Enhancing Student Well-Being: The Impact of a Mindfulness-Based Program (Mind7 +) on Stress, Anxiety, Sleep Quality, and Social Interactions in a Sample of Portuguese University Students

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Abstract. There is an urgent need to promote mental health strategies in university students, and mindfulness-based interventions provide alternative and complementary approaches. The present study aimed to investigate the impact of a mindfulness-based program (Mind7 +) on Portuguese students from the Polytechnic University of Santarem, focusing on stress levels, depression, anxiety, and sleep quality. The intervention consisted of a 8 week mindfulness-based program, with six presential sessions and two online sessions. The participants completed self-filled validated questionnaires before and after intervention. The study revealed that Mind7 + program not only positively influenced stress levels, anxiety, and sleep quality among university students but also had a positive impact on their social interactions. A correlation between sleep quality and frequency of individual practices was observed. The observed medium effect size underscores the practical relevance of Mind7 + program and the potential of mindfulness-based interventions in higher education to enhance both individual well-being and social connections. Next steps will be to adapt the mindfulness-based program for a mobile device and test with a wider intervention group, as well as an active control group.

Keywords: Mindfulness · Sleep quality · Stress · Anxiety · Digital self-help

1 Introduction

The rise in mental health problems is a general trend in our world, especially among young people. Underlying causes include climate anxiety, a highly competitive society, the uncertainty of working life, and a massive flood of information [1]. This trend was

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worsened by COVID-19 pandemic, which has led to about 25% increase of depression and anxiety disorders, with a higher incidence in people with ages of 20 to 24 years old [1]. Thus, there is an urgent need to promote mental health strategies to reverse this trend, and mindfulness-based interventions provide alternative and complementary approaches to traditional clinical practices. Recent scientific evidence shows that mindfulness meditation interventions have successfully reduced depression in emerging adults [2, 3].

University students must cope with various stressful situations: adapting to new environments, economic difficulties, making new friends, time management, workload pressures, and exams. This can lead to increased anxiety and decreased motivation to study and research. To achieve their goals and reach their potential, university students must be able to self-regulate and maintain psychological well-being. There is recent scientific evidence that integrating mindfulness in higher education leads to diverse positive outcomes such as: reduction of stress, anxiety, depression and better emotional regulation [2–4], increased well-being, higher engagement and life meaning [5], increased focus, concentration and organization [4], increased efficiency at work, better handling of interpersonal interactions, work more effectively with other members, better handling of research setbacks, and higher satisfaction with research work in PhD students [6].

In Portugal, the research of mindfulness in higher education is scarce. One study has assessed the effect of a mindfulness-based program in university students, showing significant improvement in stress, emotion regulation, mindfulness, positive solitude, and optimism [7]. Thus, we aimed to gather more information on the impact of these types of interventions in Portuguese higher education. This pilot study developed and applied a 8-week structured program, based on strategies of Mindfulness, to Portuguese students enrolled at Polythecnic Institute of Santarem (IPSantarem). As primary outcomes, we assessed subjective well-being, anxiety, stress, depression, and sleep quality. Secondary outcomes were healthy food habits, and socialization.

2 Methodology

2.1 Study Design and Ethics

This was a non-controlled experimental study, approved by the Ethics Commission of IPSantarem (Parecer Nº27-ESAS), developed according to the principles of Helsinki Declaration and the European Data Protection Regulation. The intervention Mind7 + consisted of a 8 week program, with one 4h session per week (six presential sessions and two online sessions, from October to December, 2022). Inclusion criteria were (1) adults $\geq$ 18 years old; (2) Portuguese speakers, (3) being a student in IPSantarem. No selection criterion was applied in terms of gender, educational level, health condition or social and cultural background. For enrolment, the program was advertised at the start of the semester in the institutional website, through institutional email, and face to face contact with the researchers involved in the study. The participants enrolled in the program through an online form. All participants signed an informed consent in the first session of the program and were given a code to insert on the questionnaires for data collection (pseudo anonymization of data). Participation was voluntary, and unpaid.

Questionnaires were self-filled at the first and the last week of the intervention, assuring confidentiality.

2.2 Data Collection and Analysis

The following validated scales for Portuguese language were used:; IPAQ (International Physical Activity Questionnaire), short version, to assess physical activity [8]; PSQI (Pittsburg Sleep Quality Index), short version to assess sleep quality [9]; EADS-21 (Scale of Anxiety, Depression and Stress) to assess anxiety, depression and stress [10]; 14-MEDAS (Mediterranean Diet Adherence Screener) to assess adherence to Mediterranean Diet [11]. An online questionnaire was constructed on Google forms including a section for information about the study, authorization for the use of collected data and a question for the individual code insertion; a section for demographic and health data; a section for the 14-MEDAS; and a section for the IPAQ. The two other questionnaires (EADS-21 and PSQI) were filled on paper. All questionnaires were filled in at the beginning of the first session and at the end of the last session.

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 28.0 statistical package for Windows (SPSS, Inc., Chicago, IL, USA). Continuous variables were tested for normality with Shapiro-Wilk test (recommended for samples with $n < 50$). To assess differences between pre and post intervention, parametric paired t-tests were used for normal variables, and non-parametric related samples Wilcoxon Signed Rank Tests were used for non-normal variables with acceptable skewness (-1 to 1 values). Effect sizes were determined by Cohen's D test for paired T-tests and by Z value divided by the square root of N for Wilcoxon Tests. Effect sizes were classified as small (0.2 to 0.5), moderate (0.5 to 0.8) or large (>0.8) [12]. Scale variables are presented using the mean ± standard deviation (SD). Percentages are used to represent ordinal or nominal variables. All statistical tests were based on two-sided tests (bilateral significance) with a significance level of 5% ($\alpha = 0.05$).

Non-parametric partial Spearman correlation coefficients (ρ) adjusted for confounding variables were used to investigate the potential association between variables. Data are presented as the Spearman's partial correlation values with their corresponding p-values. Correlation coeficients were classified as weak (<0.3), moderate (0.3 to 0.7) and strong (>0.7) [13].

2.3 Intervention

The program consisted of 8 sessions, based on Jon Kabat Zin MBSR (mindfulness based stress reduction) program, with the following topics: 1) concept of Mindfulness; formal and non-formal practices, diaphragmatic breathing; 2) the 9 Mindfulness attitudes; body scan; 3) dealing with stress and anxiety; scientific evidence of mindfulness effects; guided meditation; 4) flipping limiting thoughts to empowering thoughts; 10 Yoga movements and relaxing the body; guided meditation; 5) goal setting; anchoring tranquility and focus; walking meditation; 6) Yoga class; sitting meditation; values; 7) neurologic levels; loving-kindness meditation; 8) personal impact statement; mindfulness state meditation. Sessions 3 and 6 were online; all other sessions were presential. At the end of each session, the participants were introduced to the daily practices for the week (10 to 15

min in the first two weeks, 15 to 30 min the following four weeks, and 30 to 45 min the last two weeks). All course materials were available for the participants at the institutional e-learning platform (https://eraizes.ipsantarem.pt/moodle/course/view.php?id=941). All the research team was involved in the design and organization of the program.

3 Results

3.1 Sample Characterization

Forty students enrolled in the program between 9th of September and 7th of October 2022. Before the beginning of the program, 10 students cancelled their registration. At the first session (19th October), 24 participants attended the session and filled in the starting questionnaires. Two other participants joined the second session but did not fill in the starting questionnaires. Before the end of the program seven participants dropped out and did not fill in the ending questionnaires (appointed reasons for dropout were disease and lack of time due to academic workload). More than half of the participants (53.9%) attended from 5 to 8 sessions out of 8. At the end, 18 pre and post intervention questionnaires were available for paired statistical analysis. Table 1 presents the characteristics of the sample. Most were healthy, with an active lifestyle (87.5% with MET-min per week > 600) and moderate adherence to Mediterranean diet (62.5% with MEDAS score between 6 and 9). Regarding contact with nature and friends, most participants reported to be occasionally or sometimes in nature (73.1%) and with friends (69.2%).

Table 1. Characteristics of the initial sample (N = 24)

Gender (% Female)	84.6
Age (mean ± SD)	22.8 ± 6.1
BMI (% normal weight; BMI < 25 kg/m^2	61.6
Smoker (%)	19
Diagnosed pathology (%)	26.9
Physical Activity (mean MET-min/week ± SD)	2197 ± 1850
Adherence to MD (mean MEDAS ± SD)	6.3 ± 1.6

3.2 Effect of the Intervention on Depression, Anxiety, Stress, Sleep Quality and Lifestyle

Depression, anxiety, and stress are the three domains assessed by the EADS validated scale, with 7 items evaluated from 0 (best condition) to 3 (worst condition) in each domain. The items in each domain were: depression - no positive feelings, difficulty to take initiative, nothing to expect from future, feeling discouraged and melancholic, no enthusiasm, no value as a person, no meaning in life; anxiety - dry mouth, difficulty to

breathe, tremors, worry, almost in panic, changes in heart rate without physical exercise, frightened without reason; stress - difficulty in self-calming, overreact, nervous energy, feeling agitated, difficulty in relaxing, being intolerant, feeling to sensitive. Stress levels were higher than depression or anxiety, both at the start and end of the intervention (Table 2). A significant decrease was observed in anxiety and stress levels after the intervention, with medium effect sizes.

Sleep quality was calculated according to the PSQI instructions, in a scale from 0 (best condition) to 15 (worst condition). A significant decrease was observed in the calculated PSQI, indicating an improvement with a moderate effect size (Table 2).

Table 2. Values before (Pre) and after (Pos) the intervention for depression, anxiety, stress and sleep quality.

Domain (scale) Items of each domain	Pre (mean ± sd)	Pos (mean ± sd)	P-value[a,b]	Effect size[a,b]
Depression (EADS)	1.1 ± 0.8	0.9 ± 0.9	0.198[a]	0.307[a]
Anxiety (EADS)	1.1 ± 0.8	0.6 ± 1.3	**0.031**[a]	0.589[a]
Stress (EADS)	1.6 ± 0.7	1.1 ± 0.8	**0.014**[b]	0.646[b]
Sleep Quality (PSQI)	4.9 ± 3.5	3.0 ± 2.1	**0.027**[b]	0.611[b]

EADS (Scale of Anxiety, Depression and Stress), scale from 0 (best condition) to 3 (worst condition); PSQI (Pittsburg Sleep Quality Index), scale from 0 (best condition) to 15 (worst condition). Differences between pre and post intervention were tested by parametric paired t-tests for normal variables, with Cohen's D effect size (a), and non-parametric related samples Wilcoxon Signed Rank Tests for non-normal variables with acceptable skewness (-1 to 1 values) and effect sizes calculated by Z values divided by the square root of N (b); N = 18. Significant differences in bold (p-values < 0.05). Effect sizes: no effect < 0.2; small effect 0.2 to 0.5; moderate effect 0.5 to 0.8; large effect > 0.8.

Secondary outcomes were related to some lifestyle habits, in particular food habits, assessed as adherence to Mediterranean diet by (MEDAS score), physical activity, assessed in MET-min/week, frequency of contact with nature and frequency of contact with friends (Table 3). The only variable with a significant change was frequency of contact with friends, which increased (pre, occasionally or sometimes: 69.2%, frequently or most of the times: 23%; post, occasionally or sometimes: 38.4%, frequently or most of the times: 38.5%; Wilcoxon Rank Test p = 0.008; moderate effect size = 0.628).

For the participants who filled in pre and post questionnaires, 70% attended from 5 to 8 sessions. Regarding frequency of home practices, half the participants (50%) reported that they practiced sometimes but not every week, 40% reported practices 3 to 4 times per week; the other 10% divided themselves between practices once or twice a week (5%) or no practices (5%). Independently of the frequency of practices, most participants reported practicing 5 to 10 min (70%) and 30% reported spending 15 to 30 min in their practices. Favorite practices included focus on breathing, guided meditations, and yoga exercises. We further explored if the observed improvements in sleep quality, anxiety

Table 3. Values before (Pre) and after (Pos) the intervention for Mediterranean Diet Adherence (MEDAS score), Physical Activity, frequency of contact with nature and with friends).

Variable	Pre	Pos	P-value[a]	Effect size[a]
Mediterranen Diet Adherence (MEDAS; mean ± sd)	6.3 ± 1.6	6.4 ± 1.9	0.935	0.02
Physical Activity (MET-min/week; mean ± sd)	1.1 ± 0.8	0.6 ± 1.3	0.609	0.123
Frequency of contact with nature (%)				
Never	0.0	15.0	0.218	0.275
Occasionally	37.5	20.0		
Sometimes	41.7	20.0		
Frequently	20.8	40.0		
Most of the times	0.0	5.0		
Frequency of contact with friends (%)				
Never	0.0	0.0	**0.008**	0.590
Occasionally	29.2	5.0		
Sometimes	45.8	45.0		
Frequently	12.5	30.0		
Most of the times	12.5	20.0		

MEDAS, Mediterranean Diet Adherence Screener, score from 0 (worse) to 14 (best) [11]. MET-min per week calculated according to IPAQ (International Physical Activity Questionnaire) [8]. a) Differences between pre and post intervention were tested non-parametric related samples Wilcoxon Signed Rank Tests for non-normal variables with acceptable skewness (−1 to 1 values) and effect sizes calculated by Z values divided by the square root of N. Significant differences in bold (p-values < 0.05). Effect sizes: no effect < 0.2; small effect 0.2 to 0.5; moderate effect 0.5 to 0.8; large effect > 0.8.

and stress were associated with the number of sessions attended or the frequency of the mindfulness practices at home. None of the variables that improved (sleep quality, anxiety and stress) showed any correlation with the number of sessions attended (Pearson p-value > 0.05). Regarding frequency of practices, a significant correlation was observed only for sleep quality (Pearson p-value $= 0.039$), with a moderate positive association (Pearson $r = 0.538$). This correlation was maintained after adjusting for the number of presences (Pearson $p = 0.045$; $r = 0.507$). No association was observed between number of presences and frequency of practices.

4 Discussion

The present study aimed to investigate the impact of a mindfulness-based program on Portuguese students from IPSantarem, focusing on stress levels, depression, anxiety, and sleep quality. The findings revealed noteworthy insights into the effectiveness of the intervention, shedding light on the potential benefits of mindfulness practices in the context of Portuguese higher education. In the current study stress levels were

found to be consistently higher than depression or anxiety levels, both at the start and end of the mindfulness-based intervention. The results emphasize the need for targeted interventions to address stress-related challenges in the university setting.

Interestingly, the mindfulness-based program demonstrated a significant positive impact on anxiety and stress levels. This finding suggests that the program effectively contributed to reducing participants' feelings of anxiety and stress, aligning with the program's core principles of cultivating present-moment awareness and non-judgmental acceptance. These results are consistent with a growing body of research that supports the efficacy of mindfulness interventions in mitigating anxiety and stress symptoms in university students. In fact, a meta-analysis that compared the effect of mindfulness-based interventions on students mental health, with passive (no intervention) and active controls (for example, muscle relaxation, or cognitive restructuring) has shown a significant improvement in anxiety levels in the students that were subjected to the mindfulness-based intervention [14]. Also, some studies highlight that mindfulness is negatively correlated with stress in university students [15, 16].

Furthermore, the study evaluated sleep quality using the Pittsburgh Sleep Quality Index (PSQI), a widely used instrument for assessing sleep disturbances. The significant decrease in the calculated PSQI scores indicates a positive impact of the mindfulness-based program on sleep quality. Improved sleep quality is a notable outcome, as poor sleep patterns are often intertwined with stress, anxiety, and depressive symptoms. The observed moderate effect size underscores the practical relevance of this improvement in sleep quality, suggesting that the mindfulness practices employed in the intervention may have facilitated better sleep hygiene and regulation among the participants. The observed results are in line with other studies which reported that mindfulness has a mediating effect in sleep quality through lower levels of anxiety, stress, and depression [15–17]. Perceived social support along with mindfulness has also been shown to improve sleep quality in university students [18]. This is aligned with results observed for one of the secondary outcomes of the present study, which was an increase in the frequency of contact with friends, as indicated by a shift from occasional or sometimes interactions to more frequent engagements.

The results of this study contribute to the literature by highlighting the potential of mindfulness-based interventions to address multiple dimensions of well-being among university students.

When examining participants' engagement with the mindfulness-based program, it was observed that 70% of those who completed both pre and post questionnaires attended between 5 and 8 sessions. This level of participation suggests a relatively high level of program engagement among the participants. Additionally, home practice frequency was diverse, with 50% reporting occasional practice, 40% engaging 3 to 4 times per week, and the remainder practicing with varying frequencies. Most participants reported dedicating 5 to 10 min to their mindfulness practices, with a smaller percentage investing 15 to 30 min. The wide range of practice approaches reflects the adaptability of mindfulness techniques to individuals' schedules and preferences.

Regarding the correlation between program engagement and outcomes, the observed improvements in stress and anxiety levels were not significantly associated with the frequency of individual practices. This result underscores the potential accessibility and

effectiveness of mindfulness interventions even when engaged with varying levels of commitment. However, an interesting finding emerged when examining the relationship between frequency of mindfulness practice and sleep quality. A moderate positive correlation was observed, indicating that participants who engaged in mindfulness practices more frequently at home reported better sleep quality. This correlation remained significant even after accounting for the number of program sessions attended, suggesting that the frequency of home practices exerted a distinct influence on sleep quality beyond program engagement.

While the present study provides valuable insights into the effects of the mindfulness-based program, certain limitations warrant consideration. The absence of a control group and the reliance on self-reported measures could introduce biases and limit causal inferences. Furthermore, the narrow range of lifestyle habits examined may not capture the full spectrum of potential changes influenced by the intervention. Future research should explore a broader range of lifestyle habits and employ more rigorous experimental designs to further validate the findings of the present study and test its potential adaptability as a digital self-help option. With the emergence of digital technologies, it is important to address the potential use of mindfulness-based programs as digital therapeutics. Some results suggest that the efficacy of instructor-led programs and self-help programs have similar effects [14]. A meta-analysis explored the effect of mindfulness meditation intervention implemented using mobile devices, showing an improvement in stress and anxiety levels of university students [19]. Sleep quality has also been reported to improve in adults with insomnia through a self-help mindfulness-based smartphone app with guided meditations [20].

5 Conclusion

The present study revealed that a mindfulness-based program not only positively influenced stress levels, anxiety, and sleep quality among university students but also had an impact on their social interactions, as evidenced by an increase in the frequency of contact with friends. The study also highlighted the role of home practice frequency in improving sleep quality. These findings underscore the multifaceted benefits of mindfulness interventions in higher education, suggesting their potential to enhance both individual well-being and social connections. Next steps will be to adapt the mindfulness-based program for a mobile device and test with a wider intervention group, as well as an active control group.

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