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Meta-Analysis

Meta Analysis the Effectiveness of Mobile-Based Stress Management Application on Stress and Depression among Workers

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ABSTRACT

Background: The application of stress management at this time really needs a smartphone application to prevent the occurrence of severe mental disorders, reduce stress levels and use this application more effectively. The purpose of this study is to conduct a meta-analysis with the aim of studying and estimating the effectiveness of mobile-based stress management applications on stress and depression in workers.

Subjects and Method: This study is a meta-analysis using PICO, Population: Workers, Intervention: Using a mobile-based stress management application, Comparison: Not using a mobile-based stress management application, Output: Stress and Depression. The process of searching for articles between 2012-2022 uses 5 databases: PubMed, Google Scholar, ProQuest, Science Direct and Scopus. The keywords used are "stress" OR "depression" AND "apps" OR "digital health" OR "mobile health" OR "message text" OR "phone calls" OR "website" OR "email" AND "employee" OR " worker". Inclusion criteria: article must be a full paper with Randomized Controlled Trial (RCT), article using English, population namely workers, mobile-based stress management application intervention, reported results are stress, depression, include research results number of respondents, average -mean score and standard deviation (SD). Articles that met the requirements were analyzed using the RevMan 5.3 application.

Results: There were 14 articles with a Randomized Controlled Trial (RCT) research design originating from Germany, Spain, Switzerland, England, America, Thailand, Taiwan, Korea, Vietnam which were carried out by meta-analysis. The size of the stress sample is 4,865 workers. The meta-analysis shows that workers who use the mobile-based stress management application have 1.08 units lower stress than do not use the mobile-based stress management application, and it is statistically significant (SMD = -1.08; 95% CI = -1.70 to -0.45; p= 0.007). The sample size for depression is 3,983 workers. Workers using the mobile-based stress management application had depression 0.47 units lower than those not using the mobile-based stress management application, and it was statistically significant (SMD = -0.47; 95% CI = -0.85 to -0.10; p = 0.01).

Conclusion: Mobile-based stress management application use reduces stress and depresssion in workers.

Keywords: stress, depression, stress-based mobile application, worker, employee, meta analysis

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BACKGROUND

Healthy mental health needs to be owned to live and overcome life's problems, so in doing work it is necessary to have good mental health, so as to produce good work (WHO, 2022). Improved mood has an effect on increasing mental health disorders, as a measure can be seen from symptoms of depression, anxiety and stress (Lopresti et al., 2019). Stress is defined as pressure caused by a discrepancy between the desired situation and expectations, where there is an imbalance between environmental demands and the individual's ability to fulfill them and has the potential to be detrimental, threatening both himself and the environment (Ramadhany et al., 2021).

In the pre-pandemic period in 2019 it was estimated that 970 million people in the world experienced mental disorders, 82% of them were in LMICs and in 2000 and 2019 it was estimated that the prevalence of mental disorders was around 13% and 25% more people were living with mental disorders (WHO , 2022). In 2019 around 301 million people live with anxiety disorders and 280 million live with depressive disorders (WHO, 2022).

Psychosocial and community support will result in better mental health conditions (WHO, 2022). One of the factors of healthy living behavior can help reduce stress and maximize age. One of the stress management techniques is physical activity, exercise, healthy eating, adequate sleep, relaxation, attention, care, laughter, self-expression, social support and cognitive restructuring (Mount, 2002). Technology and knowledge are currently showing very rapid developments in the health sector. At present the public demand for fast and open services in the health sector is very high. The emergence of new technology causes the flow of information to become more open and fast. Support for employees to manage stressful situations consists of providing self-help: individual space, providing social support: collaborative space and general design considerations to achieve success. In this study, the results showed that all participants preferred using web and mobile to reduce stress (Weerasekara, 2022. Stress reduction strategies for workers can be carried out with mobile-based training using these methods to improve cognitive emotion regulation (Amiri et al., 2021).

The current application of stress management really needs smartphone applications to prevent severe mental disorders, reduce stress levels and can be done using simple features and the use of this application can be more effective than face-to-face interventions and can increase the duration of therapeutic effects (Budiarto and Afriani, 2018) .

Based on this background, comprehensive research from primary research is needed to get more convincing conclusions. Therefore, researchers are interested in conducting research using a systematic review approach to relevant studies, namely by using meta-analysis. Meta-analysis is a statistical combination of results from two or more separate studies with the aim of increasing precision, answering questions that were not answered by individual studies and resolving controversies that arise from studies that appear to contradict or generate new hypotheses (Weerasekara, 2022).

Based on the description above, this study aims to investigate relevant primary studies to assess the effectiveness of mobile-based stress management applications on stress and depression for workers. These findings are expected to help the community, government and health services in reducing stress on workers by using applications.

SUBJECTS AND METHOD

1. Study Design

This is a systematic review and meta-analysis. Search for articles using databases,

including PubMed, Google Scholar, ProQuest, Science Direct, and Scopus. The keywords to search the database for are “stress” OR “depression” AND “apps” OR “digital health” OR “mobile health” OR “message text” OR “phone calls” OR “website” OR “email” AND “employee” OR “workers”.

2. Steps of Meta-analysis

The meta-analysis was carried out through 5 steps as follows:

1) Defining research questions with PICO (Population: Workers, Intervention: Using a mobile-based stress management application: Not Using a mobile-based stress management application Outcome: Stress and depression
2) Searching main study articles from electronic databases such as PubMed, Google Scholar, ProQuest, Science Direct, and Scopus
3) Conducting screening and critical appraisal of the main study articles.
4) Performing data extraction and synthesize effect estimates into Rev-Man 5.3.
5) Interpreting and making conclusions.

3. Inclusion Criteria

The full paper article uses a Randomized Control Trial (RCT) study design, the relationship size used is the Mean SD, the subjects in the study are workers, the intervention provided is in the form of a mobile-based stress management application for stress and depression for workers, the results reported in the article are stress or depression or both**.**

4. Exclusion Criteria

Articles published before 2012, articles not in English, and previous research using meta-analysis.

5. Operational Definition of Variables

Stress: an individual's adaptive response to a situation that someone accepts as a challenge or a threat to their existence.

Depression: a person's emotional state which is usually characterized by extreme sadness, feelings of worthlessness and guilt, withdrawal from others, sleeplessness, loss of appetite, sexual desire, and interest and pleasure in usual activities.

Mobile application-based stress management: the use of technology to anticipate, prevent, manage and recover from perceived stress due to threats and inability to cope.

6. Study Instruments

In a systematic study guide using the PRISMA flowchart guide and assessing the quality of research articles using the Critical Appraisal Skills Program Randomized Controlled Trial Standard Checklist (CASP for RCT).

7. Data analysis

The data in this study were analyzed using the Review Manager application (RevMan 5.3). Forest plots and funnel plots are used to determine the effect size and heterogeneity of the data. Data processing is carried out based on variations between studies by determining the use of an analysis model, namely the fixed effect model or the random effect model.

RESULTS

In this meta-analysis process begins with determining research questions. The question in this study is how much the effectiveness of mobile-based stress management applications on stress and depression in workers. To further formulate PICO which will be used as a reference as a search for relevant articles. Article searches were conducted through several electronic databases including: PubMed, Google Scholar, ProQuest, Science Direct, and Scopus. There are 14 articles originating from Germany, Spain, Switzerland, England, America, Thailand, Taiwan, Korea and Vietnam. The article review process can be seen in the prism flow chart as follows.

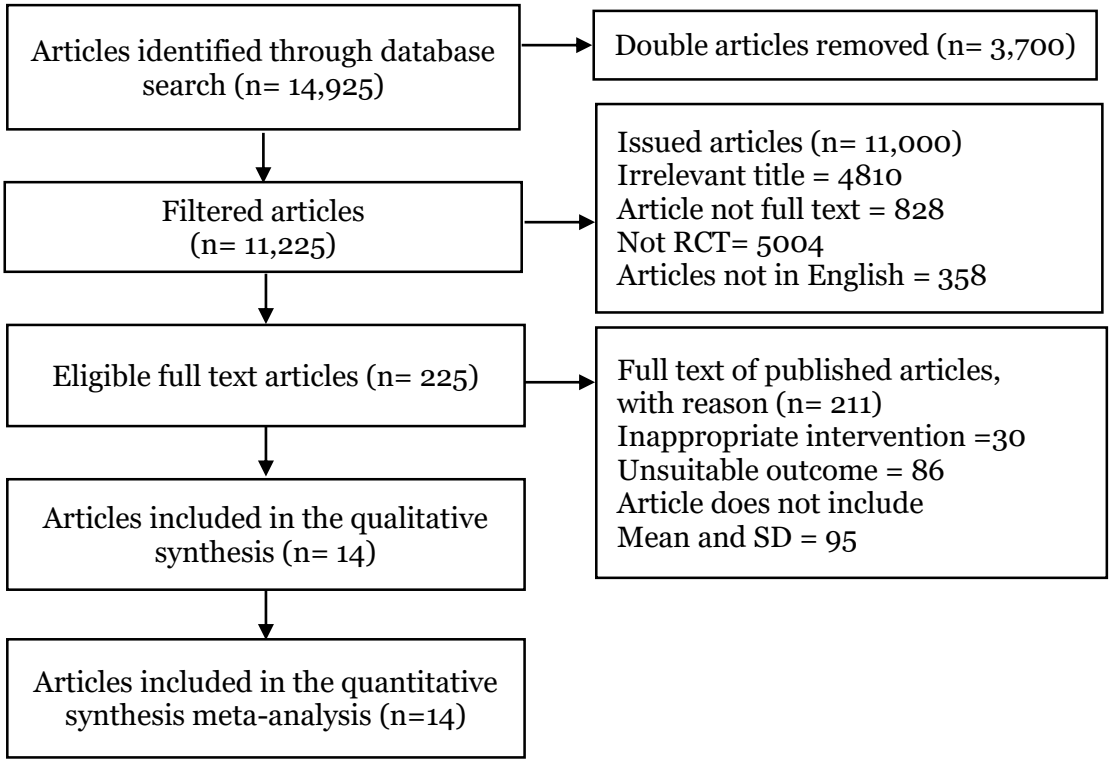

Figure 1. PRISMA flow diagram

Figure 2. Map of the Research Area

From Figure 2 it shows that the research location for the effectiveness of mobile-based stress management applications on stress and depression in workers is 14 articles originating from 3 continents namely the Americas, Europe and Asia. Three studies came from the Americas (United States of America), seven studies came from Europe (Germany, Spain, Switzerland and England), and four studies came from Asia (Thailand, Taiwan, Korea and Vietnam). Assessment of the quality of studies using the Critical Appraisal Skills Program-me Randomized Controlled Trial Standard Checklist (CASP for RCT) in researching the effectiveness of mobile-based stress management applications on stress in workers (see Table 1).

Table 1. Quality assessment of randomized controlled trials on the "Effectiveness of the Mobile-Based Stress Management Application on Stress in Workers"

Primary Study	Criteria											
	1	2	3	4	5	6	7	8	9	10	11	Total
Ebert et al., (2016)	1	1	1	1	1	1	1	1	1	1	1	11
Fiol-DeRoque et al., (2021)	1	1	1	1	1	1	1	1	1	1	1	11
Heber et al., 2016)	1	1	1	1	1	1	1	1	1	1	1	11
Huberty et al., (2022)	1	1	1	1	1	1	1	1	1	1	1	11
Lacour et al., (2021)	1	1	1	1	1	1	1	1	1	1	1	11
Luangapichart et al., (2022)	1	1	1	1	1	1	1	1	1	1	1	11
Nixon et al., (2021)	1	1	1	1	1	1	1	1	1	1	1	11
Taylor et al., (2022)	1	1	1	1	1	1	1	1	1	1	1	11

Description of the question criteria:

1 = Does this research answer the research questions clearly?
2 = Was the assignment of participants to the intervention randomized?
3 = Were all participants who entered the study accounted for in the conclusions?
4 = Were the participants, the people who analyzed the results and the researchers blinded?
5 = Were the study groups similar at the start of the randomized controlled trial?
6 = Regardless of the experimental intervention, did each study group receive the same level of care (ie, were they treated the same)?
7 = Were the effects of the intervention reported comprehensively?
8 = Is the accuracy of the reported intervention or treatment effect estimates?
9 = Do the benefits of the experimental intervention outweigh the disadvantages and costs?
10 = Can the results be applied to your local population/in your context?
11 = Will the experimental intervention provide greater value to the people in your care than any existing intervention?

Decription of the answer score:

0 = No
1 = Yes

Table 2. Description of the primary studies included in the primary study meta-analysis of the Randomized Controlled Trial (N=4,865)

Author (year)	Country	Sample	P	I	C	O
Ebert et al., (2016)	Germany	264	Employee	Using IBI's GET.ON Stress app	Not using the GET.ON IBI Stress App	stress
Fiol-DeRoque et al., (2022)	Spain	482	Health personnel	Using the mHealth application based on psycho-education and mindfulness	Do not use psychoeducation and mindfulness-based mHealth applications	stress
Heber et al., 2016	Germany	264	Employee	Using the GET.ON Stress application	Do not use the GET.ON Stress Application	stress
Huberty et al., 2022	The USA	1029	Employee	Using a commercial mindfulness app—Calm	Not using a commercial mindfulness app—Calm	stress
Lacour et al., 2021	Switzerland	150	Paramedic	Using evidence-based mobile applications	Do not use evidence-based mobile applications	stress
Luangapichart et al., 2022	Thailand	90	Medical personnel	Using the online application 'Mindful Senses (MS)	Not using the online 'Mindful Senses (MS) Application'	stress
Nixon et al., 2021	Germany	404	Employee	Using web-based stress management (SMI)	Not using web-based stress management (SMI)	stress
Taylor et al., 2022	England	2182	Health personnel	Using the Headspace MBSH digital application	Not using the Headspace MBSH digital App	stress

Table 2. is a description of the primary studies included in the meta-analysis, there are 8 articles with a Randomized Controlled Trial study design that meet the requirements to be made into systematic studies and meta-analyses related to the effectiveness of mobile-based stress management applications against stress with various research locations namely Germany, Spain, Switzerland, England, America, Thailand. There are similarities in the primary research, namely the research design using the Randomized Controlled Trial, the research subjects are workers, the intervention provided is in the form of using a mobile-based stress management application with the comparison being not using a mobile-based stress management application. However, there are differences in the number of samples, namely the smallest is 90 and the largest sample is 2182. The period of publication of articles is from 2012 to 2022. The size of the relationship used in the meta-analysis research on the effectiveness of mobile-based stress management applications on stress against workers are the Mean and Standard Deviation (see table 3).

Table 3. Mean SD of the primary studies included in the primary study meta-analysis of the Randomized Controlled Trial

Author (Year)	Intervention			Control		
	N	Mean	SD	N	Mean	SD
Ebert et al., (2016)	132	17.05	5.81	132	22.24	6.46
Fiol-DeRoque et al., (2021)	248	31	12,5	234	36	15.4
Heber et al., (2016)	132	16,25	6.35	132	22.10	5.81
Huberty et al., (2022)	584	7.65	4.08	443	8.01	4.29
Lacour et al., (2021)	73	39.0	8.4	76	49.8	13.2
Luangapichart et al., (2022)	45	5.00	2.51	42	5.07	2.58
Nixon et al., (2021)	134	17.54	6.31	135	22.95	6.43
Taylor et al.,(2022)	452	12.39	7.85	283	14.47	8.11

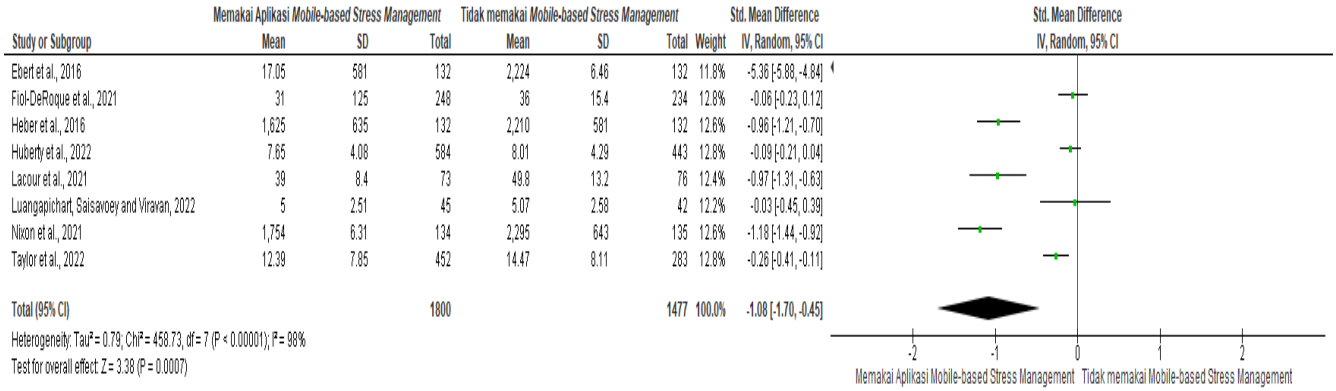

Figure 3. Forest plot of stress-based mobile application effectiveness management of stress on workers

The forest plot in Figure 3 shows the effect of using a mobile-based stress management application on worker stress, and is statistically significant. Workers using the mobile-based stress management application had 1.08 units lower stress than not using the mobile-based stress management application (SMD = -1.08; 95% CI = -1.70 to -0.45; p <

0.007). The forest plot also uses large heterogeneity of effect estimates between studies (I^2 = 98 %; p < 0.001) so that the average effect estimation calculation is carried out using a random effect model approach.

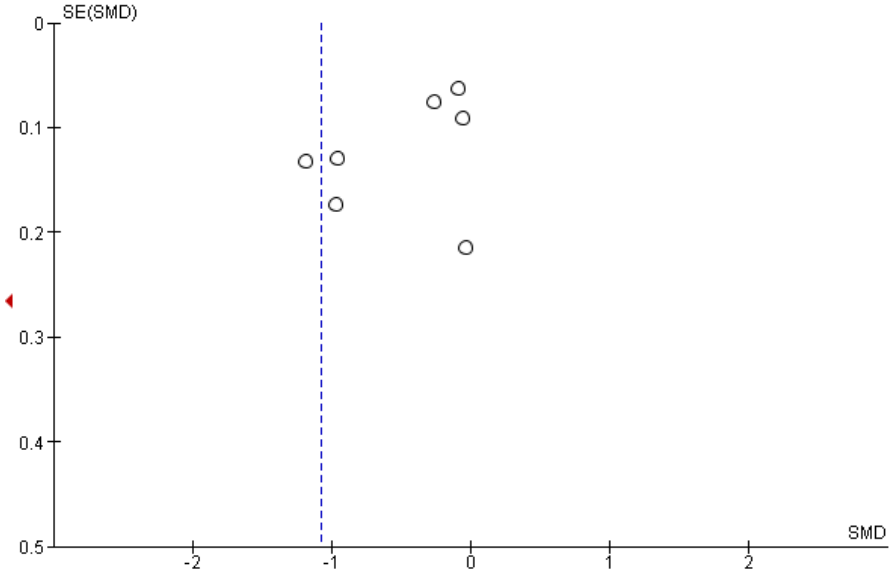

Figure 4. Funnel plot of stress-based mobile application effectiveness management of stress on workers

Based on the funnel plot in Figure 4, it shows that the distribution of effect estimates is not symmetrical to the right and left of the average vertical line of estimation, thus indicating publication bias. Because the distribution of these effect estimates is more on the right side opposite to the location of the diamond shape which is located to the left of the vertical line of the null hypothesis, the publication bias indicates that the effect estimates tend to be smaller than they really are (underestimate).

Table 4. Description of the primary studies included in the primary study meta-analysis of the Randomized Controlled Trial (N=3,983)

Author (year)	Country	Sample	P	I	C	O
Comtois et al., (2022)	The US	1356	Employee	Using an attention control app.	Without attention control applications	depression
Hsieh et al., (2020)	Taiwan	159	Nurse	Using smartphone-delivered BT (SDBT)	Without smartphone-delivered BT (SDBT)	depression
Huberty et al., (2022)	The US	1029	Employee	Using a mindfulness app—Calm	Without a mindfulness app—Calm	depression
Hwang and Jo, 2019	South Korea	56	Nurse	Using the mobile app	Without the mobile ap	depression
Imamura et al., (2021)	Vietnam	951	Nurse	Using smartphone-based iCBT stress management	Without smartphone-based iCBT stress management	depression
Luangapichart et al., (2022)	Thailand	90	Medical personnel	Using online MBI and mindfulness apps	Without online MBI and mindfulness apps	depression
Ponzo et al., (2020)	The UK	262	Employee	Using the mobile app (BioBase)	Without the mobile ap (BioBase)	depression
Wilhelm et al., (2022)	The US	80	Coach	Using app-based cognitive behavioral therapy (CBT).	Without app-based cognitive behavioral therapy (CBT).	depression

Table 4. is a description of the primary studies included in the meta-analysis, there are 8 articles with a Randomized Controlled Trial study design that meet the requirements to be used as a systematic study and meta-analysis related to the effectiveness of mobile-based stress management applications for depression with various research locations, namely the countries of Taiwan, Korea, Switzerland, Vietnam, America, Thailand. There are similarities in the primary research, namely the research design using the Randomized Controlled Trial, the research subjects are workers, the intervention provided is in the form of using a mobile-based stress management application with the comparison of not using an application mobile-based stress management. However, there are differences in the number of samples, namely the smallest is 56 and the largest sample is 1356. The period of publication of articles is from 2012 to 2022. The size of the relationship used in the meta-analysis research on the effectiveness of mobile-based stress management applications on stress against workers are the Mean and Standard Deviation (see table 5).

Table 5. Mean SD of the primary studies included in the primary study meta-analysis of the Randomized Controlled Trial

Author (Year)	Intervention			Control		
	N	Mean	SD	N	Mean	SD
Comtois et al., (2022)	152	7.1	3.9	168	7.0	3.8
Hsieh et al.,(2020)	47	8.13	6.33	39	12.29	6.95
Huberty et al., (2022)	583	5.96	4.93	443	6.47	5.12
Hwang and Jo, (2019)	26	7.11	4.49	30	7.53	6.14
Imamura et al., (2021)	288	4.5	5.2	288	4.7	6.3
Luangapichart et al., (2022)	45	5.00	3.40	42	5.05	3.48
Ponzo et al., (2020)	59	8.71	4.45	64	9.85	5.38
Wilhelm et al., (2022)	28	7.1	4.5	36	10.3	4.2

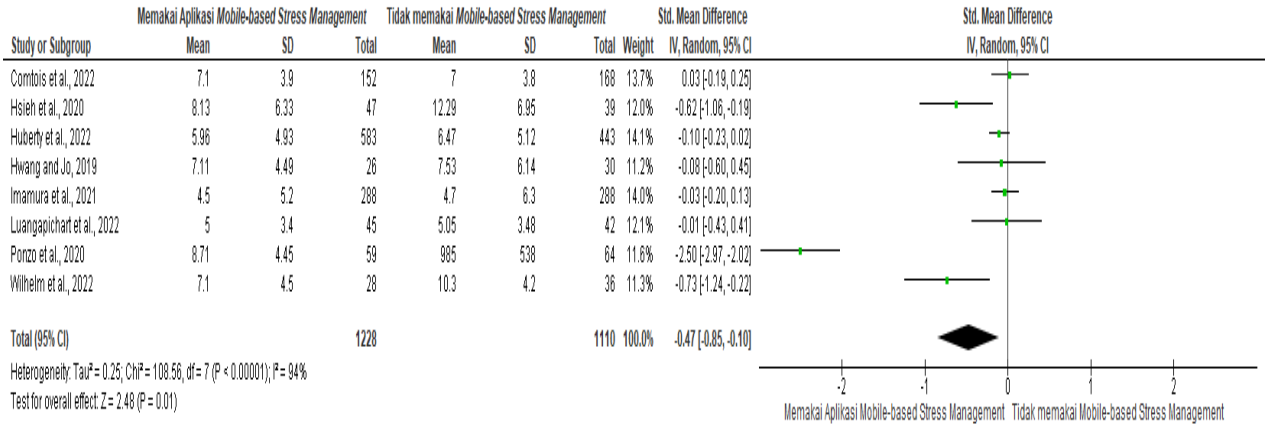

Figure 5. Forest plot of stress-based mobile application effectiveness management of depression in workers

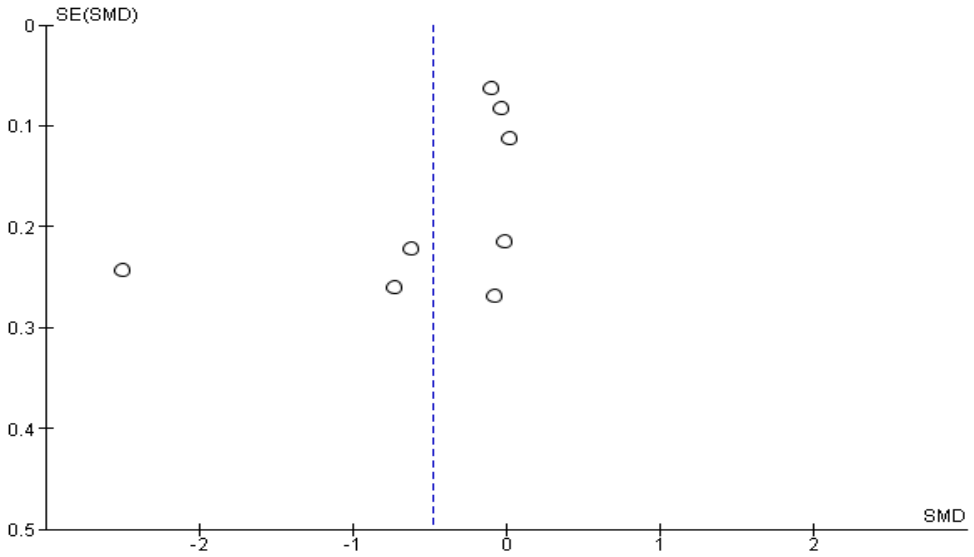

Figure 6. Funnel plot of stress-based mobile application effectiveness management of depression in workers

The forest plot in Figure 5 shows the effect of using a mobile-based stress management application on depression in workers, and is statistically significant. Workers who use the mobile-based stress management application have depression 0.47 units lower than those who do not use the mobile-based stress management application (SMD= -0.47; 95 % CI= -0.85 to -0.10; p=0.01). The forest plot also uses large heterogeneity of effect estimates between studies (I^2= 94%; p<0.001) so that the average effect estimation calculation is carried out using a random effect model approach.

The funnel plot presented in Figure 6 shows an asymmetric distribution of effect estimates to the right and left of the average vertical line of estimation, thus indicating publication bias. Because the distribution of these effect estimates is more on the right side as opposed to the location of the diamond shape which is located to the left of the vertical line of the null hypothesis, the publication bias indicates that the effect estimates tend to be smaller than the actual (underestimated).

DISCUSSION

This systematic study and meta-analysis research raises the effectiveness of mobile-based stress management applications on stress and depression in workers. This research is considered important because interventions using mobile-based stress management applications can reduce stress and depression in workers with negative consequences related to work-related stress and guided and directed stress management interventions so that they can reduce stress and depression in workers.

The effectiveness of mobile-based stress management applications on stress in workers

The results of the meta-analysis of 8 articles show the effect of using mobile-based stress management applications on stress in workers, and is statistically significant. Workers using the mobile-based stress management application had 1.08 units lower stress than not using the mobile-based stress management application (SMD= -1.08; 95% CI= -1.70 to -0.45; p<0.007). The forest plot also uses large heterogeneity of effect estimates between studies (I^2= 98 %; p<0.001) so that the average effect estimation calculation is

carried out using a random effect model approach. The funnel plot shows that the distribution of effect estimates is asymmetrical to the right and left of the average vertical line of estimation, thus indicating publication bias. Because the distribution of these effect estimates is more on the right side opposite to the location of the diamond shape which is located to the left of the vertical line of the null hypothesis, the publication bias indicates that the effect estimates tend to be smaller than they really are (underestimate).

Taylor et al., (2022) the effectiveness of the digital MBSH (Headspace) application in reducing stress for health workers, a study followed by health workers in England. Undirected digital MBSH interventions (Headspace) can reduce stress for health workers.

The effectiveness of mobile-based stress management applications on depression in workers

The results of the participant meta-analysis of 8 articles show the effect of using mobile-based stress management applications on depression in workers, and is statistically significant. Workers using the mobile-based stress management application had depression 0.47 units lower than those not using the mobile-based stress management application (SMD= -0.47; 95% CI= -0.85 to -0.10; p=0.01). The forest plot also uses large heterogeneity of effect estimates between studies (I^2= 94 %; p<0.001) so that the average effect estimation calculation is carried out using a random effect model approach.

The funnel plot shows that the distribution of effect estimates is asymmetrical to the right and left of the average vertical line of estimation, thus indicating publication bias. Because the distribution of these effect estimates is more on the right side as opposed to the location of the diamond shape which is located to the left of the vertical line of the null hypothesis, the publication bias indicates that the effect estimates tend to be smaller than the actual (underestimated).

Hsieh et al., (2020) which stated that BT and SDBT applications can improve depressive symptoms, resilience and SDBT can also reduce work stress.

The results of the study on the stress variable show the effectiveness of mobile-based stress management applications in reducing stress and these results are statistically significant. The depression variable also shows the effectiveness of mobile-based stress management applications in reducing depression and these results are statistically significant. This is because the mobile based stress management application reduces stress and depression, so that it can improve the work performance of workers and companies or workplaces.

This meta-analysis synthesizes 8 randomized controlled trial studies originating from Germany, Spain, Switzerland, England, America and Thailand. Sample size= 4,865 workers. This meta-analysis shows the effect of using a mobile-based stress management application on stress in workers, and is statistically significant. Workers using the mobile-based stress management application had 1.08 units lower stress than not using the mobile-based stress management application (SMD= -1.08; 95% CI= -1.70 to -0.45; p<0.007). The forest plot also uses large heterogeneity of effect estimates between studies (I^2= 98 %; p<0.001) so that the average effect estimation calculation is carried out using a random effect model approach. The funnel plot shows that the distribution of effect estimates is asymmetrical to the right and left of the average vertical line of estimation, thus indicating publication bias.

This meta-analysis synthesizes 8 randomized controlled trial studies originating from Taiwan, Korea, Switzerland, Vietnam, America, Thailand. Sample size= 3,983

workers. This meta-analysis concludes that the effect of using mobile-based stress management applications on depression in workers is statistically significant. Workers using the mobile-based stress management application had depression 0.47 units lower than those not using the mobile-based stress management application (SMD= -0.47; 95% CI= -0.85 to -0.10; p=0.01). The forest plot also uses large heterogeneity of effect estimates between studies (I^2= 94 %; p<0.001) so that the average effect estimation calculation is carried out using a random effect model approach. The funnel plot shows an asymmetric distribution of effect estimates to the right and left of the average vertical line of estimation, thus indicating publication bias.

AUTHOR CONTRIBUTION

Niken Yuliani Untari is the main researcher who collected the data and analyzed the data. Meanwhile, Didik Gunawan Tamtomo and Hanung Prasetya provided instructions on data analysis and preparation of publication manuscripts.

CONFLICT OF INTEREST

There was no conflict of interest in the study.

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