Effectiveness of Meditation-based Interventions on Health Problems Caused by COVID-19 Pandemic: Narrative Review

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Abstract

This article provides a quantitative review of the potential applications of meditation-based interventions (MBIs) in addressing the major health issues arising from the COVID-19 pandemic. The review assesses the effectiveness of MBIs on five prevalent disorders during the pandemic, namely depression, anxiety, stress, insomnia, and long COVID. This is achieved by selecting and scrutinizing seven studies that involve various types of online randomized controlled trials and utilize control group outcomes for effectiveness evaluation. The findings reveal a significant impact of MBIs on overall distress disorder, encompassing symptoms of depression, anxiety, and stress, with effectiveness ranging from 20.5% to 68.8%. The interventions also show moderate effectiveness on insomnia disorder with improvements between 5.2% and 38.5%. However, the effectiveness on long COVID disorder presents a mixed picture, with improvements varying from 0.0% to 71.2% across 13 related symptoms or qualities examined. This review offers compelling evidence supporting the effectiveness of MBIs in alleviating these five prevalent disorders resulting from the COVID-19 pandemic.

Keywords: *COVID-19 pandemic, disorders, intervention effectiveness, meditation-based interventions, mental and physical symptoms*

Introduction

Meditation is a profound mental training practice that employs diverse techniques to enhance concentration and awareness, ultimately leading to mental clarity, emotional serenity, and stability.[1,2] These techniques encompass focusing on various sensations, such as breath, thoughts, sounds, or visual imagery.[3,4] The realm of meditation encompasses a rich tapestry of concentration and awareness methods, including mindfulness, spiritual and mantra meditation, as well as practices such as śamatha, vipaśyanā, yoga, tai chi, and chi gong.[5]

Among these practices, mindfulness meditation has garnered substantial attention in clinical trials during the past two decades.[6,7] These clinical trials have consistently showcased the effectiveness of various meditation techniques in mitigating, preventing, or addressing a wide spectrum of mental and physical ailments, including stress, anxiety, insomnia, pain, and fatigue.[8,9]

In response to the formidable public health crisis posed by the COVID-19 pandemic, numerous clinical trials and interventions have been executed to develop new treatments or reaffirm the effectiveness of existing ones. Consequently, this article aims to assess the effectiveness of meditation-based interventions (MBIs) in alleviating health disorders or symptoms arising from COVID-19, with a primary focus on depression, anxiety, stress, insomnia, and long COVID.

This review exclusively examines studies related to symptoms or disorders stemming from or exacerbated by the pandemic, spanning from the beginning of 2020 to May 5, 2023 – the endpoint stipulated by the World Health Organization (WHO).[10] Consequently, this review holds considerable relevance and timeliness, offering an early evaluation of the scientific evidence pertaining to the effectiveness of MBIs in ameliorating the aforementioned disorders resulting from the pandemic.

A key focus of this review is to quantitatively assess the effectiveness of

How to cite this article: Tseng AA. Effectiveness of meditation-based interventions on health problems caused by COVID-19 pandemic: Narrative review. Int J Yoga 2023;16:72-8.

Submitted: 27-Jun-2023 **Revised:** 04-Sep-2023
Accepted: 17-Sep-2023 **Published:** 21-Nov-2023

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Access this article online

Website: https://journals.lww.com/IJOY

DOI: 10.4103/ijoy.ijoy_112_23

Quick Response Code:

interventions, with an emphasis on scrutinizing studies that consider randomized controlled trials and the outcomes from control groups for numerical evaluations of effectiveness. By adopting this approach, the assessment of intervention effectiveness isolates the specific impact of the implemented MBI, excluding the influences of extraneous variables.

Finally, a concluding remark is given to compare the important findings obtained and to discuss the future trends in MBI research, along with specific recommendations to enhance the repeatability and consistency of current approaches.

Backgrounds and Effectiveness Evaluation

This section addresses several key concepts essential for comprehending the assessment of intervention effectiveness, aiming to clarify potential confusion and ensure accurate interpretation of the reviewed results.

Control group

In numerous randomized controlled trials featured in this article, alongside the intervention or treatment group, researchers incorporate a control group consisting of participants who do not receive the experimental intervention. Instead, they undergo routine treatment or receive no treatment at all.[11] The purpose of the control group is to establish a baseline for comparison with the intervention group that receives the target intervention or treatment. This allows investigators to isolate the genuine effects of the intervention by minimizing the influence of factors other than the target intervention, such as the MBI.

Effectiveness of interventions

The effectiveness of many interventions explored in this review is assessed based on the extent of their beneficial effects in "real-world" or online settings, as opposed to ideal or clinical conditions.[12]

Since most reviewed interventions employ self-reported questionnaires or scales to quantify their impact on various health symptoms, the score ranges associated with each questionnaire may differ. To facilitate comparisons among the effects or scores obtained, intervention effectiveness is evaluated as a percentage relative to the baseline (preintervention) score of the intervention or experimental group.

To calculate the effectiveness in the present review, the score of the control group is considered. The effectiveness of the MBI on the target symptom is then defined as the mean score change (whether increasing or decreasing) from preintervention to postintervention in the intervention group minus the mean score change in the control group during the same period. Subsequently, the effectiveness is normalized as a percentage based on the preintervention score of the intervention group.

Statistical significance and *P* value

For a robust statistical analysis, certain conditions, including statistical significance, must be met. Statistical significance is a vital metric used to determine whether observed differences or patterns in data are likely to represent a genuine relationship or if they could have arisen by chance. It aids researchers in evaluating the reliability of their findings, ensuring they are not merely a result of random variability. Thus, statistical significance assesses the likelihood that a result derived from data obtained through testing or intervention is not due to chance but can be attributed to a specific cause.[13] The associated P value serves as a measure of the significance level, where $P \leq 0.05$ is conventionally considered statistically significant, making the analysis credible and acceptable.

Improvements on Distress Including Symptoms of Depression, Anxiety, and Stress

Distress is an encompassing term that encapsulates the amalgamated symptoms of depression, anxiety, and stress. As outlined by the American Psychological Association (APA), psychological distress is typically assessed through self-reported evaluations of depression and anxiety, with stress regarded as an associated symptom.[14] Numerous scholars define psychological distress as the presence of nonspecific symptoms associated with stress, anxiety, and depression, signaling the potential presence of significant disorders within these symptom categories.[15]

Questionnaires developed for the measurement of distress typically incorporate three distinct subscales: depression, anxiety, and stress. A prominent example is the 42-item Depression Anxiety Stress Scale (DASS-42), which comprehensively evaluates distress via three 14-item subscales dedicated to respectively gauging symptoms of depression, anxiety, and stress.[16]

According to the WHO, in the first year of the COVID-19 pandemic, the global prevalence of anxiety and depression surged by a staggering 25%.[17] Concurrently, the APA reported that the stress levels among U.S. adults reached their peak since the early days of the COVID-19 pandemic, with more than 80% of adults acknowledging emotions linked to prolonged stress and 47% to anxiety.[18] Consequently, the effectiveness of MBIs in addressing symptoms of depression, anxiety, and stress, as explored in this section, holds immense significance for a substantial portion of the population grappling with these distressing symptoms.

Improvements on depression, anxiety, and stress based on 42-item Depression Anxiety Stress Scale scores

In the span from January to March 2022, Komariah *et al.* conducted a randomized controlled trial to investigate the impact of an online MBI on reducing distress by employing the DASS-42 to evaluate depression, anxiety, and stress levels among 122 college students in Indonesia.[19] The participants were randomly divided into either an intervention group or a control group. The intervention group (n = 61) underwent a 4-week MBI regimen, involving 15 min of daily meditation practice. The initial 2 weeks included guided sessions conducted via Zoom, followed by 2 weeks of unguided practice. Prior to and following the intervention, all participants completed a web-based survey employing the DASS-42.

As previously mentioned, each of the DASS-42's three subscales measures one of the symptoms: depression, anxiety, and stress.[16] Each subscale features a score range of 0–56, with higher scores indicating a higher perception of psychological distress. After 4 weeks of intervention, the depression subscale scores decreased from 13.93 ± 9.631 to 7.54 ± 7.309 in the intervention group and from 12.36 ± 9.42 to 9.46 ± 7.70 in the control group. Likewise, anxiety scores decreased from 14.08 ± 8.74 to 8.46 ± 5.45 in the intervention group and from 13.39 ± 8.74 to 10.66 ± 6.32 in the control group. Additionally, stress subscale scores decreased from 16.31 ± 9.81 to 10.07 ± 6.96 in the intervention group and from 16.00 ± 10.00 to 14.03 ± 8.77 in the control group.

Applying the methodology described in the "Effectiveness of Interventions" subsection, the effectiveness of the MBI can be computed as follows: −3.49 (= [7.54–13.93]–[9.46–12.36]) for depression, −2.89 (= [8.46–14.08]–[10.66–13.39]) for anxiety, and − 4.27 (= [10.07–16.31]–[14.03–16.00]) for stress. When expressed as percentages, these effectiveness scores translate to substantial improvements in the three symptoms: 25.1% (=100% × 3.49/13.93) for depression, 20.5% (=100% × 2.89/14.08) for anxiety, and 26.2% (=100% × 4.27/16.31) for stress. Collectively, these improvements culminate in an overall distress reduction of 23.9% (= [25.1% +20.5% +26.2]/3), which is a sizable improvement.

Improvements of distress among 51 Chinese adults by two alternating interventions

In 2020, Zhang *et al*. conducted a study to investigate the impact of an online mindfulness-based stress reduction (MBSR) intervention on psychological distress symptoms in a cohort of 51 Chinese adults recruited from Hubei.[20] The MBSR-based intervention involved a 2-h training and psychoeducation session on mindfulness, followed by a 13-day mindfulness practice conducted via the social media platform WeChat.[21] This practice encompassed three 30-min mindfulness sessions per day. The 51 participants, with an average age of 50.12 ± 6.79, were randomly divided into two groups: Group 1 (n = 25) and Group 2 (n = 26).

To assess psychological distress, the researchers employed the 18-item Brief Symptom Inventory (BSI), which provides a score range of 0–72, with higher scores indicating greater severity of distress.[22] Three measurements were conducted at time T1, T2, and T3. During the time period between T1 and T2, Group 1 performed the MBSR intervention, while during the time period from T2 to T3, Group 2 underwent the intervention.[20] This approach facilitated the acquisition of two alternating datasets for the assessment of intervention effectiveness and comparative analysis.

When comparing BSI scores at T2 with those at T1, Group 1 served as the intervention group. Its scores decreased significantly from 31.28 ± 4.01 to 10.48 ± 3.25 (P < 0.001), while Group 2 functioned as the control group, and its scores changed insignificantly from 31.82 ± 3.27 to 32.12 ± 3.20 (P < 0.001).[20] Following the previously outlined procedure, the effectiveness of the initial MBSR intervention was calculated as −21.1 (= [10.48–31.28]–[32.12–31.82]), representing a substantial 67.5% improvement in distress (=100% ×21.1/31.28).

When comparing BSI scores at T3 with those at T2, Group 1 assumed the role of the control group and its scores changed from 10.48 ± 3.25 to 9.60 ± 2.56 (P < 0.001), while Group 2 became the intervention group, and its scores changed from 32.12 ± 3.20 to 9.15 ± 1.99 (P < 0.001). Consequently, the effectiveness of the second MBSR intervention on distress was calculated as −22.09 (= [9.15–32.12]–[9.60–10.48]), signifying a significant 68.8% (=100% × 22.09/32.12) improvement in distress. Notably, all associated P values in these data were less than 0.05, underscoring the statistical significance of the data studied.

It is noteworthy that, because of similarity between the above two effectiveness results, the 14-day time lapse between the first and the second interventions, known as the duration effect of meditation, seems having no noticeable effects or changes on the impact of the intervention on the symptoms studied.[23] Consequently, it is appropriate to use Group 1 as the control group and Group 2 as the intervention group during the period between T2 and T3.

Effectiveness of mindfulness-based stress reduction intervention on pregnant women infected by COVID-19 in Turkey

In 2021, Güney *et al*. conducted a study to assess the impact of an online MBSR intervention on alleviating distress and anxiety in 84 pregnant women diagnosed with COVID-19 from Turkey.[24] Among these 84 participants, 42 were randomly assigned to the intervention group, while the remaining 42 formed the control group. The MBSR-based intervention, administered to the intervention group, spanned 4 weeks, comprising eight sessions lasting 40–60 min each.[21]

To gauge the level of distress, Güney *et al*. utilized the 17-item Revised Prenatal Distress Questionnaire (NuPDQ), with scores ranging from 0 to 34. Higher scores indicated more severe prenatal distress. Following the 4-week intervention, NuPDQ scores decreased significantly from

19.50 ± 7.15 to 7.47 ± 3.98 ($P < 0.001$) for the intervention group, while the control group experienced a reduction from 17.16 ± 5.66 to 13.97 ± 3.33 ($P = 0.007$).[24] Consequently, the effectiveness of the MBSR-based intervention can be determined as −8.84 [= (7.47–19.50) – (13.97–17.16)], signifying a substantial 45.3% improvement in prenatal distress.

Anxiety levels were evaluated using the 21-item Beck Anxiety Inventory (BAI), where scores ranged from 0 to 63, with higher scores indicating higher anxiety levels. Following the MBSR intervention, BAI scores for the intervention group decreased significantly from 26.02 ± 10.93 to 6.50 ± 5.98 ($P < 0.001$), while the control group experienced a reduction from 19.19 ± 9.42 to 14.47 ± 5.58 ($P = 0.011$). The effectiveness of the intervention was calculated as −14.8 (= [6.50–26.02]–[14.47–19.19]), signifying a remarkable 56.9% improvement in stress symptoms for pregnant women. Notably, the stress symptom is a component of overall distress, as previously mentioned.

Improvements on Insomnia (Sleep Disorder)

Insomnia, a common sleep disorder characterized by difficulty to sleep or staying asleep, can disrupt daily functioning and lead to physical and mental health challenges. Chronic insomnia, occurring three or more nights a week for over 3 months, can increase the risk of various medical conditions, including high blood pressure, coronary heart disease, cognitive impairment, diabetes, obesity, and cancer.[25,26] Both short- and long-term insomnia symptoms resulting from COVID-19 are explored in this section.

Improvements in sleep quality for 133 medical staff from China

Between April 18 and May 3, 2020, Li *et al*. investigated the effects of a brief mindfulness meditation (BMM) on the insomnia symptom of 134 frontline medical staff in Wuhan, China.[27] Participants in the intervention group ($n = 87$), in addition to attending lectures and training sessions, followed online instructions and practiced a 15-minute BMM session daily at 8 pm for 16 days. The control group ($n = 47$) continued with their regular duties.

Insomnia was assessed using the 8-item Athens Insomnia Scale (AIS), with higher scores indicating more severe insomnia symptoms.[28] After the BMM intervention, AIS scores for the intervention group decreased from 3.84 ± 3.69 to 2.86 ± 3.14, whereas the control group's scores changed from 4.73 ± 3.35 to 4.00 ± 3.62. The effectiveness of the BMM intervention on insomnia was calculated as −0.25 (= [2.86–3.84]–[4.00–4.73]), signifying a modest 6.5% improvement in insomnia, denoting a slight increase in sleep quality due to the BMM intervention.

Neuro-meditation intervention on sleep quality and reactivity in 45 nurses from France

From June to August 2020, Hausswirth *et al*. examined the effectiveness of a neuro-meditation intervention on sleep quality and sleep reactivity in forty-five nurses (aged 25–61) from Sophia Antipolis, France.[29] Participants were classified into three groups based on systolic blood pressure (SBP): N-Group (normotensive, SBP ≤140 mmHg, $n = 16$, age = 43.8 ± 11.0), H-Group (hypertensive, SBP >140 mmHg, $n = 13$, age = 45.2 ± 10.7), and C-Group (control, SBP ≤140 mmHg, $n = 16$, age = 44.9 ± 10.6). The meditation intervention spanned 4 weeks and comprised ten 30-minute meditation sessions following the Rebalance© Impulse procedures.[29]

Sleep quality was assessed using the 6-item Spiegel Sleep Quality Questionnaire (SSQ), with scores ranging from 0 to 30, where higher scores indicated better sleep quality.[30] After the intervention, SSQ scores increased from 19.5 ± 2.5 to 22.5 ± 3.3 ($P = 0.061$) for the N-Group and from 16.1 ± 3.1 to 22.9 ± 3.1 ($P < 0.01$) for the H-Group. The C-Group's scores changed from 18.8 ± 5.0 to 19.4 ± 3.7 ($P = 0.47$). Analyzing N-Group as the intervention group and C-Group as the control group, the effectiveness of the intervention on insomnia was estimated at 2.4 (= [22.5–19.5]–[19.4–18.8]), representing a moderate 12.3% improvement in sleep quality for the normotensive N-Group. When considering H-Group as the intervention, the corresponding effectiveness was 6.2 or 38.5%, indicating a significant improvement in sleep quality for the hypertensive group. Notably, SSQ scores for C-Group and N-Group did not show statistical significance, as the associated P values exceeded 0.05.

Sleep reactivity, assessed using the 9-item Ford Insomnia Response to Stress Test (FIRST), ranges from 9 to 36, with higher scores indicating greater vulnerability to sleep sleep disruption.[31] When N-Group was considered the intervention group, the effectiveness of the intervention on sleep reactivity was estimated at −1.4 (= [26.6–26.6]–[25.2–23.8]), representing a 5.2% improvement in sleep reactivity for the normotensive group. If H-Group was the intervention group, the effectiveness of the intervention on sleep reactivity was −5.2 (= [24.3–28.1]–[25.2–23.8]), signifying an 18.5% reduction in sleep difficulty or sleep reactivity for the hypertensive group. Both improvements in sleep reactivity were considered moderate. It is noteworthy that the P values for the C-Group ($P = 0.53$) and N-Group ($P = 1.00$) in the FIRST score analyses were exceedingly high and, thus, not statistically significant.

Improvements for Long COVID Patients

Some individuals who contract the COVID-19 virus may experience persistent symptoms known as long COVID or post-COVID-19 syndrome. These symptoms continue to manifest for at least 4 weeks after the initial infection, affecting over 40%–70% of COVID-19 survivors and encompassing a wide range of manifestations that persist for weeks, months, or even years after infection.[32,33] These symptoms include general issues such as fatigue, fever, and pain, as well as specific problems related to the respiratory, cardiovascular, neurological, and digestive systems, as suggested by numerous investigations.[34-38] For example, Calalan's study even indicated that long COVID presentations' spectrum is bewildering with over 50 symptoms identified in a large systematic review on this subject.[35]

Improvements of mindfulness-breathing-singing-based intervention on respiratory and other common symptoms of long COVID

Between April and June 2021, Cahalan *et al*. conducted a study to examine the impact of an online mindfulness-breathing-singing-based intervention (MBSI) on respiratory and other common symptoms of long COVID.[35] The MBSI was delivered via Zoom, consisting of twenty 45-min sessions spanning 10 weeks. The study involved 21 participants (average age: 48.4 ± 10.1) who had been diagnosed with long COVID symptoms and had completed at least 10 (50%) of the MBSI sessions.

Pre- and post-intervention assessments were conducted using online questionnaires: the 19-item COVID-19 Yorkshire Rehab Screen (C19-YRS) and the 14-item DePaul Symptom Questionnaire Short Form (DSQ-SF). The C19-YRS collected data on various biopsychosocial aspects of health in COVID-19 survivors,[36] while the DSQ-SF evaluated two common long COVID symptoms, myalgic encephalomyelitis, and chronic fatigue syndrome, by assessing the severity and frequency of 14 common symptoms or qualities, such as fatigue, pain, and brain fog.[37]

Comparing postintervention scores with baseline scores, participants demonstrated reduced severity (improvement) after the MBSI in 11 areas: (1) breathlessness (reduced by 54.5%), (2) mobility (reduced by 6.8%), (3) fatigue (reduced by 31.3%), (4) personal care (reduced by 33.3%), (5) severity of usual activities (reduced by 28.8%), (6) pain/disability (reduced by 21.3%), (7) anxiety (reduced by 33.3%), (8) depression (reduced by 0%), (9) voice quality/issues (reduced by 50.0%), (10) appetite (reduced by 50.0%), and (11) communication/cognition (reduced by 30.2%).[35] Two other symptoms or qualities, airway complications and swallowing, were not reported by the participants and therefore were not assessed.

While no control group data were available for comparison, the outcomes from the single-group assessments suggest that the MBSI holds significant promise as a treatment option for long COVID sufferers. Furthermore, the symptoms of anxiety and depression examined here should have no major difference from those considered in the section of Distress presented earlier.

Long COVID Improvements by mind–body interventions

In a study conducted by Hausswirth *et al*., the impact of mind–body interventions on common health symptoms and mood disturbances in 34 patients with long COVID was investigated.[38] These 34 patients were randomly divided into either an intervention group (n = 17; age: 47.1 ± 8.3) or a control group (n = 17; age: 48.7 ± 10.4). The intervention consisted of ten 30-minute mind–body intervention sessions conducted over 5 weeks using the neuro-meditation Rebalance® technology mentioned earlier.[29]

Participants completed questionnaires to measure various mental and physical health symptoms. These included:

1. Physical fatigue assessed by the 7-item Chalder Fatigue Scale (CFQ-7) with a score range of 0–21
2. Mental fatigue evaluated using the 4-item Chalder Fatigue Scale (CFQ-4) with a score range of 0–12
3. Anxiety measured by the Anxiety subscale of the HADS with a score range of 0–21
4. Depression assessed by the Depression subscale of the HADS with a score range of 0–21
5. Dyspnea (breathlessness) measured using the mMRC with a score range of 0–4
6. Muscle and joint pain evaluated by the VAS Pain with a score range of 0–10
7. Headaches (also assessed using VAS Pain) with a score range of 0–10
8. Sleep quality measured by the SSQ with a score range of 0–30
9. Mood disturbances assessed by the POMS with a total score range of 0–232.[38]

By comparing the scores of the intervention group with the baseline scores of the control group, the effectiveness of the mind–body intervention were observed in: (1) CFQ 7-Physical fatigue: -12.4 (= [4.8–17.8]–[17.8–18.4]) (69.7% improvement), (2) CFQ 4-Mental fatigue: -7.4 (= [2.7–10.4]–[10.6–10.9]) (71.2% improvement), (3) HADS-Anxiety: -2.1 (= [7.2–10.8]–[11.4–12.9]) (10.8% improvement), (4) HADS-Depression: -4.6 (= [6.7–11.9]–[11.9–12.5]) (38.7% improvement), (5) mMRC-Dyspnea: -0.2 (= [1.1–1.5]–[1.2–1.4]) (13.3% improvement), (6) VAS Pain-Muscle and joint: -1.5 (= [4.6–6.4]–[6.8–7.1]) (23.4% improvement), (7) VAS Pain-Headaches: -1.9 (= [2.8–5.4]–[6.5–7.2]) (35.2% improvement), (8) SSQ-Sleep quality: 1.4 (= [18.5–15.1]–[16.0–14.0]) (9.3% improvement), and (9) overall POMS-Mood disturbances: -28.0 (= [14.2–45.5]–[55.6–58.9]) (61.4% improvement).[38]

Concluding Remarks

This article delves into the scientific evidence supporting the health benefits of MBIs, with a specific focus on quantifying their effectiveness in addressing five major disorders, i.e., depression, anxiety, stress, insomnia, and long COVID stemming from the COVID-19 pandemic. Given the prevalence of lockdown measures, online MBIs have emerged as a practical approach during this challenging period. They offer simplicity, nonpharmacological solutions, and self-sufficiency, making them easily accessible for practice without the need for external resources.

Seven online randomized controlled trials or studies were meticulously selected to investigate the effectiveness of various MBIs in mitigating five disorders associated with the pandemic. The observed effectiveness in these trials was subjected to quantitative assessment. It has been obtained that the effectiveness of the MBI on depression, anxiety, and stress symptoms was significant ranging from 20.5% to 68.8%. Moderate effectiveness was observed in addressing insomnia-related symptoms, with a ranging from 5.2% to 38.5%. Furthermore, an array of outcomes was seen in the context of long COVID, with effectiveness ranging from 0.0% to 71.2% across 13 long-COVID symptoms or qualities.

While self-reported questionnaires, as employed in all the seven studies reviewed, are commonly used to gauge perceived symptoms, they can be influenced by the choice of the type of questionnaires and by participants' subjective judgments. To minimize disparities among the questionnaires used and reduce uncertainties arising from subjective responses, future intervention trials should consider adopting modern electronic instruments (such as electrocardiogram (ECG), electroencephalogram (EEG), electromyogram (EMG), and functional magnetic resonance imaging[4,39]) and software-driven evaluation (including artificial intelligence-based tools). These digital-electronic approaches can yield quantitative outcomes, akin to the effectiveness metrics presented in this review, for symptom diagnosis, effectively mitigating bias and questionnaire-related errors. This approach promises more compelling and reproducible outcomes.

In conclusion, this review provides numerical validation that the online MBIs examined constitutes an effective intervention or therapy for depression, anxiety, stress, insomnia, and long COVID caused by the COVID-19 pandemic.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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