

**Understanding Individual Predictors of Intervention Effectiveness in Improving
Well-being Among Distressed Individuals: A Study of Ecological Momentary Interventions**

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Abstract

Background Mental illness affects over 970 million people worldwide. Ecological Momentary Interventions (EMIs) offer a possibility for personalized healthcare. The study aimed to investigate the role of stress and symptom severity in the efficacy of EMIs on well-being.

Method Through convenience sampling, mainly university students were recruited. For 16 days, participants received EMIs based on Cognitive Behavioral Therapy, Acceptance and Commitment Therapy, and Positive Psychology. Measures were collected pre-intervention using the Psychological Distress Scale (K-10), while pre- and post-intervention measures using the Brief Symptom Inventory (BSI) and Mental Health Continuum - Short Form (MHC-SF). Data analysis included paired t-tests, regression analysis, and moderation analysis.

Results The final sample ($N = 51$, $M_{age} = 22.49$, 61.5% female) revealed significant improvement in well-being scores ($p = .025$), a significant decrease in the general symptom severity ($p = .002$), and an increase in symptom count ($p = .003$). No significant relationship was found between pre-intervention distress and changes in well-being, but the symptom-specific distress moderated this relationship ($p = .042$).

Conclusion EMIs from this study improve well-being and symptom severity. Higher symptom-specific distress was associated with greater improvements in well-being. These individual stressors and differences should be considered in future intervention design. Personalization of these differences can enhance the effectiveness of such interventions, especially when paired with traditional mental health care. However, the necessity to include a control group becomes evident.

Introduction

Well-being, characterized by health, happiness, and success, is an important variable of mental health. It includes positive feelings and positive functioning and consequently, influences the quality of life, social relationships, employment, and daily functioning (Ryff & Keyes, 1995; WHO, 2022b). Well-being is especially important to consider in mental health research, as higher levels may prevent mental illnesses, that affect over 970 million people worldwide. Approximately, 280 million people suffer from depression, while over 260 million have anxiety (WHO, 2022a) and if not treated accordingly, such mental illnesses can even lead to physical health issues. For example, studies showed that individuals with depression have an 80% increased risk of developing cardiovascular disease and a 58% higher prevalence of metabolic diseases (Aarons et al., 2008; Cuddah et al., 2016; Penninx & Lange, 2018). Therefore, understanding the variables that influence one's sense of well-being is important to prevent mental illness and improve mental health outcomes.

Impact of Stress on Well-being

One of the factors influencing well-being and mental health outcomes is stress (WHO, 2022b). It is the body's response to demands or challenges, interfering with life's balance by physical, mental, or emotional tension (Rehman, 2015). Furthermore, high levels of psychological distress significantly contribute to negative health outcomes, as they negatively impact well-being (Morley, 2014). This negative impact on well-being not only adds to an increased risk of physical health issues but also leads to adverse health behaviors, including smoking, substance abuse, and physical inactivity (Leary et al., 2021).

Considering these negative impacts on health and well-being, effective early intervention seems necessary to reduce distress, improve well-being, and prevent mental health problems

from developing. However, there are several important factors to consider when developing effective interventions to improve well-being. One of those factors is high initial stress levels, which may negatively impact the efficacy of such interventions by affecting coping responses and social support (Goode et al., 1998). Furthermore, Kulmala et al. (2013) found particularly chronic stress to have a negative impact on the efficacy of later interventions, emphasizing the importance of early interventions, to prevent a consistent and chronic level of stress. Thus, it becomes evident that initial stress levels have to be treated with caution in intervention design aimed at improving well-being.

The Role of Symptom Severity

Another important factor to consider alongside stress is the individual's severity of symptoms from disorders and their effect on the sense of well-being (Connell et al., 2014). Symptom severity is an important factor in mental health research as it reflects the positive and negative aspects of life and was found to often result in reduced well-being (Connell et al., 2014). Moreover, initial levels of symptom severity can even influence intervention outcomes, when targeting well-being improvement. For instance, higher levels of symptom severity may result in differing intervention outcomes, potentially leading to varying gains in well-being after an intervention (Hansell et al., 2022; Weijers et al., 2020).

Furthermore, the study by Weijers et al. (2020) revealed a negative correlation between well-being and symptom severity, with higher levels of symptom severity being associated with lower levels of well-being. This further highlights the importance of symptom severity, when considering well-being change. However, several studies suggest a similar effect of symptom severity on stress. For instance, Knowles et al. (2016) found a direct association of symptom severity with stress in patients with irritable bowel syndrome, where more severe symptoms

resulted in lower psychological well-being. Additionally, a link between higher levels of gastrointestinal symptom severity and higher perceived stress was found, which in turn also affects overall well-being (Roy et al., 2020). These studies highlight the influence of symptom severity on stress levels, opening more questions about its relation to well-being.

The connection between stress and well-being, the correlation of symptom severity and well-being, as well as the influence of symptom severity on stress, suggest a potential influence of symptom severity on the relationship between initial stress and well-being (Goode et al., 1998; Knowles et al., 2016; Kulmala et al., 2013; Roy et al., 2020; Weijers et al., 2020). This suggestion is further supported, as higher symptom severity may lead to higher stress responses and fewer coping resources, according to the stress and coping theory (Lazarus & Folkman, 1984, pp. 19-31, 141-154, 235-253). Thus, further insight into the connection between these factors is crucial to improve mental health outcomes and to design effective interventions. To investigate the relationship between individual mental health factors such as mental well-being, symptom severity, and level of stress, Ecological Momentary Interventions (EMI) can be utilized as they are considered an effective tool in personalized treatment (e.g. Balaskas et al., 2021; Marciniak et al., 2020).

Ecological Momentary Interventions

Due to their proven effectiveness, improving well-being in an individual's daily life can be effectively achieved by EMIs. They involve implementing interventions at various time points throughout the day, in the context of the individual's activities and are commonly delivered through mobile technology, particularly smartphone apps (Balaskas et al., 2021). These smartphone-delivered interventions provide a useful addition to traditional mental health care, due to their wide availability and adaptability, as well as their potential in reducing distress

(Reininghaus et al., 2023). Moreover, a significant effect was found of EMIs on mental health outcomes, such as anxiety, depression, and perceived stress, with a stronger effect when additional support from a mental health professional was provided (Versluis et al., 2016).

Targeting distress and other components of mental health care to improve mental well-being through EMIs, may be achieved best by implementing therapeutic practices into these interventions, that are already proven to be effective (Schueller et al., 2017). Cognitive Behavioral Therapy (CBT), Acceptance and Commitment Therapy (ACT), and Positive Psychology (PP) are three such approaches, that provide supporting evidence of their effectiveness in improving mental health outcomes (e.g Carr et al., 2023; Marciniak et al., 2020; Myin-Germeyes et al., 2022).

EMIs and CBT

CBT is one of the most used therapeutic approaches. It aims to develop effective coping and emotional regulation strategies, by identifying and challenging negative thought patterns and behaviors. Thus, CBT can effectively deal with stress by providing support in the management of stress symptoms, and by addressing the negative thought patterns and behaviors (Boyle et al., 2010; Leary et al., 2021). By designing the EMIs based on CBT practices, mental health can effectively be improved by increasing mental well-being and reducing the severity of symptoms experienced (Marciniak et al., 2020). Furthermore, a study showed that a smartphone-based CBT intervention, which works in similar ways to an EMI, effectively decreased perceived stress and increased various domains in quality of life (Hwang et al., 2021), providing further support for utilizing CBT-based EMIs.

EMIs and ACT

Similar to CBT, ACT is a behavioral and cognitive form of therapy. However, its focus lies on increasing psychological flexibility through mindfulness, acceptance, and value-driven behavior change (Arnold et al., 2022). Generally, ACT interventions have shown positive outcomes, including increased acceptance, engagement in value-driven behavior, improved cognitive flexibility, and reduced psychological distress (AdiLoğlu & Kurtuluş, 2023). In the context of EMIs, a study investigated the effect of an ACT-based EMI on patients being highly at risk of developing psychosis. Paired with classical face-to-face therapy, the study resulted in a general decrease in distress associated with psychotic experiences and lowered the severity of symptoms, supporting the implementation of ACT practices in EMIs (Myin-Germeyes et al., 2022).

EMIs and PP

Positive Psychology, and interventions based on it, aim to enhance well-being by promoting joy, engagement in valuable activities, building positive connections, finding meaning, and achieving goals by integrating processes, such as mindfulness gratitude, and hope (Ciarrochi et al., 2022). A mega-analysis of meta-analyses found a significant effect of PP-based interventions on well-being, quality of life, depression, anxiety, and stress (Carr et al., 2023). Therefore, implementing PP practices in the context of EMIs should lead to promising results in improving well-being and tackling symptom severity and stress.

The Current Study

Despite the growing body of research on mental health variables and EMIs, a gap remains on how individual differences, like initial stress levels or symptom severity, influence EMI efficacy. Considering the complex relationship among well-being, stress, and symptom

severity (Kulmala et al., 2013; Weijers et al., 2020; Knowles et al., 2016), this study aims to gain a deeper understanding of these important factors within EMIs, so they can be tailored to individual needs. Therefore, the primary research question is: “What is the role of stress and symptom severity in the efficacy of EMIs on well-being?”, and the following hypotheses were formulated:

H1: Well-being scores will significantly improve from pre- to post-intervention.

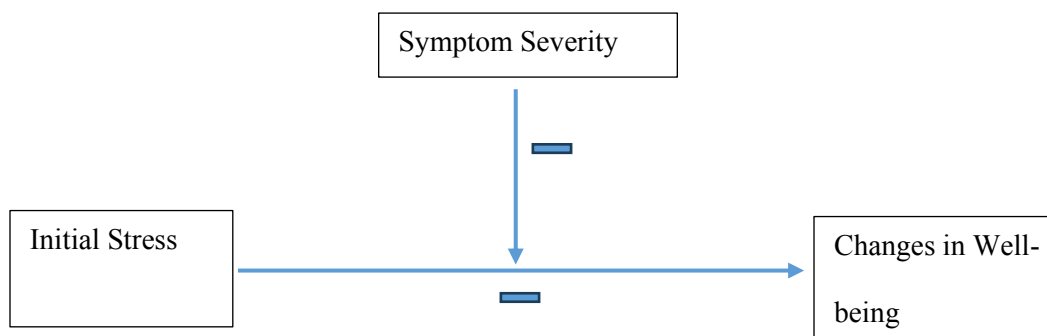
H2: Scores in symptom severity will significantly decrease from pre- to post-intervention.

H3: Higher levels of pre-intervention stress will predict a smaller increase in well-being scores post-intervention.

H4: Higher levels of symptom severity will strengthen the negative impact of pre-intervention stress on well-being improvements (Figure 1).

Figure 1

Hypothesized Moderation Effect of Symptom Severity on the Relationship between Pre-Intervention Stress and Changes in Well-being Scores (H4)



Methods

Participants

Participants were recruited using convenience and snowball sampling. The researchers distributed flyers on their university campus, shared them with their family and friends, and approached people via social media groups. Mainly university students from the University of Twente, as well as from German universities were recruited. As an incentive for participation, individuals were offered Amazon vouchers for up to 50 euros, based on the completion rate of the questionnaires. They were offered 5 Euro for the pre-intervention questionnaires, 10 Euro for an EMA completion of 60%, 20 for a completion of 70%, 30 Euros for individuals with at least 80% completion, and finally, 15 Euro for the completion of the post-intervention questionnaires. Additionally, students from the University of Twente were recruited via SONA systems, with the incentive of receiving study credits according to a similar incremental reward system, instead of the money if desired. Inclusion criteria for the study consisted of a minimum age of 18 years, sufficient English skills, ownership of a smartphone, as well as a score of at least 20 on the Kessler Psychological Distress Scale (K-10), indicating psychological distress to be at least mildly existent. Ethical approval was given prior by the Ethics Committee of Behavioral, Management, and Social Sciences of the University of Twente (Approval Code: 240007).

Design & Procedure

This paper is part of the larger “ALERT” project, with multiple researchers working on different aspects. This research team consisted of six Bachelor students, three Master students, and one PhD candidate, under the instructions of this thesis supervisor. The “ALERT” project is a micro-randomized trial, investigating the effects of EMIs on mental health outcomes and was pre-registered on the Open Science Framework (<https://osf.io/z645p/>). As everyone researched

different aspects of the study, this paper only focuses on three key measures of this larger-scale study: psychological distress, symptom severity, and well-being.

The data collection started on the 25th of March 2024 and lasted until the 6th of May 2024. The main part of the study lasted for 23 days, divided into a 7-day baseline assessment period and a 16-day intervention period. To collect the participants' baseline data in measures before the intervention, an online questionnaire needed to be filled in with approximately 20 to 30 minutes completion time, before engaging in the main part. For the intervention period, participants were assigned up to three interventions per day taking approximately 5 minutes to complete. These interventions were delivered through the mobile application “mPath”, a tool built for mental health support and interventions.

Upon signing up for the study, participants were asked to fill out the K-10 questionnaire to ensure only individuals with a sufficient score were included in the further steps of the study. Eligible participants were then invited to an online briefing session, where the study procedure was explained, questions could be answered and if necessary, support in testing the mPath application was provided. Participants started the main part of the study on a Monday, following the completion of the baseline questionnaire. The participants were assigned randomly to one of two groups, each receiving the EMIs in a different order, while each EMI exercise was assigned for four days in a row. Participants had a 30-minute window to complete the EMI, upon receiving the notification. After completing the 23 study days, participants were asked to fill in the post-intervention questionnaires. After finalizing the study, participants were offered the opportunity to schedule a debriefing session, to discuss individual results, feedback, and to share personal experiences.

The interventions for the EMIs included four different exercises based on therapeutic practices from CBT, ACT, and PP, being Gratitude Journals (Appendix A), Savoring Positive Memories (Appendix B), Opening Up (Appendix C), and Cognitive Reappraisal exercises (Appendix D). The exercise Gratitude Journals stems from PP and included listing things participants were grateful for and reflecting on them. Savoring Positive Memories, derived from ACT, asked participants to recall happy memories in detail and focus on their emotions. Opening Up aimed to explore and accept negative emotions also based on ACT principles. Lastly, the Cognitive Reappraisal Exercise asked participants to reframe negative thoughts by challenging them, representing classical CBT methodology.

Measures

Psychological distress

Firstly, the level of psychological distress among participants was measured, using the Kessler Psychological Distress Scale (K-10). It is a brief screening tool, used to assess people's psychological distress with ten items, over the past 30 days. To score the results, each item on the K-10 is rated on a five-point Likert scale, ranging from 1 (none of the time) to 5 (all of the time). The final score is then calculated by summing all item scores, with a final score range from 10 to 50, where higher scores indicate higher psychological distress. It possesses a good internal consistency with a Cronbach's Alpha of .91 and a strong inter-item correlation from .350 to .659, in a study on a Portuguese sample (Pereira et al., 2019). The K-10 in this study displayed a moderately lower reliability, with an alpha of .84.

Symptom Severity

Next, the symptom severity of the participants was assessed, by utilizing the Brief Symptom Inventory (BSI). This test measures nine dimensions of symptoms through 53 items, as

well as measuring three global indices: the Global Severity Index (GSI), the Positive Symptom Distress Index (PSDI), and the Positive Symptom Total (PST). As general symptom severity is of interest in the context of this paper, only the global indices were investigated. Each of the 53 Items is rated on a five-point Likert scale, from 0 (not at all) to 4 (extremely). To calculate the GSI, the mean of all 53 items is determined, which indicates the general severity of symptoms an individual experiences. The PST is a count of all responses, not answered with 0, indicating the number of symptoms the research subject possesses, while the PSDI is summing the values of the non-zero responses, divided by the PST score, indicating the level of stress one experiences through their symptoms. While no alpha reliability is reported for the global indices, the BSI has a test-retest reliability from .87 to .90 (Derogatis, 1975). The internal consistency for the BSI for the current sample revealed a pre-intervention alpha of .95 with somewhat of an increase to .96 post-intervention.

Well-being

The last measure observed in this paper is well-being, measured by the Mental Health Continuum–Short Form (MHC-SF), which is composed of 14 items investigating emotional, social, psychological, and overall well-being, utilizing a six-point Likert scale ranging from 0 (never) to 5 (every day). The total well-being used in this study is calculated by summing up all item scores, divided by the number of items with higher scores indicating higher well-being. The three sub-scales are calculated by summing up pre-determined items, that are relevant for the specific sub-scale. It has a good internal consistency ($\alpha = .83$), with the test-retest reliability averaging .68 within three months (Lamers et al., 2010). Furthermore, the internal consistency in this study's measure revealed a pre-intervention alpha of .90, which decreases insignificantly to .88 post-intervention.

Data Analysis

The collected data from this study was analyzed, using R 4.3.3 through the interface of R Studio (Posit Team, 2024) to test the hypotheses. To test Hypothesis 1 and 2, a paired t-test was conducted on each measured scale, to compare pre- and post-intervention means. Additionally, change scores were calculated by subtracting post - from pre-intervention outcomes.

Subsequently, a negative number indicates an increase on the according scale and vice versa.

To address Hypothesis 3, a simple linear regression was conducted. The relationship between pre-intervention distress (K-10 scores) and changes in well-being scores was assessed, with the change score of well-being as the dependent variable and pre-intervention distress as the independent variable.

Finally, for Hypothesis 4, a moderation analysis was performed using linear regression models, to test if the relationship between pre-intervention distress and changes in well-being is moderated by the pre-intervention symptom severity. The model was run, with changes in well-being as the dependent variable, pre-intervention distress as the independent variable, and combined pre-intervention BSI indices (GSI, PST, PSDI) as moderators. The interaction terms between the distress score and each of the pre-intervention BSI indices were included.

Results

Descriptive Statistics

After an initial 174 registrations, the final sample consisted of 51 participants. This large discrepancy between registrations and the final sample is the result of participants not meeting the inclusion criteria, as well as the omitting of 21 participants, as a cut-off was made due to time-related reasons, where these participants were still in the EMI phase of the study. This resulted in these 21 participants not filling out the post-intervention questionnaire at the time, the

data analysis was started. The sample of $N= 51$ was composed of 17 males (32.7%), 32 females (61.5%), and one non-binary participant (1.9%), while one participant preferred not to report their gender (1.9%). Moreover, the sample consisted mainly of Dutch and German students, which can be observed in Table 1, alongside the other sample characteristics.

When investigating the pre-intervention scores, it can be seen that participants yielded a mean well-being score of 2.57 ($SD = 0.95$) and performed somewhat worse in mean well-being scores, compared to a non-clinical Dutch adult sample (Lamers et al., 2010). Furthermore, the BSI indices showed an initial score of 1.12 ($SD = 0.62$) for the GSI, 21.20 ($SD = 10.70$) for the PST, and 4.23 ($SD = 6.90$) on the PSDI. Notably, all three BSI indices had nearly double the value of a norm sample of white adolescents (Derogatis, 1975)

Table 1*Sample Characteristics (N=51)*

Variable	Description	%	<i>n</i>
Age	18-34 years	-	51
	(<i>M</i> =22.49, <i>SD</i> =3.28)		
Gender	Male	32.7	17
	Female	61.5	32
	Non-binary	1.9	1
	Prefer not to say	1.9	1
Nationality	Dutch	23	12
	German	36.5	19
	Other	40.5	20
Occupation	Employed full time	1.9	1
	Employed part-time	9.8	5
	Unemployed, looking for work	1.9	1
	Student	54.9	28
	Working student	31.4	16

Changes in Well-being and Symptom Severity

The results of the conducted t-test showed a significant improvement in well-being scores from pre- to post-intervention, supporting Hypothesis 1. Furthermore, a significant decrease in the GSI could be observed, while the PST unexpectedly increased significantly. The PSDI however, did not change significantly. Table 2 provides a clear overview of the change scores and t-scores from pre- to post-intervention for well-being, as well as symptom severity.

Table 2*Change in mean scores and t-test results of well-being and symptom severity indices.*

	<i>Pre-</i>	<i>Post-</i>	<i>Mean</i>	<i>t-value</i>	<i>df</i>	<i>p-value</i>	<i>95% CI</i>	
	<i>intervention</i>	<i>intervention</i>	<i>Difference</i>				<i>LL</i>	<i>UL</i>
	<i>mean (SD)</i>	<i>mean (SD)</i>	<i>(SD)</i>					
Well-being (MHC-SF)	2.57 (0.95)	2.76 (0.89)	-0.19 (0.95)	-2.31	50	.025	-0.37	-0.03
Global Severity Index (GSI)	1.12 (0.62)	0.85 (0.55)	0.27 (0.62)	3.36	50	.002	0.11	0.42
Positive Symptom Total (PST)	21.20 (10.70)	24.83 (12.56)	-3.63 (9.89)	-3.15	50	.003	-6.74	-1.49
Positive Symptom Distress Index (PSDI)	4.23 (6.90)	4.59 (13.56)	-0.36 (11.15)	-0.21	50	.833	-4.68	3.79

Note. CI = confidence interval; LL = lower limit; UL = upper limit

Impact of pre-intervention stress on well-being

Contrary to the third hypothesis, no significant relationship was found between pre-intervention distress and change in well-being scores ($\beta = 0.0229$, $p = 0.104$). Overall, the regression model was found to be statistically insignificant ($F(1, 49) = 2.748$, $p = .104$), explaining approximately 5.31% of the variance in well-being change. Upon investigating a plot on this relationship (Appendix E) a small positive trend can be seen, suggesting the hypothesized trend. However, this should not be considered further, due to the models' insignificance.

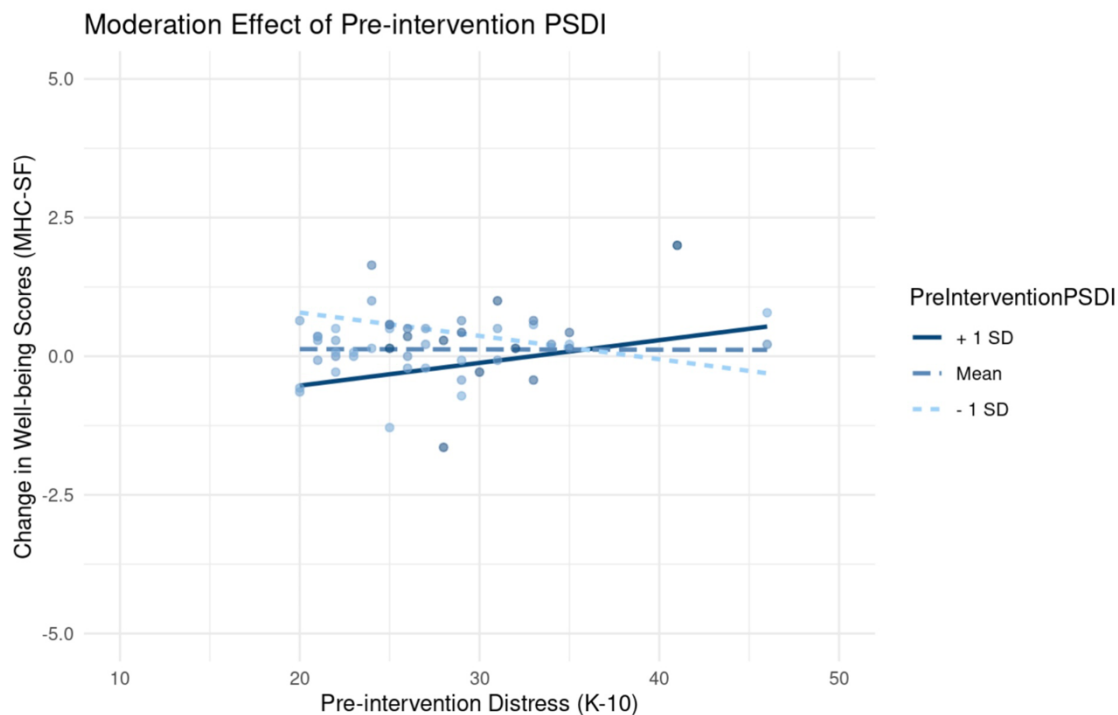
Moderating Role of Symptom Severity

Finally, the moderation analysis to test for the fourth hypothesis revealed no significant interaction effect for the GSI ($\beta = 0.0358$, $t(43) = 0.951$, $p = .347$), nor the PST ($\beta = 0.004$, $t(43) = 1.214$, $p = .231$). However, the interaction term for the PSDI did turn out to moderate the relationship between pre-intervention distress and changes in well-being scores ($\beta = 0.006$, $t(43) = 2.048$, $p = .043$). This indicates a stronger increase in well-being scores for individuals with higher PSDI scores, as pre-intervention distress increases. Furthermore, the overall regression model turned out to be statistically significant ($F(7, 43) = 2.324$, $p = .042$), explaining approximately 27.44% of the variance in well-being score changes.

This interaction can be examined further in the interaction plot (Figure 2). It displays three different levels of pre-intervention PSDI, being at the mean, and one standard deviation below and above the mean. It shows how, as PSDI scores increase, the well-being score also increases, while the line for the mean score is relatively flat. Moreover, when PSDI scores decrease, well-being scores decrease simultaneously.

Figure 2

Interaction Plot of the moderation effect on the relationship between initial distress and well-being changes.



Discussion

This study aimed to investigate the relationship between initial psychological distress and its effect on the efficacy of EMIs, in improving well-being and reducing symptom severity, among distressed individuals. Through the exploration of these relationships, the study contributes to the understanding of how certain individual differences influence EMIs and adds to the understanding of how EMIs can be optimized for mental health interventions.

When looking at the changes in well-being scores from pre- to post-intervention, a significant improvement could be found, supporting the first hypothesis. This finding aligns with existing research and highlights the positive impact of EMIs on mental health (e.g. Balaskas et al., 2021; Marciniak et al., 2020; Reininghaus et al., 2023; Versluis et al., 2016). Moreover, the

findings suggest that EMIs within this specific context of the chosen interventions, effectively enhance well-being. A possible explanation for the found improvements is the continuous support provided by the EMIs, helping the participants to apply the intervention tasks and reinforce positive behavioral changes. Despite the random assignment of the EMIs, the regularity of the interventions may have contributed to sustained engagement and well-being improvements.

Additionally, the study found different results for the three dimensions of symptom severity, assessed in this paper. For the general severity of the experienced symptoms, a decrease could be identified. However, the number of symptoms increased, and the distress experienced by the symptoms did not change significantly. These findings are supported by Wood (1986), as it was noted that an increase in the total number of symptoms reported, still allows a decrease in the severity of the experienced symptoms. Another implication could be the nature of the used EMIs, encouraging self-reflection and monitoring. Subsequently, enhancing symptom identification and awareness, as prior research found such an effect of interventions (Balaskas et al., 2021). Moreover, it was found that self-monitoring increased symptom awareness and reporting, which in turn improved health-related quality of life (Basch et al., 2016). Furthermore, effective coping strategies learned through the EMIs may influence the subjective experience of the symptoms. Riegel et al. (2022) further support this claim, indicating symptom recognition mediates the relationship between self-care monitoring and management behaviors, which reduces subjective severity even when the symptom frequency increases. This further aligns with these studies' findings, as the stable level of distress from the symptoms indicates an effective management of this associated stress, despite the increase in symptom frequency.

Contrary to the third hypothesis, higher levels of pre-intervention stress did not predict less increase in well-being post-intervention, suggesting independence of well-being changes from initial stress levels. This aligns with previous studies by Reininghaus et al. (2023) and Bell et al. (2017), who also found no significant impact of initial stress levels on intervention outcomes. Thus, it is implied that EMIs composed of CBT, ACT, and PP can enhance well-being, regardless of the initial stress levels of participants.

The analysis of the fourth hypothesis revealed only symptom-specific distress to moderate the relationship between initial stress and well-being changes. Moreover, this means that participants with higher scores in symptom-specific distress showed greater improvements in well-being changes, contrary to the hypothesis. Subsequently, these outcomes imply that the EMI approach in this study is particularly effective for individuals with higher symptom-specific distress. This is further supported by Schueller et al. (2017) who found EMIs to be particularly effective in treating depression and anxiety by targeting the symptom-specific stressors in their daily life settings. This adds to the findings that EMIs tailored to individuals with a history of emotional abuse were particularly effective, emphasizing the potential to improve the well-being of individuals with high symptom-specific distress through personalization (Nguyen-Feng et al., 2019). Furthermore, this aligns with the prior findings from this paper, where a constant level of symptom-specific distress suggested effective management of the symptoms, despite an increase in symptom frequency.

Implications & Recommendations

The findings from this study have several implications for future research and practice. Firstly, personalization of the EMIs to the individual symptoms, especially for individuals with high symptom-specific distress, needs to be considered. Future intervention design should tailor

the content to the needs of the participants to increase the efficacy, as highlighted by Dao et al. (2021). These recommendations align with Schueller et al. (2017) and their suggested efficacy of EMIs by addressing specific stressors, also emphasizing the need for personalization.

Furthermore, the observed improvement in well-being shows how continuous implementation and support of the EMIs can have beneficial effects. Thus, incorporating long-term engagement strategies can contribute to improved intervention benefits, as Bell et al. (2017) and Schueller et al. (2017) suggested continuous support to reinforce positive behavioral changes and maintain well-being improvements.

Moreover, considering the absent effect of initial stress levels on well-being, it becomes evident that the EMIs in this study's context can be applied regardless of initial stress levels. However, despite the insignificance of initial stress, symptom severity should be considered in future research. The different effects on symptom severity in this study, highlight the necessity of exploring the underlying mechanisms and how the different dimensions of symptom severity interact with well-being changes. Specifically, longitudinal studies are needed to better understand this relationship and to assess the lasting effects of EMIs, as suggested by prior research (Bell et al., 2017; Dao et al., 2021; Schueller et al., 2017; Versluis et al., 2016). Lastly, it should be considered to integrate EMIs into traditional therapy, as research suggested an enhanced efficacy of EMIs if paired with traditional mental health care (e.g. Balaskas et al., 2020; Myin-Germeyes et al., 2022). By doing so, EMIs could potentially become a valuable tool in mental health care, providing easy access to strategies aimed at improving mental health.

Limitations

Several limitations apply to this study, that need to be considered. Firstly, the reduced sample size, due to time-related reasons might play a role in the outcomes of the study and may

affect the generalizability. The specific demographics of the sample being mainly students, further contributes to this limited generalizability. Using a bigger and more representative sample to improve the generalizability of the results, would help determine a broader applicability of EMIs, as suggested by Sin et al. (2020).

Moreover, the absence of a control group makes it difficult to attribute the changes in well-being and symptom severity solely to the interventions. Thus, drawing causal inferences becomes difficult, as the intervention outcomes may have been influenced by external factors. Including a control group in the study design allows for better assessment of EMI efficacy, and should be considered to control for external variables.

Additionally, the duration of the study does not allow for an assessment of the long-term effects such a study might have, like the implementation of the EMI exercises in everyday life. A longitudinal study design would be necessary to assess the sustained impact of EMIs on mental health (Marciniak et al., 2020), and could provide insights into the lasting benefits and potential drawbacks of EMIs over time.

Conclusion

The present study found significant improvements in well-being from pre- to post-intervention. A decrease in the severity of symptoms was found, while the number of symptoms increased, and the symptom-specific distress remained stable. Against expectations, initial stress levels did not predict changes in well-being. However, higher symptom-specific distress was found to result in greater well-being improvements and highlights the importance of personalizing interventions to specific symptoms and stressors. Future research should include bigger and more representative samples. Furthermore, including a control group in the study design allows us to draw causal inferences, while assessment of the longitudinal effects of EMIs

may be beneficial in future studies. A personalized approach could significantly improve EMI effectiveness in addressing mental health issues incorporating EMIs into traditional mental health care, could significantly improve their effectiveness in addressing mental health issues.

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Appendix A

Gratitude Journal

This activity, the **Gratitude Journal**, is designed to focus on things in your life you're thankful for. This practice can be about anything from simple pleasures (like enjoying a delightful lunch) to major life events (such as the birth of a healthy niece).

Viewing positive experiences as gifts helps prevent taking them for granted. Research indicates that regularly engaging in this exercise can significantly boost well-being.

Instructions

1. **List down three things** currently in your life – events, experiences, people, or any other aspect – that you feel grateful for. You can write them down in the textbox below or on paper.
2. Reflect on **why** you are grateful for these particular things. You can write these reflections down in the textbox below, use pen and paper, or simply ponder them without writing.
3. **Pay attention to the feelings that arise** during your reflection on them. You can ask yourself the following questions:
 - Which emotions do you notice as you reflect on what makes you grateful right now?
 - How does your body react to these feelings of gratitude? (Do you feel warmer, more relaxed, or perhaps a smile forming on your face?)
 - What changes do you observe in your mood as you focus on these grateful feelings?

Appendix B

Savouring: Positive Memory

Experiencing positive emotions can often be achieved by revisiting joyful memories. The Positive Memory exercise is an effective way to do just that.

This exercise involves recalling a happy memory in as much detail as possible and focus on how you felt during that moment. Good example memories for this exercise are those where you felt significant positive emotions such as joy, love, or inspiration, but it can also be any other memory you experienced as pleasant.

Instructions

1. Think of a memory where you experienced strong positive emotions.
2. Aim to reconstruct the memory in as much detail as possible. If you like, you can write your thoughts in this textbox or use pen and paper. Consider these question to guide your writing:
 - o What exactly happened in the memory you selected?
 - O What were your feelings at the moment it occurred?
 - O How do you feel now as you revisit this memory?
 - O What changes do you observe in your mood as you focus on this positive memory?

Try to include many details to vividly recall the experience, but remember to keep the writing process enjoyable.

Appendix C

Opening up

The goal of this exercise is to accept and embrace negative thoughts and emotions instead of trying to get rid of them. Resisting unpleasant feelings may actually cause them to become stronger and more frequent. By embracing our thoughts and feelings and accepting that they are there, we don't need to suffer from our struggles in trying to control them.

Instructions

5. What have you been struggling with lately (e.g., stress, anger, sadness, insecurity, guilt, shame, pain, worries...)? You can write it down in the text box below
TEXT BOX
2. See if you can open up to these unpleasant thoughts and feelings, allowing them to just be there.
3. Explore what there is to experience—Are the feelings getting heavier, lighter, do they remain the same, or do they fluctuate?
4. Can you stay present with these difficult thoughts and feelings and keep in touch with them?
5. See if you can continue giving some space to these unpleasant feelings for a while, instead of trying to control them or trying to get rid of them.

Appendix D

Cognitive Reappraisal Exercise

With this exercise, we will have a good look at unpleasant thoughts you may have and help you to investigate if they are really helpful and true, or if there are more positive alternative thoughts that are more realistic. The unpleasant thoughts you may have, such as worries about the future, negative thoughts about yourself or others, or memories about an unpleasant situation in the past, are often unrealistically negative and not helpful. With this exercise, we will see if we can replace these unpleasant thoughts with more positive, more realistic thoughts.

Instructions

1. Think of an unpleasant thought that is causing you stress or negative emotions lately. Take a moment so you have the unpleasant thought clear in your mind, and write it down in the text box below

[TEXT BOX]

2. Now try to challenge this unpleasant thought a little: Is it really true? What evidence do you have for it? Is this unpleasant thought helping you?

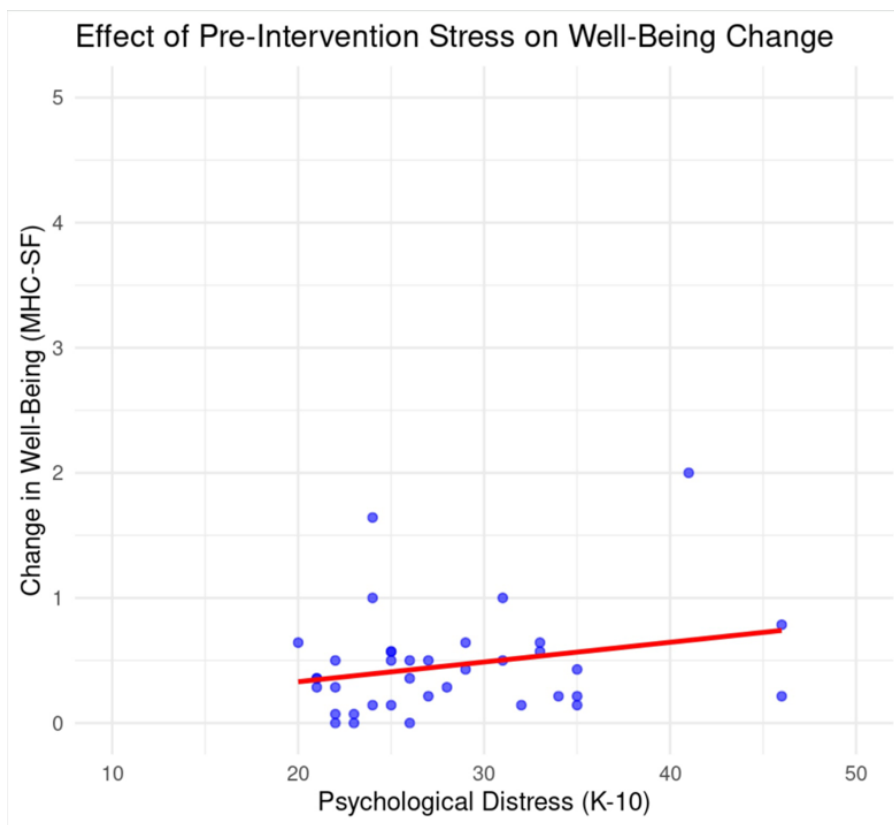
3. What would you tell a close friend if they were having these thoughts?

4. Now try to come up with another, more positive interpretation, and write it in the text box below. What evidence do you have for this more positive thought? Is this thought more helpful to you?

[TEXT BOX]

5. Take a moment to think about both thoughts. Is it possible that your unpleasant thoughts are not the most realistic or helpful ones? See if you can challenge your unpleasant thoughts this way for a while, and replace them with more helpful, more positive thoughts

Appendix E



Scatter plot of the relationship between pre-intervention distress and changes in well being