenvinge, J. H. (2019). Long-term mental health effects of mindfulness training: A 4-year follow-up study. *Mindfulness*, 10(8), 1661–1672. <https://doi.org/10.1007/s12671-019-01100-2>
- Spijkerman, M. P. J., Pots, W. T. M., & Bohlmeijer, E. T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: A review and meta-analysis of randomised controlled trials. *Clinical Psychology Review*, 45, 102–114. <https://doi.org/10.1016/j.cpr.2016.03.009>
- Strauss, C., Cavanagh, K., Oliver, A., & Pettman, D. (2014). Mindfulness-based interventions for people diagnosed with a current episode of an anxiety or depressive disorder: A meta-analysis of randomised controlled trials. *PLoS ONE*, 9(4), e96110. <https://doi.org/10.1371/journal.pone.0096110>
- Sugiura, Y., Sato, A., Ito, Y., & Murakami, H. (2012). Development and validation of the Japanese version of the Five Facet Mindfulness Questionnaire. *Mindfulness*, 3(2), 85–94. <https://doi.org/10.1007/s12671-011-0082-1>
- Tang, N., Han, L., Yang, P., Zhao, Y., & Zhang, H. (2019). Are mindfulness and self-efficacy related to presenteeism among primary medical staff: A cross-sectional study. *International Journal of Nursing Sciences*, 6(2), 182–186. <https://doi.org/10.1016/j.ijnss.2019.03.004>
- Tao, S., Geng, Y., Li, M., Ye, J., & Liu, Z. (2022). Effectiveness of mindfulness-based stress reduction and mindfulness-based cognitive therapy on depression in poststroke patients-A systematic review and meta-analysis of randomized controlled trials. *Journal of Psychosomatic Research*, 163, 111071. <https://doi.org/10.1016/j.jpsychores.2022.111071>
- Vonderlin, R., Biermann, M., Bohus, M., & Lyssenko, L. (2020). Mindfulness-based programs in the workplace: A meta-analysis of randomized controlled trials. *Mindfulness*, 11(7), 1579–1598. <https://doi.org/10.1007/s12671-020-01328-3>
- Walton, M., Murray, E., & Christian, M. D. (2020). Mental health care for medical staff and affiliated healthcare workers during the COVID-19 pandemic. *European Heart Journal: Acute Cardiovascular Care*, 9(3), 241–247. <https://doi.org/10.1177/2048872620922795>
- Wang, H., Farokhnia, F., & Sanchuli, N. (2023). The effects of the COVID-19 pandemic on the mental health of workers and the associated social-economic aspects: A narrative review. *Work*, 74(1), 31–45. <https://doi.org/10.3233/WOR-220136>
- Williams, H., Simmons, L. A., & Tanabe, P. (2015). Mindfulness-based stress reduction in advanced nursing practice. *Journal of Holistic Nursing*, 33(3), 247–259. <https://doi.org/10.1177/0898010115569349>
- Yamanaka, T., Yamagishi, N., Nawa, N. E., & Anderson, S. J. (2021). Assessing changes in mood state in university students following short-term study abroad. *PLoS ONE*, 16(12), e0261762. <https://doi.org/10.1371/journal.pone.0261762>
- Zhang, Y., Xue, J., & Huang, Y. (2020). A meta-analysis: Internet mindfulness-based interventions for stress management in the general population. *Medicine*, 99(28), e20493. <https://doi.org/10.1097/MD.00000000000020493>

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