Effects of an 8-week app-based mindfulness intervention on mental health in working women: A randomized controlled trial

Riko Uwagawa, Koichiro Adachi, Mariko Shimoda, Ryu Takizawa

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Abstract

Background: Although working women experience increased work-related stress, preventive interventions to reduce its negative effects on their mental health are insufficient.

Objective: This study evaluated the effectiveness of an 8-week mindfulness-based self-help intervention via a smartphone application across four domains (general psychological, work-related, family-related, and work-to-conflict) among working women.

Methods: This study recruited women workers via various media sources, such as crowdsourcing sites and social networking services. Participants were randomly assigned to the intervention (n=106) or waitlist control groups (n=107). Participants in the intervention group practiced guided mindfulness meditation every day at their convenience via an app on their cell phones for eight weeks. The app provides an 8-week program with four meditation contents per two weeks. Participants in the waitlist control group lived as usual for eight weeks. We conducted web-based questionnaires to assess participants' general psychological (life satisfaction, perceived stress, depressive and anxiety symptoms, trait anger, mindfulness), work-related (work performance, job satisfaction, quantitative job overload, job control), family-related (family satisfaction, partner satisfaction), and work-to-family conflict indicators.

Results: An analysis of covariance, controlled for pre-intervention scores, revealed that the intervention significantly increased life satisfaction (b=1.47, ?=0.11, P=.005) and decreased perceived stress (b=-2.00, ?=-0.17, P=.012), depressive and anxiety symptoms (b=-1.24, ?=-0.15, P=.02), and trait anger/reaction (b=-0.59, ?=-0.11, P=.04). The intervention group demonstrated significantly increased life satisfaction (t93=-3.36, P=.001) and decreased depressive and anxiety symptoms (t93=2.35, P=.02).

Conclusions: The app was effective in reducing perceived stress, depressive and anxiety symptoms, and trait anger/reaction, and in improving life satisfaction among working women. However, to improve work- and family-related indicators, higher-intensity interventions may be required, such as modifying the intervention content or extending its duration. Clinical Trial: University Hospital Medical Information Network Clinical Trials Registry (UMIN-CTR) UMIN000051796; https://center6.umin.ac.jp/cgi-open-bin/ctr_e/ctr_view.cgi?recptno=R000059110.

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Results: An analysis of covariance, controlled for pre-intervention scores, revealed that the intervention significantly increased life satisfaction (b=1.47, β=0.11, P=.005) and decreased perceived stress (b=-2.00, β=-0.17, P=.012), depressive and anxiety symptoms (b=-1.24, β=-0.15, P=.02), and trait anger/reaction (b=-0.59, β=-0.11, P=.04). The intervention group demonstrated significantly increased life satisfaction (t_{93}=-3.36, P=.001) and decreased depressive and anxiety symptoms (t_{93}=2.35, P=.02).

Conclusions: The app was effective in reducing perceived stress, depressive and anxiety symptoms, and trait anger/reaction, and in improving life satisfaction among working women. However, to improve work- and family-related indicators, higher-intensity interventions may be required, such as modifying the intervention content or extending its duration.

Trial Registration: University Hospital Medical Information Network Clinical Trials Registry (UMIN-CTR) UMIN000051796; https://center6.umin.ac.jp/cgi-open-bin/ctr_e/ctr_view.cgi?recptno=R000059110.

Introduction

The impact of work-related stress on workers' mental health has been recently investigated and its significant social impact has become an issue [1]. According to the World Health Organization, work-related stress refers to "the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope." [2]

Working women experience increased work-related stress compared with working men. The American Psychological Association found that women consistently exhibited higher levels of stress than men and had additional difficulty in coping [3]. Furthermore, women are more likely to develop stress-related symptoms owing to neurobiological differences, a sense of burden from the dual roles of balancing work and family, and exposure to job insecurity [4-6]. Work-family conflict of working women have a negative impact on their stress and furthermore on their physical and mental health, and a framework regarding the relationship between these is presented [7]. Work-related factors may affect women and men differently, with women possibly being further affected owing to their work and family roles. With the global aim of gender parity in the labor market [8], the number of women in the working population is expected to increase. Therefore, preventive interventions to reduce the negative effects of work-related stress on women's mental health are required. However, such support is insufficient [9,10].

Traditionally, psychiatry has focused on the treatment of mental disorders rather than prevention. However, mental health is more than the absence of mental illness [10,11]. Therefore, interventions that focus on preventing mental health problems among women workers before they worsen and improving positive aspects, such as life satisfaction, could have positive effects on women's well-being and their work, family, and society as a whole.

Mindfulness meditation is an effective intervention strategy for improving mental health and well-being. Mindfulness is the awareness that emerges from deliberate, non-judgmental attention to experiences as they unfold moment-by-moment [12]. As mindfulness-based interventions reduce symptoms of depression, anxiety, and perceived stress and improve sleep quality and well-being [13-15], they are attracting attention as a preventive intervention strategy.

Additionally, the effectiveness of mindfulness meditation provided by smartphone applications has been recently highlighted. According to the International Telecommunication Union, there are over 8.89 billion mobile subscriptions worldwide [16]. Therefore, mobile technology can be used to provide preventive healthcare interventions to numerous people.

A traditional mindfulness-based program is high-intensity (eight weekly sessions of 2.5 hours per session and 30–40 minutes of practice per day) and time-constrained, which creates a participation barrier for non-clinical working women. The mobile-based mindfulness intervention is an app-based, voice-guided meditation practice that allows users to practice at their own convenience, which offers the advantages of high convenience and low cost [17-19]. Furthermore, online mindfulness interventions are effective in improving depression, anxiety, stress, rumination, and well-being [20,21].

However, no studies have examined the effects of mobile-based mindfulness meditation on working women from work, family, and work–family conflict aspects, as well as general measures. To our knowledge, only two studies have examined the effectiveness of mobile-based mindfulness meditation among working women. Santos et al. [10] found that an app-based mindfulness and positive psychology intervention effectively reduced perceived stress and anxiety symptoms in working women. Coelhoso et al. [11] revealed that a well-being mobile app designed to handle psychological stress based on relaxation training, breathing techniques, meditation (mindfulness, loving meditation, such as mindfulness, loving, kindness, and empathetic joy), and positive psychology principles improved working women's work-related well-being and reduced their work-related and overall stress.

Conversely, no study has examined working women's well-being from the four aspects of general psychological, work-related, family-related, and work–family conflict indicators. Examining their effects is essential for the future applications of mindfulness meditation as it will help us comprehensively understand how mindfulness meditation works for women workers.

Therefore, this study aimed to evaluate the effectiveness of an 8-week mindfulness meditation intervention via a smartphone application among women workers through a randomized controlled trial. Effectiveness was examined via four indicators: general psychological, work-related, family-related, and work-to-conflict measures. Furthermore, we examined the measures it would effectively influence. We hypothesized that participants in the intervention group (self-care mindfulness meditation via the smartphone application) would have a higher level of general psychological (life satisfaction, perceived stress, depressive and anxiety symptoms, trait anger, mindfulness), work-related (work performance, job satisfaction, quantitative job overload, job control), family-related (family satisfaction, partner satisfaction), and work-to-family conflict indicators compared with those in the waitlist control group.

Methods

Participants

This study recruited 397 women workers via various media sources, such as crowdsourcing sites and social networking services. Inclusion criteria included those who were (a) biologically female, (b) employed for at least 20 hours per week, (c) owned an iPhone (for convenience of the application used), and (d) aged 18–64 years. Exclusion criteria included those who (a) received treatment for a mental disorder, (b) scored ≥13 on the 6-item Kessler Psychological Distress Scale (K6) Japanese version, (c) were on leave, and (d) were currently pregnant or likely to become pregnant within six months. Among the participants, 95 did not meet the inclusion and exclusion criteria. Hence, 302 women workers who met the criteria were asked to respond to the pre-intervention assessment, and 213 who completed the assessment were randomly assigned to the intervention (n=106) or waitlist control group (n=107). The participants were asked to respond to the post-intervention assessment, and 196 women workers completed the assessment (intervention group = 95, waitlist control group = 101). Of 213 participants who completed the pre-intervention assessment, four who worked <19 hours per week on average in the pre-intervention assessment were excluded from analysis (intervention group = 1, waitlist control group = 3). Data from 209 participants (intervention group = 105, waitlist control group = 104) were finally analyzed. Figure 1 illustrates the CONSORT flow diagram.

Figure 1. CONSORT flowchart for participants
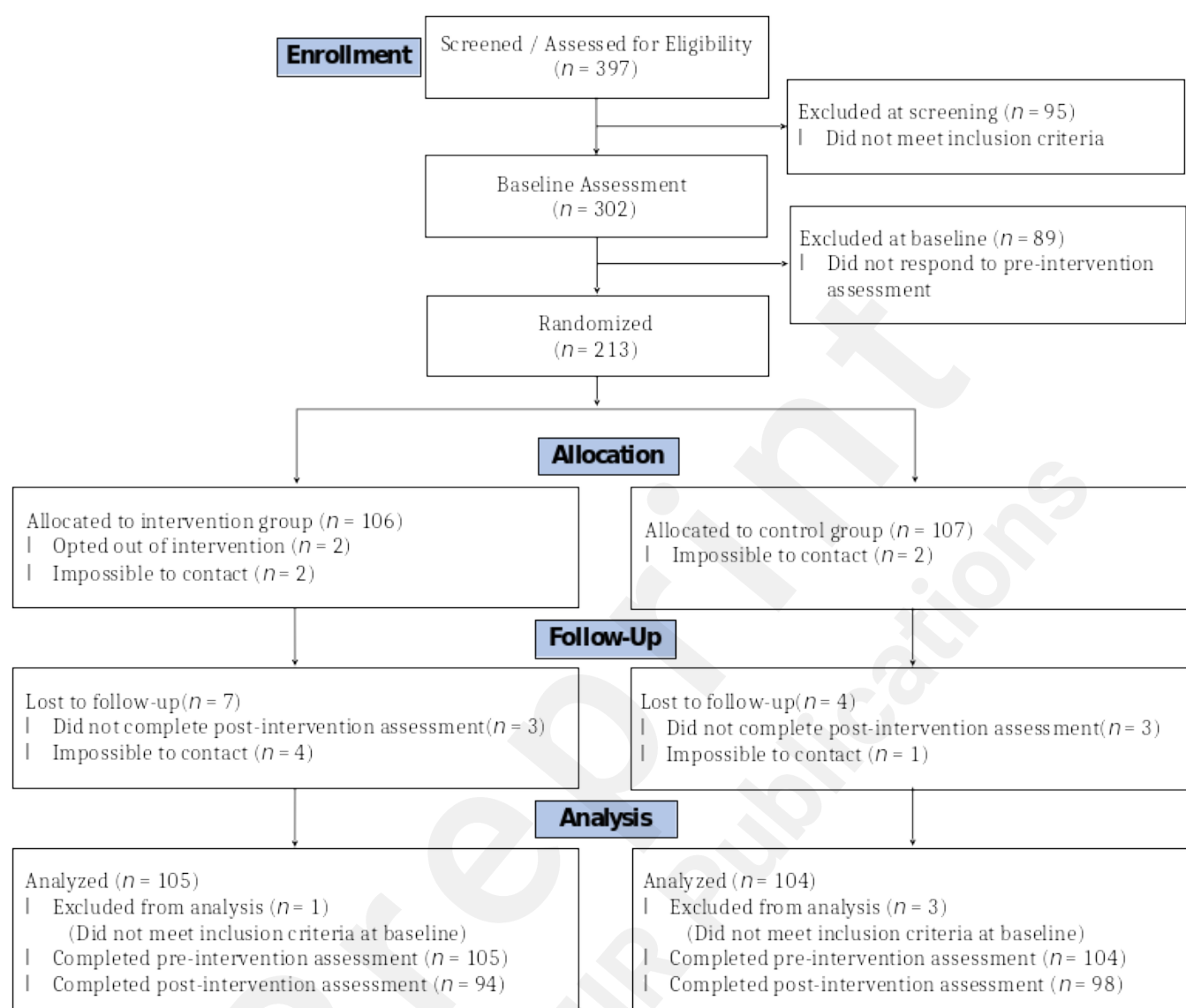
Procedure

This study was conducted from July 2023 to January 2024 via web forms. Participants in the intervention group installed the app for meditation after the pre-intervention assessment. Participants practiced guided mindfulness meditation via the app on their cell phones every day at their convenience for eight weeks. After eight weeks, the participants received the post-intervention questionnaire via the app and email. The participants in the waitlist control group lived as usual for eight weeks after the pre-intervention assessment. After eight weeks, they also responded to the post-intervention questionnaire via e-mail.

This study was approved by the Life Science Research Ethics and Safety Committee, the University of Tokyo (23-144, 23-227, 24-020). This study was registered in the University Hospital Medical Information Network (UMIN) Clinical Trials Registry (UMIN000051796).

8-week Mindfulness-based Self-help Intervention via the Smartphone Application

Mindfulness meditation was conducted via the iOS app, with the content changed every two weeks (Table 1). The application displayed the day's meditation content and explanation on the home screen. After viewing this screen, the participants pressed the play button to hear the guided audio and practiced meditation. Figure 2 illustrates the display of the application. In addition, the psychoeducation pages on mindfulness and self-compassion were created and inserted on the application (Figure 3).

The content was based on the self-help style mindfulness meditation used by Armstrong [22] for college students. Armstrong used a weekly 30-minute intervention for three weeks, with weekly content changes of "breathscape," "nowscape," and "body scan" [22]. "Breathscape" corresponded to "mindfulness of breath," "nowscape" to "mindfulness of breath, sound, and body," and "body scan" to "body scan meditation." As "body scan" was partially included in "mindfulness of breath, sound, and body," the latter was conducted after the former. Furthermore, as the effectiveness of interventions that incorporated elements of self-compassion was recently highlighted, "loving-kindness meditation" was ultimately added. As daily 13-minute meditation was effective after eight weeks [23], the intervention period was designed to be eight weeks.

Table 1. Content of the 8-week self-help mindfulness-based meditation.

Week	Types of meditation	Minutes
1, 2	Mindfulness of breath	7 min.
3, 4	Body scan	7 min.
5, 6	Mindfulness of breath, sound, and body	12 min.
7, 8	Loving-kindness meditation	12 min.

Figure2. Display of the smartphone application

Figure3. Display of the psychoeducation

瞑想とは？

✓ 瞑想とは？

瞑想は5分〜10分間リラックスして目を閉じたままゆっくりと呼吸を繰り返すのが基本的なやり方で、頭がスッキリしたり心が落ち着くなど様々な効果があることが研究で分かっています。

日本ではまだあまり普及していませんが、**海外では瞑想は一般的**なもので、AppleやGoogle、ゴールドマンサックスなど大企業でも福利厚生として瞑想プログラムが取り入れられており、年々そのような企業は増えていっています。

セルフコンパッションとは？

✓ セルフコンパッションとは？

仕事で失敗した時や、日常生活で上手くいかない時などに、自身の能力の無さを感じて、自分を責めてしまうことはないでしょうか。

ストレスを受けた時に、**自分を責めるのではなく、大切な人が落ち込んでいるときに思いやりを向けるように、自身にも思いやり（優しく温かい感情、自身の幸せを願う）を向けてあげることをセルフコンパッションと表現され、近年、効果的なストレスマネジメントの方法として注目されていて、研究も進んでいます。**

それは、何か条件付けをして自身を思いやるというものではなく、無条件なものです。ただあ

Measurements

General Psychological Domain

Well-being

Well-being was assessed as life satisfaction using the 5-item Satisfaction with Life Scale. Participants evaluated their subjective life satisfaction on a 7-point Likert scale that ranged from 1 (strongly disagree) to 7 (strongly agree) [24,25]. Sample items included "In most ways, my life is close to my ideal." The total score was a sum of all the individual item scores, and higher scores indicated greater life satisfaction. In this study, Cronbach α were .85 and .81 for the pre- and post-intervention assessments, respectively.

Mental Health Outcomes

Perceived Stress

The 10-item Perceived Stress Scale was used to assess perceived stress. Participants rated how unpredictable, uncontrollable, and overloaded they found their lives on a 5-point Likert scale that ranged from 0 (never) to 4 (very often) [26,27]. Sample items included "How often have you been upset because of something that happened unexpectedly?" The total score was a sum of the individual item scores, and higher scores indicated greater perceived stress. Cronbach α were .69 and .79 for pre- and post-intervention, respectively.

Depressive and Anxiety Symptoms

K6 was used to assess depression and anxiety symptoms. Participants described how often they experienced depressive symptoms in the past 30 days on a 5-point Likert scale that ranged from 0 (none of the time) to 4 (all of the time) [28,29]. Sample items included "How often did you feel nervous?" and "How often did you feel restless or fidgety?" The total score was a sum of all the individual item scores, and higher scores indicated a greater severity of depression and anxiety. Cronbach α were .83 and .80 for pre- and post-intervention, respectively.

Trait Anger

"Trait anger (T-Ang; 10-item)," a subscale of the 57-item State-Trait Anger Expression Inventory 2 (STAXI-2), was used to assess the traits of anger reaction [30-32]. Participants evaluated their perceptions of anger proneness on a 4-point Likert scale that ranged from 1 (strongly disagree) to 4 (strongly agree). Sample items included "I am quick tempered." T-Ang included two subfactors: T-Ang/Temperament (T-Ang/T; trait of feeling anger with or without stimulus) and T-Ang/Reaction (T-Ang/R; frequency of experiencing feelings of anger in situations involving irritation or negative evaluation). The total score within each sub-factor and all items was calculated by summing the item scores. Higher scores indicated greater trait anger. Cronbach α were T-Ang=.84, T-Ang/T=.79 and T-Ang/R=.77 for pre-intervention and T-Ang=.83, T-Ang/T=.84 and T-Ang/R=.76 for post-intervention.

Mindfulness

The 15-item Mindful Attention Awareness Scale was used to assess dispositional mindfulness [33,34]. Participants rated the degree to which they functioned without awareness of the present experience in daily life on a 6-point scale that ranged from 1 (almost never) to 6 (almost always). Sample items included "I could be experiencing some emotion and not be conscious of it until some time later." All items were reversed as they assessed the lack of mindful attention and awareness. The total score was a sum of all the reversed-item scores, and higher scores indicated greater mindful attention and awareness. Cronbach α were .81 and .87 for pre- and post-intervention, respectively.

Work-related Domain

Work Performance

The World Health Organization Health and Work Performance Questionnaire Short Form was used to assess work performance. The questions included: "On a scale of 0-10, where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of most workers in a job similar to yours?"(possible performance) and "Using the same 0–10 scale, how would you rate your overall job performance on the days you

worked during the past four weeks?"(actual performance) [35-37]. Participants evaluated the workplace costs of health problems regarding self-reported sickness leaves and reduced job performance (presenteeism). Presenteeism was assessed by "absolute" and "relative presenteeism." "Absolute presenteeism" was calculated by multiplying the score of actual performance by 10. Higher scores indicated greater performance. "Relative presenteeism" was calculated by the ratio of actual performance to possible performance (restricted to the range of 0.25–2.0, where values <0.25 and >2.0 were converted to 0.25 and 2.0, respectively). Higher scores indicated greater performance.

Job Satisfaction

Job satisfaction was assessed via a single item from the Brief Job Stress Questionnaire (BJSQ) [38]. Participants rated the degree to which they agreed with the item, "I am satisfied with my job," on a 4-point Likert scale that ranged from 1 (dissatisfied) to 4 (satisfied). Higher scores indicated greater job satisfaction.

Quantitative Job Overload

"Quantitative job overload (3-item)," a subscale of the BJSQ, was used to assess job overload [38]. Participants rated the degree of their job overload on a 4-point Likert scale that ranged from 1 (disagree) to 4 (agree). Sample items included "I have a lot of work to do." The total score was a sum of all the individual item scores, and higher scores indicated a greater job overload. Cronbach α were .64 and .56 for pre- and post-intervention, respectively.

Job Control

"Job control (3-item)," a subscale of the BJSQ was used to assess job control [38]. Participants rated the degree of their job control on a 4-point Likert scale that ranged from 1 (disagree) to 4 (agree). Sample items included "I can work at my own pace." The total score was the sum of the individual item scores, and higher scores indicated a greater sense of job control. Cronbach α were .60 and .64 for pre- and post-intervention, respectively.

Family-related Domain

Family Satisfaction

Family satisfaction was assessed via a single item from the BJSQ [38]. Participants rated the degree to which they agreed with the item, "I am satisfied with my family life," on a 4-point Likert scale that ranged from 1 (dissatisfied) to 4 (satisfied). Higher scores indicated greater family satisfaction.

Partner Satisfaction

Partner satisfaction was assessed via a single item, "Using the 10-point scale, how would you rate your current level of satisfaction with your relationship with your partner?" Only participants who lived with their partners were asked to respond. Participants rated the degree of their satisfaction with their partner on a 10-point Likert scale that ranged from 1 (dissatisfied) to 10 (satisfied). Higher scores indicated greater satisfaction.

Work-to-Family Conflict Domain

The 22-item Survey Work-home Interaction-NijmeGen was used to assess the four subscales that reflected the underlying dimensions of work–family spillover: (1) Work–family negative spillover (WFNS, eight items; e.g., "You do not have the energy to engage in leisure activities with your spouse/family/friends because of your job."), (2) Family–work negative spillover (FWNS, four items; e.g., "You do not feel like working because of problems with your spouse/family/friends."), (3) Work–family positive spillover (WFPS, five items; e.g., "You fulfill your domestic obligations better because of the things you have learned on your job."), (4) Family–work positive spillover (FWPS, five items; e.g., "You have greater self-confidence at work because you have your home life well organized.") [39,40]. Responses were rated on a 4-point Likert scale that ranged from 0 (never) to 3 (always). The total score of each subscale was calculated as a sum of all the individual item scores. Higher scores on the positive (WFPS and FWPS) and negative spillover subscales (WFNS and FWNS) indicated greater positive and negative impacts, respectively. Cronbach α were WFNS=.88, FWNS=.79, WFPS=.73, and FWPS=.78 for pre-intervention and WFNS=.89, FWNS=.76, WFPS=.79, and FWPS=.83 for post-intervention.

Statistical Analysis

We conducted Chi-squared and *t*-tests in order to examine whether there are differences in demographic variables and psychological indices between the intervention and control groups. Subsequently, we conducted *t*-tests to examine whether there were differences in demographic variables and psychological indices of participants in the intervention and waitlist control groups respectively and in the frequency of practice of participants in the intervention group between the dropouts and completers.

For the intervention effects, we conducted an analysis of covariance (ANCOVA; independent variables: intervention group=1, waitlist control group=0) that used the least squares method as an estimation method, controlled for pre-intervention scores. We conducted an ANCOVA that used the least squares estimation method, controlled for pre-intervention scores, age, employment status, psychiatric history, education, and marital status. Additionally, paired *t*-tests were conducted to determine any differences in the pre- and post-intervention assessments within each group. An intention-to-treatment analysis was used. R version 4.3.2 (2023-10-31) was used for statistical analysis.

Results

Baseline

Table 2 shows the participants' demographic characteristics. Chi-squared and t-tests revealed no differences in demographic variables and psychological indices between the intervention and waitlist control groups (*Ps*>.05).

Table 2. Participants' demographic information.

	Intervention group (*n*=105)	Waitlist control group (*n*=104)	Difference statistic (*df*)
Age in years, mean (*SD*)	36.81 ± 10.82	36.81 ± 10.70	*t* =0.00(207), *P*=.999
Education level, *n* (%)			χ^2=6.25(3), *P*=.10
Less than bachelor's degree	46 (43.6%)	31 (29.8%)	
Bachelor's degree	48 (45.7%)	60 (57.7%)	
Master's degree	11 (10.6%)	11 (10.6%)	
Doctor's degree	0 (0.0%)	2 (1.9%)	
Marital status, *n* (%)			χ^2=2.84 (3), *P*=.42
Married	46 (46.8%)	50 (48.1%)	
Single	51 (44.7%)	42 (40.4%)	
Divorced	6 (6.4%)	11 (10.6%)	
Widowed	2 (2.1%)	1 (1.0%)	
Employment status, *n* (%)			χ^2=2.13(1), *P*=.14
Regular employment	66 (62.9%)	54 (51.9%)	
Non-regular employment	39 (37.1%)	50 (48.1%)	
Psychiatric history, *n* (%)			χ^2=2.56(1), *P*=.11
Yes	7 (6.7%)	15 (14.4%)	
No	98 (93.3%)	89 (85.6%)	
Living with a partner, *n* (%)			χ^2=0.04(1), *P*=.83
Yes	52 (49.5%)	54 (51.9%)	
No	53 (50.5%)	50 (48.1%)	
Youngest child age in years, *n* (%)			χ^2=2.05(3), *P*=.56
0-2	8 (7.6%)	5 (4.8%)	
3-18	30 (28.6%)	30 (28.8%)	
19-	4 (3.8%)	8 (7.7%)	
None	63 (6.00%)	61 (58.7%)	

Comparing Completers and Dropouts Within Each Group

In the intervention group, no statistically significant differences were observed in demographic

information and psychological measurement scores between the dropouts and participants who completed the post-intervention assessment ($Ps > .05$). In the waitlist control group, there were differences in age ($t_{102}=2.66$, $P=.009$), T-Ang ($t_{102}=-2.22$, $p=.03$, Cohen $d=0.93$), T-Ang/R ($t_{102}=-2.26$, $P=.03$, Cohen $d=0.95$), and job control ($t_{102}=-2.57$, $P=.012$, Cohen $d=1.08$). Dropouts were significantly younger ($Mean=25.83$, $SD=4.62$), more angry (T-Ang: $Mean=24.00$, $SD=9.06$; T-Ang/R: $Mean=11.00$, $SD=4.65$), and perceived an additional sense of job control ($Mean=9.17$, $SD=1.60$) compared with the retained participants (age $Mean=37.48$, $SD=10.61$; T-Ang: $Mean=18.76$, $SD=5.39$; T-Ang/R: $Mean=8.34$, $SD=2.68$; job control: $Mean=6.56$, $SD=2.45$).

Practice Frequency

Participants in the intervention group used the app for a mean of 42.32 days (75.57%, $SD=15.63$) in eight weeks. A significant difference was observed in practice frequency between participants who completed the program ($n=94$; $Mean=44.77$, $SD=13.07$) and those who began but dropped out ($n= 7$; $Mean=9.43$, $SD=8.18$; $t_{99}=7.031$, $P<.001$).

Outcomes

Group Effects

Table 3 presents the scores of the pre- and post-intervention assessments. Table 4 presents the results of ANCOVA. The ANCOVA, controlled for pre-intervention scores, revealed significant group effects on life satisfaction ($b=1.47$, $\beta=0.11$, $P=.005$), perceived stress ($b=-2.00$, $\beta=-0.17$, $P=.012$), depressive and anxiety symptoms ($b=-1.24$, $\beta=-0.15$, $P=.02$), and T-Ang/R ($b=-0.59$, $\beta=-0.11$, $P=.04$). The ANCOVA, controlled for pre-intervention scores and demographic data (age, employment status, psychiatric history, education, marital status), revealed significant group effects on life satisfaction ($b=1.35$, $\beta=0.10$, $P=.02$), perceived stress ($b=-1.92$, $\beta=-0.16$, $P=.02$), depressive and anxiety symptoms ($b=-1.17$, $\beta=-0.14$, $P=.03$), and T-Ang/R ($b=-0.75$, $\beta=-0.14$, $P=.012$).

Differences Between Pre- and Post-intervention Assessment Within Each Group

Regarding the intervention group, the post-intervention scores of life satisfaction were significantly higher ($Mean_{pre}=17.70$, $SD_{pre}=6.68$; $Mean_{post}=18.80$, $SD_{post}=6.76$; $t_{93}=-3.36$, $P=.001$, Cohen $d=0.22$ 95% CI [0.09, 0.35]) and those of depressive and anxiety symptoms were significantly lower ($Mean_{pre}=6.16$, $SD_{pre}=4.06$; $Mean_{post}=5.37$, $SD_{post}=3.61$; $t_{93}=2.35$, $P=.02$, Cohen $d=0.27$ [0.04, 0.50]) than the pre-intervention scores.

Regarding the waitlist control group, the post-intervention scores of perceived stress were significantly higher ($Mean_{pre}=17.62$, $SD_{pre}=5.95$; $Mean_{post}=19.94$, $SD_{post}=6.38$; $t_{97}=-4.20$, $P<.001$,

Cohen d=0.40 [0.21,0.60]) and those of partner satisfaction were significantly lower than the pre-intervention scores ($Mean_{pre}$=7.69, SD_{pre}=2.05; $Mean_{post}$=7.15, SD_{post}=2.43; t_{50}=2.41, P=.02, Cohen d=0.25 [0.04, 0.45]).

Table 3. Scores of the pre- and post-intervention assessments.

	Intervention group							Waitlist control group							t - test		
	Pre		Post					Pre		Post							
	Mean	SD	Mean	SD	t	P value	Cohen d 95%CI	Mean	SD	Mean	SD	t	P value	Cohen d 95%CI	t	P value	Cohen d 95%CI
General psychological domain																	
Life Satisfaction	17.70	6.68	18.80	6.76	-3.36	.001	0.22 [0.09, 0.35]	18.62	6.89	18.58	6.32	0.87	.38	0.05 [-0.06, 0.15]	0.23	.82	0.03 [-0.25, 0.31]
Perceived Stress	18.71	5.14	18.65	5.65	0.43	.67	0.05 [-0.19, 0.29]	17.62	5.95	19.94	6.38	-4.20	<.001	0.40 [0.21, 0.60]	-1.48	.14	0.21 [-0.07, 0.50]
Depressive and Anxiety Symptoms	6.16	4.06	5.37	3.61	2.35	.02	0.27 [0.04, 0.50]	6.20	4.89	6.41	4.71	-0.99	.33	0.08 [-0.08, 0.25]	-1.71	.09	0.25 [-0.04, 0.53]
Trait Anger	18.50	5.16	18.27	5.31	1.40	.17	0.10 [-0.04, 0.23]	19.06	5.73	18.92	5.58	-0.39	.70	0.03 [-0.12, 0.18]	-0.82	.41	0.12 [-0.17, 0.40]
Trait Anger/Temperament	7.09	2.62	6.94	2.54	1.89	.06	0.12 [-0.01, 0.24]	7.49	2.78	7.30	2.95	0.58	.56	0.04 [-0.10, 0.19]	-0.90	.37	0.13 [-0.15, 0.41]
Trait Anger/Reaction	8.50	2.65	8.28	2.71	1.19	.24	0.10 [-0.07, 0.27]	8.49	2.86	8.71	2.74	-1.81	.07	0.14 [-0.01, 0.29]	-1.10	.27	0.16 [-0.12, 0.44]
Mindfulness	43.36	10.65	44.05	11.31	-0.39	.70	0.03 [-0.10, 0.07]	43.74	9.85	44.33	11.75	-0.36	.72	0.02 [-0.11, 0.16]	-0.16	.87	0.02 [-0.26, 0.31]
Work																	
Work Performance																	
Absolute presenteeism	61.43	19.24	62.02	18.64	-0.35	.73	0.04 [-0.19, 0.27]	61.06	19.50	61.84	18.69	-0.43	.67	0.05 [-0.17, 0.27]	0.07	.95	0.01 [-0.27, 0.29]
Relative presenteeism	1.00	0.29	1.05	0.27	-1.33	.19	0.17 [-0.08, 0.42]	1.00	0.33	1.01	0.32	-0.42	.67	0.05 [-0.19, 0.30]	0.94	.35	0.14 [-0.15, 0.42]
Job Satisfaction	2.30	0.72	2.33	0.79	0.12	.90	0.01 [-0.21, 0.24]	2.19	0.87	2.19	0.83	-0.63	.53	0.05 [-0.10, 0.20]	1.16	.25	0.17 [-0.12, 0.45]
Quantitative job overload	6.90	2.36	6.89	2.43	-0.23	.82	0.02 [-0.17, 0.22]	7.32	2.59	7.15	2.30	0.79	.43	0.07 [-0.10, 0.23]	-0.76	.45	0.11 [-0.17, 0.39]
Job control	6.64	2.33	6.46	2.23	1.37	.17	0.11 [-0.05, 0.26]	6.71	2.48	6.60	2.29	-	.84	0.02 [-0.15, 0.18]	-	.66	0.06 [-0.22,

							0.21						0.44			0.35]
Family																
Family Satisfaction	2.00	0.77	1.94	0.81	1.34	.18	0.13 [-0.06, 0.33]	2.01	0.82	2.04	0.88	-0.76	.45	0.07 [-0.12, 0.26]	-0.85	.40	0.12 [-0.16, 0.41]
Partner Satisfaction	7.52	2.14	7.39	2.25	0.22	.82	0.02 [-0.15, 0.19]	7.69	2.05	7.15	2.43	2.41	.02	0.25 [0.04, 0.45]	0.50	.62	0.10 [-0.29, 0.49]
Work-to-Family Conflict																
Work-Family Negative Spillover	5.62	4.92	5.63	4.48	0.20	.84	0.02 [-0.14, 0.17]	5.51	5.51	5.18	5.23	1.28	.20	0.08 [-0.04, 0.20]	0.63	.53	0.09 [-0.19, 0.37]
Family-Work Negative Spillover	1.25	1.71	1.20	1.72	0.46	.64	0.05 [-0.16, 0.26]	1.19	1.66	1.36	1.85	-0.98	.33	0.09 [-0.09, 0.28]	-0.60	.55	0.09 [-0.20, 0.37]
Work-Family Positive Spillover	7.08	3.04	7.02	3.05	-0.11	.92	0.01 [-0.18, 0.20]	6.77	3.30	7.13	3.72	-0.96	.34	0.08 [-0.09, 0.25]	-0.23	.82	0.03 [-0.25, 0.32]
Family-Work Positive Spillover	7.09	3.51	7.20	3.55	-0.33	.75	0.03 [-0.17, 0.24]	7.19	3.94	7.36	3.97	-0.22	.83	0.02 [-0.19, 0.23]	-0.28	.78	0.04 [-0.24, 0.32]

Table 4. Comparison between the control and the intervention groups.

	controlling for pre-scores					controlling for pre-scores and demographic data				
	b	β	*SD*	*t*	*P* value	*b*	β	*SD*	*t*	*P* value
General psychological domain										
Life Satisfaction	1.47	0.11	0.52	2.82	.005	1.35	0.10	0.55	2.44	.02
Perceived Stress	-2.00	-0.17	0.79	-2.55	.012	-1.92	-0.16	0.83	-2.33	.02
Depressive and Anxiety Symptoms	-1.24	-0.15	0.51	-2.43	.02	-1.17	-0.14	0.53	-2.21	.03
Trait Anger	-0.66	-0.06	0.53	-1.26	.21	-0.91	-0.08	0.54	-1.67	.097
Trait Anger/Temperament	-0.22	-0.04	0.25	-0.85	.40	-0.22	-0.04	0.27	-0.82	.41
Trait Anger/Reaction	-0.59	-0.11	0.29	-2.03	.04	-0.75	-0.14	0.30	-2.54	.012
Mindfulness	-0.02	0.00	1.03	-0.01	.99	0.01	0.00	1.09	0.01	.99
Work										
Work Performance										
Absolute presenteeism	0.05	0.00	2.4	0.02	.98	-0.33	-0.01	2.62	-0.13	.90

			9							
Relative presenteeism	0.04	0.07	0.04	0.93	.36	0.03	0.05	0.04	0.67	.50
Job Satisfaction	0.03	0.02	0.10	0.26	.79	0.02	0.01	0.10	0.21	.83
Quantitative job overload	0.01	0.00	0.28	0.05	.96	0.06	0.01	0.28	0.23	.82
Job control	-0.24	-0.05	0.24	-0.99	.32	-0.27	-0.06	0.25	-1.09	.28
Family										
Family Satisfaction	-0.14	-0.08	0.10	-1.37	.17	-0.14	-0.08	0.11	-1.30	.19
Partner Satisfaction	0.50	0.11	0.30	1.64	.103	0.40	0.09	0.32	1.24	.22
Work-to-Family Conflict										
Work-Family Negative Spillover	0.37	0.04	0.44	0.84	.40	0.19	0.02	0.46	0.41	.68
Family-Work Negative Spillover	-0.21	-0.06	0.22	-0.93	.35	-0.32	-0.09	0.23	-1.39	.17
Work-Family Positive Spillover	-0.21	-0.03	0.40	-0.53	.60	0.04	0.01	0.41	0.11	.91
Family-Work Positive Spillover	-0.07	-0.01	0.48	-0.14	.89	-0.07	-0.01	0.51	-0.13	.90

Discussion

This study examined the effectiveness of a mindfulness meditation intervention via a smartphone application among healthy women workers. To our knowledge, this was the first study that examined the effects of the mindfulness meditation intervention via a smartphone application on four domains (psychological, work, family, and work-to-family conflict) among women workers. Women workers who received the intervention demonstrated higher post-intervention scores on the general psychological indicators (life satisfaction, perceived stress, depressive and anxiety symptoms, and trait anger/reaction) than those in the waitlist control group, controlled for pre-intervention scores as well as age, employment status, psychiatric history, education, and marital status. However, the intervention was not effective in the other three domains (work, family, and work-to-family conflict). In particular, life satisfaction and depression and anxiety symptoms significantly improved in the intervention group.

Our results corroborated the findings of Santos et al. [10] and Coelhoso et al. [11] that app-based mindfulness interventions reduced perceived stress and anxiety symptoms and improved subjective well-being among working women. Additionally, we found that app-based mindfulness interventions were useful for reducing reactive anger in working women. Working women are more likely to experience stress owing to neurobiological differences and balancing work and family than men, which may impair their well-being [3-7]. Mindfulness interventions enhance acceptance and observation skills by halting in daily life, paying attention to what is happening "here and now," and observing and accepting things as they are. Therefore, acceptance and observation skills enable working women to pause and look at things as they are without being overwhelmed by negative thoughts and feelings when they are burdened by work and family in their daily lives. This is likely to calm their anger, lower their subjective stress, and increase their sense of well-being.

Conversely, this study observed no improvements in work-related, family-related, and work-to-family conflict indicators after the intervention. Previous studies have reported that mindfulness interventions increase family satisfaction among elementary and secondary school teachers, partner satisfaction among participants in a romantic relationship, and work satisfaction and performance among workers, and decrease the work-to-family conflict among workers [41-47]. The inconsistency of our results with those of previous studies could be owing to differences in sex, intervention duration, and meditation time per session. Moreover, this preventive intervention may have been too short to reduce burden in the three work- or family-related domains. Furthermore, the intervention content was aimed at general meditation ("mindfulness of breath," "body scan," "mindfulness of breath, sound, and body," and "loving-kindness meditation"), rather than work- or family-specific content, and was implemented in a specific order. Therefore, the 8-week low-intensity meditation intervention could have led to an improvement in the individual's general well-being; however, the effect on work- or family-related indicators may have occurred after a few months. Alternatively, higher-intensity interventions may be required, such as modifying the intervention's contents or extending its duration. Additionally, only one item was used to measure work performance and job,

family, and partner satisfaction, whereas three items were used to measure job satisfaction and control. Therefore, the number of questions may have been too small to detect significant differences.

Limitations and Future Directions

This study has some limitations. First, in this study, subgroup analyses were not conducted to examine the impact of the subjects' traits on intervention effects. The effects of our mindfulness intervention on general psychological, work-related, family-related, and work-to-family conflict indicators may differ based on other factors. Some participants may have benefited on work-related, family-related, or work-to-conflict indicators. Therefore, it is necessary to examine the factors that moderate the effect of mindfulness interventions.

Second, the mindfulness intervention used in this study was not designed as target- and context-specific. Previous studies have developed target- and context-specific mindfulness interventions, such as for the workplace and parenting. Therefore, future studies should be designed specifically for working women, with an aim to increase the effects on work- and family-related indicators.

Conclusion

This study examined the effects of mindfulness interventions via a smartphone application on women workers' general psychological, work-related, family-related, and work-to-family conflict indicators through a randomized controlled trial. Our results revealed that the intervention increased life satisfaction and reduced perceived stress, depressive and anxiety symptoms, and anger reactions.

Acknowledgements

Conflicts of Interest

None declared.

Abbreviations

ANCOVA: Analysis of covariance

BJSQ: Brief job stress questionnaire

STAXI-2: State-Trait anger expression inventory 2

T-Ang/R: Trait-anger/reaction

T-Ang/T: Trait-anger/temperament

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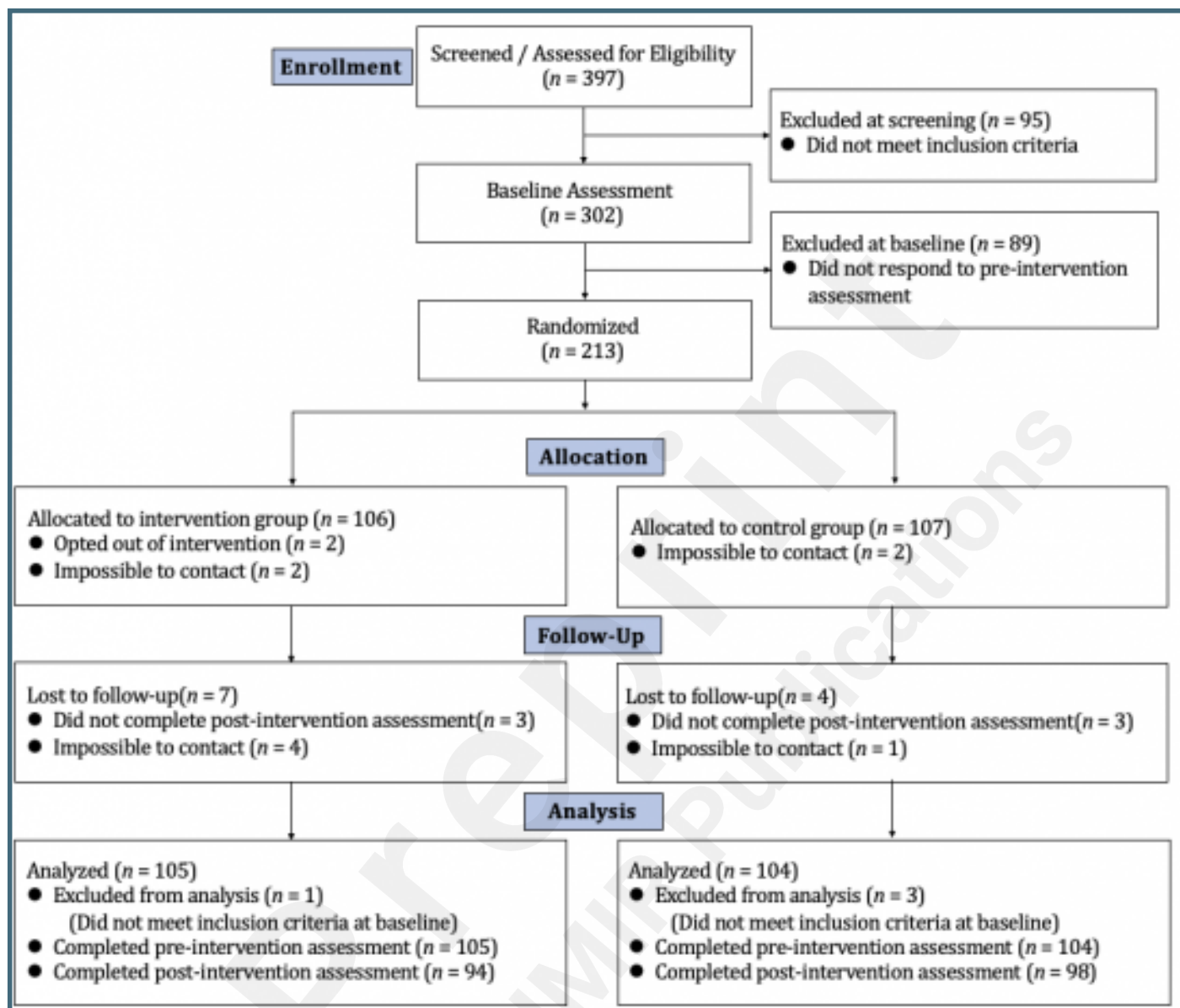47. Slutsky J, Chin B, Raye J, Creswell JD. Mindfulness training improves employee well-being: a

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Supplementary Files

Figures

CONSORT flowchart for participants.

Display of the smartphone application.

Display of the psychoeducation.

セルフコンパッションとは？

✓ セルフコンパッションとは？

仕事で失敗した時や、日常生活で上手くいかない時などに、自身の能力の無さを感じて、自分を責めてしまうことはないでしょうか。

ストレスを受けた時に、**自分を責めるのではなく、大切な人が落ち込んでいるときに思いやりを向けるように、自身にも思いやり（優しく温かい感情、自身の幸せを願う）を向けてあげることをセルフコンパッション**と表現され、**近年、効果的なストレスマネジメントの方法として注目されていて、研究も進んでいます。**

それは、何か条件付けをして自身を思いやるというものではなく、無条件なものです。ただあ

瞑想とは？

✓ 瞑想とは？

瞑想は5分〜10分間リラックスして目を閉じたままゆっくりと呼吸を繰り返すのが基本的なやり方で、頭がスッキリしたり心が落ち着くなど様々な効果があることが研究で分かっています。

日本ではまだあまり普及していませんが、**海外では瞑想は一般的**なもので、AppleやGoogle、ゴールドマンサックスなど大企業でも福利厚生として瞑想プログラムが取り入れられており、年々そのような企業は増えていっています。