A digital approach to workplace mental health: A randomized controlled trial examining the effectiveness of a smartphone-based personalized intervention

Meanne Chan[1], Charlie Lau[2], Sisi Li[3], Megan Lam[4]

[1]Wofoo Joseph Lee Consulting and Counselling Psychology Research Centre, Lingnan University
[2]Department of Rehabilitation Sciences, The Polytechnic University of Hong Kong
[3]School of Public Health, Shanghai Jiao Tong University
[4]Neurum Ltd.

Objective: This two-arm randomized controlled trial aimed to examine the effectiveness of a smartphone-based online platform which incorporates ecological momentary assessments and ecological momentary interventions with the use of machine learning to reduce psychological distress in working adults. Method: 205 working adults were recruited from a local company. Eligible participants were randomized into either the intervention (n = 106) or the waitlist control condition (n = 99). Participants received 4-week smartphone-based personalised psycho-education sessions and evidence-based exercises related to cognitive behavioural and mindfulness principles, driven by data about emotional state, mood, and feedback after each exercise. Reduction in symptoms of depression, anxiety, and stress, was examined as the primary outcome measure. Results: Significant time (before vs. after intervention) by group (intervention vs. control) interaction effect was found, $F (1, 175) = 56.67$, $p < .001$, $\eta^2 = .25$. Participants in the intervention group reported less depression, anxiety, and stress symptoms after the intervention ($M = 14.38$, $SD = 15.14$) than before the intervention ($M = 28.90$, $SD = 17.99$). The attrition rate was 86%. Conclusions: This smartphone-based intervention leveraging both ecological momentary assessments and ecological momentary interventions and employing machine learning was effective in reducing distress in working adults. Findings have informed the next phase of this digital health platform, which will optimize the intervention model via personalization, and contribute to the expanding field of digital mental health.

Keywords: Digital health; Workplace mental health; EMA; EMI; Personalization; Randomized controlled trial

Overview of workplace mental health

Working adults are particularly vulnerable to stress. Longitudinal analyses showed that work-related stress such as excessive workload, effort-reward imbalance and low work social support was associated with increased risk of depression and anxiety disorders (Melchior et al., 2007) and poor mental well-being (Law et al., 2020) in working adults.

The Need for An Alternative to Face-to-face Intervention

Despite the rising prevalence of mental health issues, the mental health service is underutilized (Lam et al., 2015), suggesting that there is an immense service gap in the existing mental health system which may not sufficiently support the needs of individuals with mental health difficulties. In face of the high prevalence of mental disorders and underutilization of mental health services, an online platform may provide an alternative to face to face therapy in enhancing mental health of individuals who are reluctant to seek help because of stigma or other reasons.

Mobile Health

Mobile health (mHealth) platforms, which refers to the use of mobile and wireless devices to improve healthcare (Adibi, 2015) and are general applications to assess naturalic variables. Some of the mHealth platforms also include intervention elements that leverage data collected via mHealth. However, intervention drawing from data collected via mHealth remains an emerging field such that there remains considerable opportunity to leverage more sophisticated aspects of personalization in the rise of consumer-friendly tools that enable individuals to track a wide range of variables including mood and activity (Dugas, Gao & Agarwal, 2020).

Ecological momentary assessment and ecological momentary intervention

Advancements, availability and affordability of mobile technology give rise to ecological momentary assessment (EMA) approach which allows individuals to report symptoms, experiences, behaviours and cognitions during their everyday lives (in real time) and in naturalistic settings (in real world) (Myin-Germeys et al., 2018). Similarly, ecological momentary intervention (EMI) refers to the delivery of intervention while individuals are engaged in their everyday lives (Heron & Smyth,

2010). Emerging evidence showed the effectiveness of EMI in alleviating anxiety and stress (Gee, Griffiths & Gulliver, 2016) and treating a variety of health behaviours and psychological symptoms (Heron & Smyth, 2010). However, while EMA and EMI share similar advantages over traditional assessment and treatment procedures (e.g. improved ecological validity and real-world generalizability), their implementations and utilizations have remained largely separate.

The Current Study

The current study aims to evaluate the effectiveness of a smartphone-based intervention (i.e. Clara) which leverages both EMA and EMI with the use of machine learning in reducing distress in working adults. It was hypothesized that the DASS-21 score will decrease significantly in the intervention group but not in the waitlist group.

Method

Participants. 205 full-time working adults were recruited from two local manufacturing companies. Inclusion criteria included individuals aged 18 years or above, ability to read and understand Chinese or English and consistent access to the Internet and a smartphone. Exclusion criteria included mental illness diagnosis history, currently receiving professional mental health services and current use of psychotropic medication.

Procedure. Eligible participants were randomized into either the intervention (n = 106) or the waitlist control condition (n = 99). During the 4-week study period, participants in the intervention group were invited to report 1) how they are feeling in general, 2) whether they are feeling any particular emotion such as happy, disappointed and worried and 3) the source of emotion such as family, work and friends every time they log in. Participants then received an exercise driven by data about emotional state, mood, and feedback after each exercise. Reduction in symptoms of depression, anxiety, and stress, was examined as the primary outcome measure.

Interventions. Clara consisted of more than 700 psycho-education sessions and evidence-based exercises related to cognitive behavioural and mindfulness principles.

Measure. 21-item Depression, Anxiety, and Stress Scale (DASS-21) was used. Participants rated the extent to which they experienced symptoms depicted in the items (e.g., "I found it hard to relax") on a 4-point scale (0 = Did not apply to me at all, 3 = Applied to me very much or most of the time).

Results

A two-way mixed ANOVA revealed a significant interaction effect between Time (before vs. after intervention) and Condition (intervention vs. control), $F(1, 175) = 56.67$, $p < .001$, $\eta 2 = .25$. Specifically, while participants in the intervention group reported less depression, anxiety, and stress symptoms after the intervention ($M = 14.38$, $SD = 15.14$) than before the intervention ($M = 28.90$, $SD = 17.99$), participants in the control group reported more symptoms after the intervention ($M = 23.65$, $SD = 16.86$) than before the intervention ($M = 20.33$, $SD = 16.28$). The attrition rate was 86%.

Discussion

This study examined the effectiveness of a smartphone application which incorporates EMA and EMI to reduce distress in working adults. Consistent with the hypothesis and emerging studies involving EMI, the results demonstrated that the smartphone application was effective in reducing distress in the intervention group, suggesting that the digital platform employed in the current study could support working adults in real time and in naturalistic settings. While only a passive control group was used, the waitlist control paradigm of most real-world RCTs was followed. Not only do the findings add to the expanding field of digital mental health by incorporating EMA and EMI and employing machine learning, patterns and trends from this study can inform future directions of personalized intervention platforms targeting psychosocial wellbeing in addition to physiology and health.

References

Adibi, S. (Ed.). (2015). Mobile health: a technology road map (Vol. 5). Springer.

Dugas, M., Gao, G. D., & Agarwal, R. (2020). Unpacking mHealth interventions: A systematic review of behavior change techniques used in randomized controlled trials assessing mHealth effectiveness. *Digital Health, 6*, 16. doi:10.1177/2055207620905411

Heron, K. E., & Smyth, J. M. (2010). Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. *British Journal of Health Psychology, 15*, 1-39. doi:10.1348/135910709x466063

Lam, L. C. W., Wong, C. S. M., Wang, M. J., Chan, W. C., Chen, E. Y. H., Ng, R. M. K., . . . Bebbington, P. (2015). Prevalence, psychosocial correlates and service utilization of depressive and anxiety disorders in Hong Kong: the Hong Kong Mental Morbidity Survey (HKMMS). *Social Psychiatry and Psychiatric Epidemiology, 50*(9), 1379-1388. doi:10.1007/s00127-015-1014-5

Law, P. C. F., Too, L. S., Butterworth, P., Witt, K., Reavley, N., & Milner, A. J. (2020). A systematic review on the effect of work-related stressors on mental health of young workers. *International Archives of Occupational and Environmental Health, 93*(5), 611-622. doi:10.1007/s00420-020-01516-7

Loo Gee, B., Griffiths, K. M., & Gulliver, A. (2016). Effectiveness of mobile technologies delivering Ecological Momentary Interventions for stress and anxiety: a systematic review. *Journal of the American Medical Informatics Association*, *23*(1), 221-229.

Melchior, M., Caspi, A., Milne, B. J., Danese, A., Poulton, R., & Moffitt, T. E. (2007). Work stress precipitates depression and anxiety in young, working women and men. *Psychological medicine*, *37*(8), 1119.

Myin-Germeys, I., Kasanova, Z., Vaessen, T., Vachon, H., Kirtley, O., Viechtbauer, W., & Reininghaus, U. (2018). Experience sampling methodology in mental health research: new insights and technical developments. *World Psychiatry, 17*(2), 123-132. doi:10.1002/wps.20513