

App yourself: a meta-analysis on the effectiveness of well-being mobile apps on employee well-being and mental health

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Abstract

Mental health of employees became a pressing managerial concern for employers looking to increase performance and retention of employees. Mobile apps can provide a convenient solution of easily available, adaptable, and employee-driven tools to address employees' mental health issues. This paper investigates the effects of the potential of a mobile-based intervention on mental health at work. Specifically, we conduct a meta-analysis of the effectiveness of mobile apps provided to employees according to their level of stress, anxiety, depression, and overall well-being, comparing mind and physical dimensions. We explore these effects for employees of different hierarchical levels. Our results show that mobile apps do reduce stress, especially mind-oriented ones, and increase overall well-being. The effectiveness of the mobile apps depends on the level of the employees with stress being reduced more among top tier and well-being being increased more among low tier. Companies should provide mobile solutions to support the mental health of their employees: we provide suggestions on how to choose and adopt the mobile solution to the organizational context.

Keywords: Anxiety, Depression, Mental health, Meta-analysis, Mobile app, Stress, Well-being.

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Introduction and theoretical background

In recent years, individual well-being at work has become a topic of attention (Clifton & Harter, 2021) and since the Covid-19 pandemic (McFadden et al., 2021; Pink et al., 2021) and big shift toward remote working (Charalampous et al., 2019), it is the pinnacle of organizational, societal, and individual goals. Indeed, work has a significant impact on individual physical and psychological health: research as well as organizational practices are called to address the new changes in working conditions and prioritize employee well-being (Pagàn-Castaño et al., 2020; Sorensen et al., 2021). Investing in employee mental health is beneficial for employees, organizations, and society (Ochoa & Blanch, 2018). Thus, beyond personal (e.g., better health Colenberg et al., 2021) and societal (e.g., Galderisi et al., 2015) advantages, there are clear reasons for organizations to target better employee well-being, since it is related to a better performance (Warr & Nielsen, 2018), alliance with corporate values and goals (Schwartz & Sortheix, 2018), higher employee engagement, productivity, creativity and lower turn-over (Matthews et al., 2022; Morrow & Brough, 2019; Dolan et al. 2008; Huppert 2009b; Lyubomirsky et al. 2005). In this study we define employee mental health and well-being as the psychological states of currently employed individuals and investigate the effectiveness of mobile apps provided and incentivized by the employers.

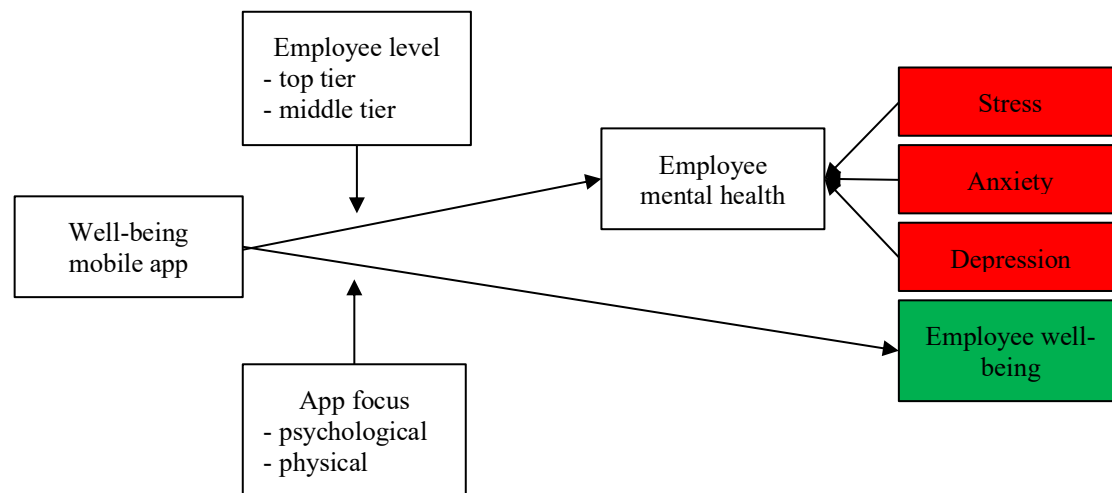
In psychological research, well-being is a theoretical concept that refers to an individual's state of psychological equilibrium (Rodman & Fry, 2009). It is agreed that well-being is a state of positive feelings and functioning well in life (Keyes, 2005) in which the individual realizes his or her own abilities, copes with the normal stresses of life, works productively and fruitfully, and is able to make a contribution to his or her community (WHO, 2004; p. 4). Subjective well-being is commonly used to operationalize general well-being (Diener, 2013) and can be measured as affective (i.e., happiness Schueller & Parks, 2014) and cognitive (i.e., life satisfaction Burns, 2016). Well-being is considered as a multidimensional construct that goes beyond the absence of mental illness or negative states (Keyes, 2002, Keyes, 2007). Indeed, studies show that mental well-being and mental illness represent two different dimensions as they are moderately interrelated (Keyes, 2005, Weich et al., 2011). Therefore, in this study we relate to the operationalized measures of well-being, such as satisfaction with life and general affective state.

Beyond the well-being, dimensions of employee mental health should be considered (Warr, 1990), namely stress, anxiety, and depression tendencies. These states can be mild and thus represent a dimension of overall subjective well-being (i.e., depressed and gloomy vs. relaxed and calm), while they could also be diagnosed as clinical states of mental illness (Fox, 1999). The dimensions of anxiety, depression, and stress (e.g., DASS, cf. Vignola & Tucci, 2014) are often measured together. Thus, the disorder of affect is measured on a continuum between stress (i.e., initial state of alertness, fatigue, and worry), anxiety as a set of general distress (i.e., irritability, agitation, tension, hyperstimulation, and frustration), and depression as low levels of positive affect (i.e., feelings of hopelessness, lack of energy and self-esteem). Therefore, the three conditions have common physiological and emotional features at different levels of intensity (Mello et al., 2007).

Since the realization of the paramount importance of well-being, large corporations¹ and small businesses started to include well-being in strategic plans and practical programs (Sorensen et al., 2018). Previous studies have shown that focused workplace interventions on employee well-being can be effective (Melnyk et al., 2020). While these interventions can take shape of seminars, therapy, and workplace meditations, the increased pace of work rhythm, working-from-home (Charalampous et al., 2019), and the need of independent control and accountability (De Moya & Pallud, 2020) bring forward the need of a well-being-focused resource that can be accessed at any time and in any place and can be under control of each employee. This is now possible due to the increasing offer of well-being mobile apps. Thus, by 2022 there are more than 20,000 well-being apps available, and the market is expected to grow even more². And indeed, some studies show that giving access to such apps can increase employee well-being (Bostock et al., 2019), decrease depression (Mascara et al., 2020), and work-related fatigue (van Drongelen et al., 2014). However, the studies are controversial, as some do not find any significant effect (Thøgersen-Ntoumani et al., 2020; Mascaro et al., 2020). Furthermore, it is unclear whether physical (Haufe et al. 2019; Thøgersen-Ntoumani et al., 2020) or psychological (Mascaro et al., 2020; Schulte-Frankenfeld et al. 2021) activities impact on employee well-being to the same extent and whether employees at all levels can benefit from such apps in a similar way.

To tackle these research lacunae, we carried out a meta-analysis of the effect of well-being mobile apps on the employee well-being and mental health. We test the conceptual model as depicted on Figure 1. We analyze separately the effect of a continuous use of a destined app on stress, anxiety, depression (i.e., mental health), and global well-being. We expect that well-being mobile apps increase employee well-being and decrease the propensity of negative states of mental health.

Figure 1. Conceptual model



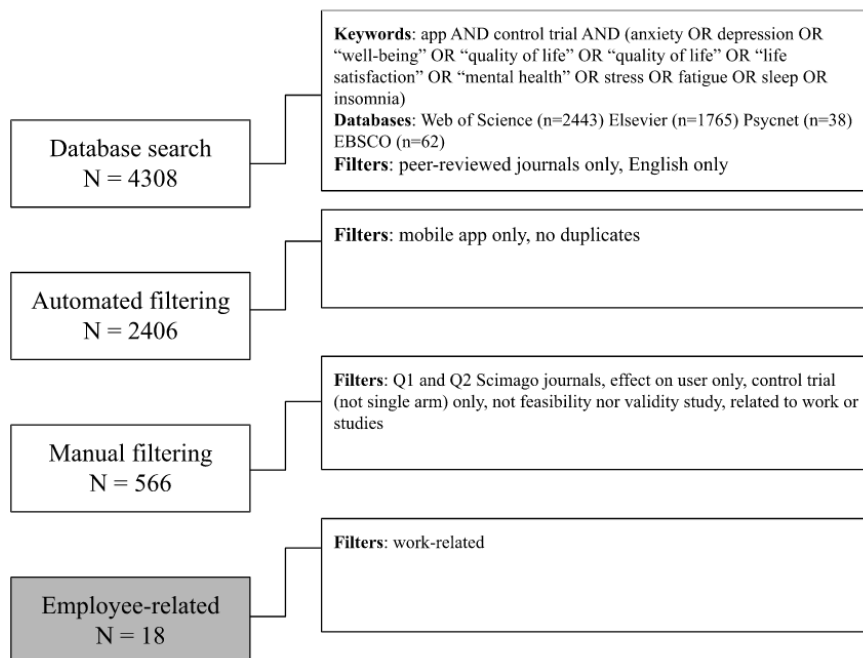
¹ <https://www.forbes.com/sites/tracybrower/2021/03/14/wellness-and-the-future-of-work-some-of-the-best-companies-share-their-new-solutions/>

² <https://www2.deloitte.com/xe/en/insights/industry/technology/technology-media-and-telecom-predictions/2022/mental-health-app-market.html>

Method

This meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al. 2009) and the Cochrane recommendations for the reduction of subjectivity biases and data extraction errors (Higgins et al. 2011). Four databases were used to access the relevant studies: PsycNet, Elsevier, EBSCO, and Web of Science. For the main keywords we used all the terms that can cover mobile applications and that include one of the physical and emotional states that can be related to well-being. The inclusion criteria on the databases related to the language of the studies (i.e., English) and type of publication (i.e., peer-reviewed journals). As mobile apps are a recent phenomenon, we do not limit the research to any timeline. The initial search resulted in N=4308 papers. We filtered out all duplicates and papers not focused on mobile apps, which resulted in the sample of N=2406. The automatic filtering allowed to restrict the studies to papers published in journals ranked Q1 to Q2 on SCIMAGO in order to prevent publication biases (Van Aert et al., 2019). Further manual filtering based on abstracts and full-papers when necessary focused on identification of studies that are directly related to the conceptual framework in terms of (1) users (actual users versus caregivers or parents), (2) device used (smartphone vs. web app or physical intervention), (3) method (randomized trial vs. feasibility studies or protocol), (4) presence of control group, and (5) evaluating one of the studied outcomes. This filtering allowed us to reduce the sample to N=566. Finally, only N=18 studies related to work-related use of well-being mobile apps. We chose to focus on the particular cases where companies introduced and incentivized the use of well-being apps to evaluate the managerial implications of providing such apps to employees. First of all, job stress is different from general life stress (O'Connor et al., 2021) and independent use of well-being mobile apps might be not related with mental health and well-being at work. Second, there is sufficient evidence that employee well-being when managed by human resources leads to a better performance (Peccei & Van de Voorde, 2019) and hence it is more important to identify how company induced well-being solutions work.

Figure 2. Structured literature review procedure



The meta-analytic analyses were conducted with Stata version 14. With regard to the diversity in mobile applications (i.e., intervention) and respondents (i.e., the population), we expected a high level of heterogeneity and, therefore, opted for the random effects model (Hedges & Vevea, 1998). As we have a limited number of available studies, we decided to include all studies with corresponding dependent variables, without excluding the outliers.

Results

Characteristics of included studies

The final sample includes 18 studies published from 2014 to 2022. We note that half of the studies are carried out in Europe (9/18), followed by Australia (4/18), and USA (3/18). Most of the interventions addressed psychographic issues, such as work-related fatigue, stress, and mind depression. However, such health issues as bad quality of sleep, sedentary lifestyle, low metabolism, and chronic pain were also stated as motivations for implementing a well-being mobile app. The vast majority of the apps were oriented on mind (13/18) proposing meditation, advice for better sleep and stress reduction, breathing and mindfulness exercises. Fourteen studies focused on employees of middle tier. The measures of mobile apps effectiveness greatly differ among the studies. However, the most common measures are depression, anxiety, and stress scale (DASS-21), quality of life (QoL and SF-36) and well-being (WHO-5 and Warwick-Edinburgh Mental Well-being Scale). Most interventions lasted 1-2 months and we have included the instant effect of the mobile app after the main intervention to allow the maximum response quantity and quality. The overall sample consists of N=2207 for the effect on stress, N=1211 for the effect on anxiety, N=1500 for the effect on depression, and N=2439 for the effect on well-being. The characteristics of the selected papers are presented in Appendix A.

Meta-analyses results

We find that the well-being apps at workplace resulted in significantly reduced levels of stress in the immediate comparison with the control condition of no app use ($g = -0.250$, CI 95% [-0.388; -0.113]; $z = -3.565$, $P < .001$). The effect size was significantly and moderately heterogeneous ($Q = 21.09$, $p < .050$, $I^2 = 52.6\%$). The subgroup analyses showed that for stress the psychological vs. physical focus did not result in significant differences ($Q = 1.67$ (df1), $p = 0.196$), indicating that for the stress outcome, app focus was not a source of heterogeneity. Yet, the middle and top tier employee levels were impacted in a significantly different way ($Q = 12.11$ (df1), $p = 0.000$), indicating that employee level is a potential source of heterogeneity and a viable moderator for the stress outcome. Furthermore, the level of heterogeneity of effect size among the middle tier ($Q = 7.28$, $p > .050$; $I^2 = 3.9\%$) and the top tier ($Q = 1.11$, $p > .050$; $I^2 = 0\%$) is low and insignificant. In contrast to the stress outcome, wellbeing apps were not effective in reducing participants' anxiety and depression. The results are insignificant both for apps focusing on psychological and on physical activities and there is no significant difference based on the app activity (anxiety: $Q = 0.02$ (df1), $p = 0.883$; depression: $Q = 0.14$ (df1), $p = 0.713$), indicating that for the anxiety and depression outcomes, app focus was not a source of heterogeneity. At the same time, overall well-being was increased immediately after the use of a wellbeing app ($g = 0.394$, CI 95% [0.100; 0.687]; $z = 2.630$, $P < .001$). Yet, the size effect was highly and significantly heterogeneous ($Q = 99.53$, $p < .001$, $I^2 = 91\%$). For well-being the apps focusing on mind and on sport are significantly different ($Q = 15.90$ (df2), $p = 0.000$), indicating that app focus could be a potential source of heterogeneity. While for the two sport apps included in the analyses the heterogeneity is

low and insignificant ($Q = 0.77$, $p > .050$, $I^2 = 0\%$), the effect size for psychological apps is highly and significantly heterogeneous ($Q = 70$, $p < .001$, $I^2 = 93\%$). The subgroups of top and middle tier employees do not differ from each other ($Q=1.19$ $p=0.275$), indicating that for the well-being outcome, employee level was not a source of heterogeneity.

Discussion

Theoretical implications

We find that overall wellbeing apps help to reduce stress and have a positive effect on overall wellbeing. The absence of immediate impact on anxiety and depression might stem from the fact that both these conditions are more permanent and necessitate more than a few months of app guided activities. Indeed, perceived stress refers to the ability to respond to stressors, whereas anxiety and depression refer to the health risks associated with prolonged or unrelieved severe stress (Kessler et al., 2015). However, mobile apps can be helpful in relieving momentary stress and in boosting positive emotions that could be reflected in overall well-being evaluations. We find that both app orientation (for well-being) and employee level (for stress) could be potential moderators of app effect.

Managerial implications

Providing mental-health apps to the employees represent an effective and easily accessible tool for employers and employees to improve well-being at work and reduce stress. However, deeper psychological disorders such as anxiety and depression need to be treated with a more developed approach and require follow-up by specialists. Furthermore, the effects of apps also depend on employee engagement (Bartlett et al., 2022). For this reason, it may be advisable to guide the introduction of the application with an approach that better engages employees, such as seminars or group therapy. However, applications should not replace a good organizational strategy and an adapted lifestyle. Finally, more apps should combine both sports and meditation-oriented activities. For instance, Calm app is focused on meditations, but has one section of calming through exercise (mild stretching); on the other hand, sport-oriented apps, even yoga ones, are not very focused on meditation (within one app), so an appropriate solution might be to focus on both dimensions with the same rigor.

Limitations and future research

Apart from confirming the general utility and potential of mobile apps to improve individual employee well-being, this study identifies directions for further research. Thus, further studies should focus on long-term effects of using health and well-being apps beyond (e.g., one year and more). Second, further research should consider an indirect effect of health mobile apps on long-term conditions, such as depression, anxiety, and overall well-being through mediation by stress, mood, and mindfulness. Furthermore, few studies combine psychological and physiological activities, yet the app focus is complementary. Moreover, other moderators could be considered: socio-demographics, such as age, technology savviness, time available to use the app, and type of the industry (many studies were run during the pandemic among the most stressed employees in health sector and education). Finally, factors, such as the usability, quality (Zhang et al., 2017) of the application and the regularity of use of the applications by the employees can be considered in the effectiveness of well-being apps.

Appendices

Appendix A: Characteristics of the selected papers

Study	Country	Targeted issue	Focus	Profession	Employee level	Type of app	App interventions	Dimension of well-being and mental health
Fiol-DeRoque et al. 2021	Spain	mental health during COVID-19 pandemic	psychological	healthcare	middle tier	PsyCovid App	app targeting emotional skills, healthy lifestyle behavior, burnout, and social support	Depression, anxiety, stress (DASS-21)
Coelhoso et al. 2019	Brazil	well-being and stress	psychological	healthcare	middle tier	No name	relaxation, breathing, meditation, and positive psychology principles	Depression, anxiety, stress (DASS-21)
Schulte-Frankenfeld et al. 2021*	Germany	perceived stress and self-regulation	psychological	students	top tier	No name	brief mindfulness meditation programme	Stress, life satisfaction, and self-regulation
Lee et al. 2017	South Korea	chronic neck pain and occupational disorder	physical	office	middle tier	No name	McKenzie method (biopsychosocial system of musculoskeletal care emphasizing patient empowerment and self-treatment)	Quality of life (SF-36) [WB]
Bartlett et al. 2022	Australia (Tasmania)	stress and mental health	psychological	office	middle tier	No name	lessons, activities & guided meditations	Quality of life (AQoL) [WB]; stress; distress [D]
Xu et al. 2021	Australia	work stress	psychological	healthcare	top tier	No name	mindfulness practice	Stress (PSS), wellness (WEMWBS) [WB]
van Drongelen et al. 2014	Netherlands	sleep and fatigue	both	pilot	top tier	MORE energy	tailored advice on sleep, fatigue, physical activity, & nutrition / sport	Checklist individual strength [WB]
Thøgersen-Ntoumani et al. 2020	Australia	sedentary lifestyle	physical	office	middle tier	START	walking / sport	Anxiety, depression, well-being (WHO-5)
Haufe et al. 2019	Germany	metabolic syndrome	physical	factory	middle tier	No name	sport (lifestyle & exercise)	Anxiety severity, depression severity, quality of life (SF-36) [WB]

Stephenson et al. 2021	Northern Ireland	sedentary behavior	physical	office	middle tier	Worktivity	self-monitoring and feedback on sedentary time, prompts to break sedentary time, and educational facts	Stress, distress [D], quality of life (QoL) [WB]
van der Meer et al. 2020	Netherlands	PTSS	psychological	healthcare	middle tier	SUPPORT Coach	various CBT-based exercises to self-manage PTSS (e.g., progressive muscle relaxation, change cognitive perspective, and pleasant events with others)	Post-traumatic syndrome severity (PCL-5) [S]
Hirshberg et al. 2022	USA	well-being during COVID pandemic	psychological	school	top tier	Healthy Minds Program	mindfulness-based program	Psychological distress (stress-PSS, anxiety and depression-PROMIS) [S], well-being (WHO-5)
Weber et al. 2019	Germany, England, and Northern Ireland	stress and mental health	psychological		middle tier	Kelaa Mental Resilience	science-based health and wellbeing	General stress (COPSOQ); wellbeing (<i>WEMWBS</i>)
Rich et al. 2021	UK	stress and work outcomes	psychological	university	middle tier	No name	mindfulness-based program	Stress (DASS-21)
Mistretta et al. 2018	USA	stress	psychological	clinic	middle tier	No name	resiliency-based intervention	Depression, anxiety, stress (DASS-21); well-being (WHO-5)
Bostock et al. 2019	UK	stress and well-being	psychological	office	middle tier	Headspace app	guided audio meditations	Anxiety and depression symptoms (HADS); well-being (WEMWBS)
Deady et al. 2022*	Australia	depression	psychological	any	middle tier	HeadGear	behavioral activation and mindfulness intervention	Anxiety (GAD), well-being (WHO-5)
Mascaro et al. 2020	USA	well-being and performance	psychological	office	middle tier	Headspace	mindfulness-based program	Anxiety, stress, depression (DASS-21)
<p>* study not used due to the incomplete result presentation; [A] = anxiety, [D] = depression, [S] = stress, [WB] = well-being; DASS-21 = Depression Anxiety Stress Scales (Lovibond & Lovibond, 1995) , SF-36 = The Short Form Health Survey (Ware & Sherbourne, 1992), QoL = Quality of life (Richardson et al., 2014), WEMWBS = Warwick-Edinburgh Mental Well-being Scale (Tennant et al., 2007); WHO-5 = Well-Being Index (Topp et al., 2015) ; PSS= Perceived Stress Scale (Cohen et al., 1983). ; PROMIS = Patient-Reported Outcomes Measurement Information System ; Copenhagen Psychosocial Questionnaire – Revised Version (COPSOQ II; Pejtersen et al., 2010); HADS = Hospital Anxiety and Depression scale (Zigmond & Snaith, 1983)</p>								

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