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Acceptance and effectiveness of mindfulness-based interventions within regular university course teaching: Comparison of two different formats with a control group

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Abstract

The present study aimed to develop and comparatively evaluate two formats of mindfulness-based interventions (MBI) for implementation within regular university course teaching. The primary outcome was the acceptance of the two formats. The secondary outcome was the effectiveness measured by subjective ratings of the interventions, and changes in mindfulness and stress compared to a passive control group. A total of 91 students were assigned to either one of two intervention groups or the control group. The first intervention group received a MBI as a separate course (*mindfulness course*; MC); the second group received a brief MBI at the beginning of another course (*mindful beginning of course*; MBOC). Questionnaires were administered prior to the first MBI session (T1) and a week after the last MBI session (T2). Acceptance was assessed in the intervention groups at T2. Effectiveness measures were subjective ratings at T2 (intervention groups only) as well as mindfulness (FFMQ-D) and perceived stress (PSQ) assessed at T1 and T2 in all three groups. Both formats were highly accepted and rated as beneficial. Though some ratings were higher for the MC than the MBOC. Compared to the control group, mindfulness increased more in the MC group, but so did stress. In contrast, mindfulness and perceived stress remained unaffected in the MBOC group. MBIs implemented within regular university course teaching are a low-threshold approach to reach larger numbers of students. Different delivery modes and intensities are feasible and accepted by the students.

Keywords Mindfulness · MBI · Stress · Students · Acceptance · University teaching

University students appear to be healthier than peers not attending university. This applies, however, for physical health but not mental health (Grobe & Steinmann, 2015). The number of visits to a psychologist/psychotherapist and the prescription of psychotropic drugs like antidepressants are considerably higher in university students than in non-university peers (Grobe & Steinmann, 2015). In terms of prevention, universities already deliver stress management programs and psychosocial counseling, but evidence suggests that many students in need do not receive treatment (Auerbach et al., 2016; Ebert et al., 2019; Herbst et al., 2016). An alternative are low-threshold interventions like stress reduction interventions implemented within regular university course teaching. In the present study, two formats of mindfulness-based interventions (MBIs) for the implementation within regular university course teaching were developed and evaluated in terms of acceptance (primary outcome) and effectiveness (secondary outcome).

More than every fourth student in Germany reports high stress levels, 24.4% feel exhausted, an initial symptom of burnout (Grützmacher et al., 2018). International research similarly found that 37.5% of students have an increased risk of burnout due to stress (Williams et al., 2018). A variety of intrapersonal and university-related stressors like uncertainties due to the transition from school to university and related adjustments, too high expectations and dealing with the university-related workload might account for the high stress level (Bouteyre et al., 2007; Herbst et al., 2016; Kriener et al., 2018). At the same time, students often do not know how to effectively cope with stress and therefore use

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dysfunctional coping strategies, e.g., distraction and substance use (Herbst et al., 2016; Miller et al., 2017). Very intense and/or chronic demands can cause negative emotions such as fear, incompetence, and anger which are associated with psychological and physical disorders (Bouteyre et al., 2007; Enns et al., 2018; Fares et al., 2016). This is reflected by high rates of students suffering from affective and anxiety disorders as well as depressive episodes (Grobe & Steinmann, 2015). That in turn causes a loss of academic performance and more frequent premature withdrawal from higher education (Ishii et al., 2018; Middendorff et al., 2017).

In sum, these studies highlight the urgent need of stress reduction interventions for students. Accordingly, many universities in Germany deliver stress reduction interventions (Ackermann & Schumann, 2010; Herbst et al., 2016) and provide psychological counseling services (Ackermann & Schumann, 2010; Deutsches Studentenwerk, 2021). Interventions involve orientation weeks/events, sport and relaxation programs, Mental Health Days and workshops addressing stress, exam anxiety and mindfulness. Nevertheless, long waiting lists for stress management programs and psychosocial counseling indicate a high demand that cannot be met by those services (Deutsches Studentenwerk, 2021). Moreover, national (German) and international studies show that the number of highly stressed students exceeds the proportion of students seeking help services, suggesting that many students have not yet made use of those services (Ebert et al., 2019; Herbst et al., 2016). Only one sixth of all students with mental disorders receive adequate treatment (Auerbach et al., 2016). Reasons for not taking part in interventions are for example, that they believe that their problems do not require professional help and/or are not serious enough (Downs & Eisenberg, 2012; Herbst et al., 2016). To reach more students, especially those at risk and prevent the high prevalence of stress and related mental disorders, low-threshold interventions are needed. The implementation into regular university course teaching is one approach in this regard.

Interventions based on the principles of mindfulness, would be adequate for this (Bamber & Schneider, 2020). Mindfulness means a "kind of a nonelaborative, nonjudgmental, present-centered awareness in which each thought, feeling, or sensation that arises in the attentional field is acknowledged and accepted as it is" (Bishop et al., 2004, p. 232). Reviews found MBIs to reduce stress, rumination and trait anxiety and increase empathy and self-compassion (Chiesa & Serretti, 2009; Sharma & Rush, 2014). Moreover, a recent intervention study showed changes in mindfulness completely mediating the effect of MBIs on changes in stress (Shankland et al., 2021).

For the target group of students, an increasing number of reviews and intervention studies have also demonstrated positive outcomes of MBIs (Dawson et al., 2019; Halladay et al., 2019; Lynch et al., 2018). They showed less stress and rumination, as well as less depression and anxiety compared to passive control groups. Compared to active control groups, the differences were smaller but still convincing with regard to reduced stress and (trait) anxiety (Dawson et al., 2019). The association between mindfulness and anxiety has further consequences on students' academic success (Charoensukmongkol, 2019). As first-year students appear to have higher stress levels due to new living arrangements, higher demands and a new social environment, this student group is a particularly important target group (Ramler et al., 2016). Studies have shown that MBIs enhanced their adjustment to university-life and reduced their stress level indicated by lower salivary cortisol (Ramler et al., 2016).

Another advantage of MBIs is that they allow a variety of delivery formats. The most widespread intervention, the mindfulness-based stress reduction (MBSR) by Jon Kabat-Zinn (2013), includes 8-weeks of training with weekly group sessions (2–2.5 h), 45 min of home practice six days per week, and an additional Mindfulness-Day. Interestingly, there are also studies on briefer, less intense formats. A recent review including very brief MBIs infers that even a single session or a five-minute intervention can have a positive impact on a variety of health-related outcomes, including stress (Howarth et al., 2019). Moreover, meta-analyses comparing brief MBIs to more intense interventions did not find significant differences in effectiveness (Carmody & Baer, 2009). This finding also applies to brief MBIs in the university setting (Dawson et al., 2019; Halladay et al., 2019). Thus, there are different extensive and intensive formats of MBIs which could be implemented differently into regular university course teaching (e.g., Bamber & Schneider, 2020; Ramler et al., 2016; Miller et al., 2017).

In summary, prior research showed positive effects of different formats of MBIs on the healthy general population as well as on student samples. What remains unclear is to what extent students accept such interventions implemented within their regular university courses and if the kind of implementation affects their acceptance and effectiveness. Although there are initial results that different formats are accepted by students (Bamber & Schneider, 2020; Miller et al., 2017), to our knowledge no study with a comparative design exists to date. Our study advances this evidence by comparing two intervention formats and thus providing deeper insights on acceptance and effectiveness of formats which are differently implemented within regular university course teaching.

The Present Study

The initial problem of high stress levels in students and low participation rates of stress management interventions at universities suggests low-threshold interventions such as the implementation of stress reduction interventions into regular course teaching. MBIs are an adequate approach in

this regard due to their effects on stress reduction in students and different delivery formats. MBIs with different modes and intensity levels can be considered for implementation into regular university course teaching but have not yet been comparatively investigated. Therefore, it remains open (1) whether students accept MBIs as a part of regular course teaching and if the acceptance differs between intervention formats with varying delivery mode and intensity, and (2) whether these formats differ in effectiveness. The present study aimed to answer these questions.

Two formats of MBIs that were differently implemented in university course teaching were developed and evaluated: as a separate course (*mindfulness* course; MC) and as a brief beginning of another course (*mindful beginning of* course; MBOC). As implemented into regular courses, the evaluation focused primarily on the acceptance of the MBIs and possible differences between the two formats. The secondary outcome was the effectiveness. It was firstly evaluated by comparing subjective ratings of the two formats. Secondly, changes in mindfulness and perceived stress were compared to a control group.

Methods

Study Design and Procedure

A controlled study was conducted with three groups and two time points of data assessment. Two intervention groups were compared to a passive control group with no treatment. The interventions were delivered in the courses for students enrolled in the bachelor's program in health promotion at a university in southern Germany.

The students were informed about the study at the beginning of the winter semester 2019/2020. They were informed about anonymity, the voluntary nature of participation in the study and the opportunity to withdraw from the study at any point. Everyone who gave written informed consent was allowed to take part in the study. There were no further requirements.

Questionnaires were administered during courses. The baseline assessment (T1) took place after receiving signed informed consent but prior to the first intervention session (November 2019). The post intervention assessment (T2) took place approximately ten weeks later, about one week after the last intervention session.

Ethics approval was given by the institutional ethics committee.

Participants

A total of 91 students were enrolled in the courses in which the study took place. Of these eligible students, 75 were present at the T1 assessment: they provided written informed consent to the assessment and the intervention and filled in the questionnaire. Because of not being available at T2 or unclassifiable questionnaires (T1, T2) due to incorrect codes, the final sample consists of 47 students (63% of T1 participants). Figure 1 shows the flowchart of participants throughout the stages of the study.

Intervention

Two formats of a MBI were developed and delivered by the first author, who holds a B.A. in health promotion and extensive experience in mindfulness training. In addition, she was a lecturer in the bachelor's program in health promotion: a statistics course in the third semester and a course dealing with key personal skills in the first semester. The implementation of the brief MBI (MBOC) took place at the beginning of the statistics course. The key personal skills course was chosen for the MC format. For this course, the students are randomly divided into smaller groups with different lectures and varying topics. It was thus possible to teach mindfulness in one group and to use the other group as control group.

Mindfulness Course (MC)

The first format of MBI was quite extensive but still less time-consuming than the traditional Mindfulness Based Stress Reduction (MBSR) of Jon Kabat-Zinn (2013). It was delivered as a separate course and comprised four 90-min sessions. This duration is equivalent to regular university courses and to the duration of other mindfulness trainings for students (Kuhlmann et al., 2016; Lynch et al., 2018). Group size was 9 students. The first session took place in November 2019, followed by a session every two weeks. The content was derived from the traditional MBSR (Kabat-Zinn, 2013) but modified according to other MBIs for students (Eskic et al., 2019; Galante et al., 2018; Kuhlmann et al., 2016; Lynch et al., 2018) focussing on students' needs and interests. Accordingly, mindfulness, stress, coping, mindful communication and the transfer to the student's degree program and professional ambitions were addressed. Every session included formal practical exercises such as short meditations or a body scan as well as the corresponding theoretical background (slide presentation). At the end of each session participants were given a handout and the presentation. Between the sessions, students were asked to practice formal and informal exercises (meditation, mindful eating etc.). Students were allowed to miss no more than one session out of the four to pass the course. According to T2 data, the average missed attendance was $M = 0.86$ $(SD = 0.53)$. Students who did not want to take part in this intervention had the opportunity to

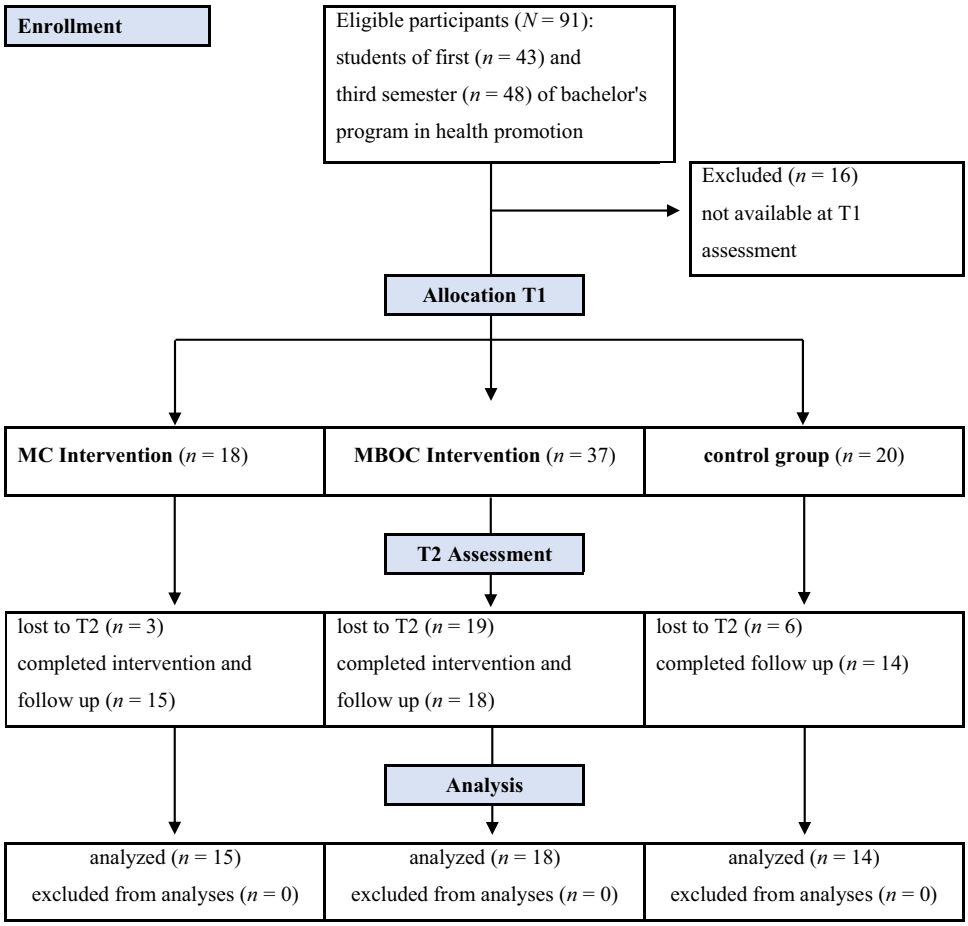

Fig. 1 Flowchart of participants

attend the alternative group of the course and to participate in the control group. Only one student made use of it.

Mindful Beginning of Course (MBOC)

The second format was a brief MBI delivered at the beginning of another course (statistics course). Following Miller et al. (2017), it included eight sessions of 5–10 min mindfulness practice. The group consisted of 35 to 40 students. The intervention started in November 2019 after the first assessment and finished at the end of January (two weeks of Christmas holidays in between). The focus was on the practice of mindfulness meditation in accordance with the traditional MBSR (Kabat-Zinn, 2013) and other short practical MBIs used in the university setting (Lynch et al., 2018; Miller et al., 2017). The practice was always followed by a brief reflection. No theory was taught. Students who did not want to participate in the intervention were asked either to join the course 10 min later or to sit quietly in the classroom during the intervention. Very few students made use of this possibility.

Measures

Standard demographic measures such as age, relationship status, university-related workload and workload of secondary employment, were assessed at T1. Due to the small group sizes, gender and ethnical background were excluded to guarantee anonymity. Acceptance and effectiveness were examined using various indicators.

Acceptance

Acceptance was assessed at T2 in the intervention groups. Based on previous studies measuring acceptance (Löcherer & Apolinário-Hagen, 2017; Sekhon et al., 2017) the following seven indicators were used: Importance of MBIs generally and at university ("I consider mindfulness-based interventions (at university) to be important", 1 = *do not agree at all* to 5 = *fully agree*), former interest in mindfulness ("how interested were you on mindfulness before the intervention?", 1 = *very low* to 5 = *very high*), importance of participation ("it was important for me to take part", 1 = *do not agree at all* to 5 = *fully agree*) and frequency

of participation("how often did you participate?", MC: *1 to 4 sessions*, MBOC: 1 = *never* to 5 = *always*). Moreover, participants were asked for an overall rating (school grades 1 to 6; 1 = *excellent*) and whether they would recommend the intervention to a friend ("would you recommend the intervention to a friend?" *yes/no*).

Effectiveness

Effectiveness was examined twofold: First, subjective ratings were assessed at T2 in the intervention groups to test whether significant differences between the two formats exist. Second, mindfulness and perceived stress were assessed at T1 and at T2 in all three study groups to compare changes over time between the intervention groups and the control group.

Subjective ratings concerned the benefits emerging from the intervention: general benefit ("how useful was the MBI?", 1 = *not at all useful* to 5 = *very useful*), personal benefit ("how high do you estimate your personal benefit?", 1 = *very low* to 5 = *very high*) as well as university-related benefits ("how high do you estimate your university-related professional benefit", "…your university-related interdisciplinary benefit?", 1 = *very low* to 5 = *very high*). Furthermore, an increase in interest ("the intervention raised my interest in mindfulness" 1 = *do not agree at all* to 5 = *fully agree*), dealing with the topic in leisure time ("I dealt with the topic in my leisure time", 1 = *do not agree at all* to 5 = *fully agree*), and the intention to continue practicing ("I plan to continue the practice", 1 = *do not agree at all* to 5 = *fully agree*) was measured.

Mindfulness was measured using the German version of the Five Facet Mindfulness Questionnaire (FFMQ-D) translated by Michalak et al. (2016). With 39 Items, it measures five different aspects of mindfulness (nonreactivity, nonjudging, acting with awareness, describing and observing) which can be aggregated to a general mindfulness-factor including all aspects except observing (Baer et al., 2006; Baer et al., 2008; Michalak et al., 2016). An example item for *non-reactivity* is "when I have distressing thoughts or images, I am able just to notice them without reacting". Items were rated on a 5-point Likert-type scale ranging from 1 = *never* to 5 = *very often or always true* with higher scores indicating higher levels of mindfulness. Reliability for the German version is acceptable (Michalak et al., 2016). Cronbach's alpha for the current sample was within an acceptable range with $\alpha = .88$ (T1) and $\alpha = .93$ (T2) for the general mindfulness factor and $\alpha \geq .77$ (T1 and T2) for the subscales.

Perceived stress was assessed by the German version of the Perceived Stress Questionnaire (Fliege et al., 2001). The PSQ consists of 20 items measuring four subcategories (joy, worries, tension and demands) that can be aggregated to an overall factor. Participants were asked to rate how often they have experienced the specific feelings or thoughts in the last four weeks (e.g., "you feel under pressure from deadlines"). Other than the original PSQ a five-point Likert-scale was used ranging from 1 = *never* to 5 = *very often*. Considering this sample, the reliability for all scales was Cronbach's $\alpha \geq .93$.

Data Analyses

IBM SPSS statistics version 25 was used for data analyses. A p value of $< .05$ with an α-level of 5% was set for statistical significance. To estimate and interpret the effect size, partial η-square values (small $\geq .01$; medium $\geq .06$ and large $\geq .14$) were calculated for the mixed ANOVAs and r (small $\geq .10$; medium $\geq .30$ and large $\geq .50$) for Mann-Whitney-U-tests. The interpretation is in accordance with Cohen (1988; Richardson, 2011). For unsystematic data loss (max. 10% missing answers), a missing item value was replaced by the individual mean value of the respective scale.

Demographic data was analyzed descriptively by frequencies, means, standard deviations and medians. For drop-out analyses t-tests and Mann-Whitney-U-tests as well as Chi^2-tests were used depending on data distribution. To compare the two interventions groups, Mann-Whitney-U-tests were used. For comparison of the two intervention groups with the control group, mixed ANOVA (three groups at two time points) were performed followed by Bonferroni-corrected post-hoc tests. The corrected p-values are reported. Effect sizes were calculated for all tests.

Results

At T1, 75 students took part in the assessment. Although most students were present during the MBIs, the longitudinal study sample consisted of only 47students (63%), due to not being available at the T2 assessment or unclassifiable questionnaires (T1, T2) due to incorrect codes (see Fig. 1).

To exclude a systematic drop-out, students who completed both assessments ($n = 47$) were compared to those who did not complete the assessment at T2 (or were not assignable, $n = 28$). Analyses showed no significant differences for age, university-related workload and workload of secondary employment. There were also no differences in mindfulness. Though, significant differences in drop-out rates were revealed for group assignment and perceived stress. The drop-out rate was lowest in students of the MC (17%; $n = 3$), followed by the control group (30%, $n = 6$) and the MBOC (51%, $n = 19$), $\chi^2(2) = 6.85$, $p = .032$, $\varphi = .302$. Regarding perceived stress, the students who dropped out showed significantly higher levels in overall-PSQ ($U = 380.00$, $z = -2.86$, $p = .004$, $r = .33$), worries ($U = 474.00$, $z = 2.02$, $p = .043$, $r = .23$), demands ($U = 412.00$, $z = -2.71$, $p = .007$,

$r = .31$) and tension ($U = 379.50$, $z = -3.06$, $p = .002$, $r = .35$) compared to the final sample. This indicates a systematic drop-out from data assessment of MBOC students and students who were more stressed at T1. This needs to be considered when interpreting the results.

Examining the final study sample of 47 participants for group differences in baseline-measures, no significant differences were found for age, family status and secondary employment. The mean age was 21.62 years ($SD = 3.72$) and the majority was in a relationship or married (58%, $n = 27$). Secondary employment was pursued by 57% ($n = 27$), mostly under 15 h per week (75%, $n = 21$). Yet the three groups differed significantly in university-related workload (CG and MC: Md = 11–20 h and MBOC: Md = 21–30 h; Kruskal-Wallis-H(2) = 6.15, $p = .046$). Bonferroni-corrected post-hoc tests revealed differences to be significant between CG and MBOC only ($z = -2.41$; $p = .048$; $r = .43$): students in the control group spent less time studying than students of the MBOC group at T1.

Acceptance

The primary research question was whether MBIs implemented in regular course teaching are accepted by the attending students and whether the acceptance differs between intervention formats with varying delivery mode and intensity. Acceptance ratings are displayed in Table 1. Mann-Whitney-*U*-tests for nonparametric variables were applied to test differences between the two MBI formats for significance.

Students of both groups strongly agreed with the statement that MBIs are generally important. The MC students, however, showed a significantly stronger agreement in terms of the importance of MBIs at university, $U = 85.00$, $z = -1.99$, $p = .046$, $r = .35$. Both intervention groups reported a strong interest in mindfulness already before the start of the interventions. In accordance with this, the importance ratings of participation were high in both groups and so were the self-reported participation rates. Notably, students of the MC rated the importance significantly higher, $U = 80.00$, $z = -2.19$, $p = .029$, $r = .38$. The overall rating was 1–2 (*very good* to *good*) and almost all students of both formats would recommend the MBI to a friend.

Effectiveness

The secondary research question regarded differences in effectiveness of the two MBIs with varying delivery mode and intensity.

Subjective Ratings

First, subjective ratings of effectiveness were compared between the two intervention groups using Mann-Whitney-*U*-Tests. Descriptive data are displayed in Table 2.

Subjective ratings were on average moderate to high indicating both formats to be effective. The general helpfulness was rated highest followed by the increase of interest in mindfulness. Both ratings however differed significantly in favor of the MC: Participants of the MC group rated their intervention significantly more helpful than the MBOC students did ($U = 58.00$, $z = -3.14$, $p = .002$, $r = .55$) and reported a higher increase in interest in mindfulness, $U = 47.50$, $z = -3.37$, $p = .001$, $r = .59$. They additionally agreed stronger with the statement that they had dealt with mindfulness in their leisure time, $U = 82.50$, $z = -1.98$, $p = .048$, $r = .34$. The university-related professional benefit was rated lowest in both groups.

Table 1 Acceptance ratings by the intervention groups: Descriptive statistics and *U*-tests

Measure	MC ($n = 15$)	MBOC ($n = 18$)	*U*-test
	M (*SD*)	*M* (*SD*)	*r*
Importance of MBIs generally	4.67 (0.49)	4.39 (0.78)	.16
Importance of MBIs at university	4.67 (0.49)	4.11 (0.83)	.35*
Former interest in mindfulness	3.87 (0.99)	3.94 (0.94)	.03
Importance of participation	4.67 (0.79)	4.06 (0.87)	.38*
Frequency of participation	3.21 (0.58)[a]	4.89 (0.32)[b]	N/A
Overall rating (school-grade)	1.33 (0.49)	1.50 (0.51)	.17
			PearsonChi[2]
	n (%)	*n* (%)	*V*
Recommendation of MBIs to a friend	15 (100%)	16 (89%)	.23

$r = \left|\frac{z}{\sqrt{n}}\right|$; N/A not applicable; Cramer-$V = \sqrt{\frac{\chi^2}{n \times (\min(k,m)-1)}}$

[a]value range from 1 to 4

[b]value range from 1 = *never* to 5 = *always*

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2 Subjective ratings of effectiveness by the two intervention groups: Descriptive statistics and *U*-tests

Measure	MC ($n=15$) *M* (*SD*)	MBOC ($n=18$) *M* (*SD*)	*U*-test *r*
Generally helpful	4.87 (0.35)	3.94 (1.00)	.55**
Personal benefit	4.07 (0.59)	3.61 (0.85)	.30
University-related professional benefit	3.60 (0.74)	3.56 (1.04)	.03
University-related inter-disciplinary benefit	4.33 (0.49)	3.72 (1.07)	.30
Increase in interest	4.67 (0.49)	3.67 (0.84)	.59***
Dealt with topic in leisure time	3.87 (0.52)	3.06 (1.35)	.34*
Intention to continue practicing	4.27 (0.80)	3.72 (0.89)	.30

ES: Effect size $r = \left|\frac{z}{\sqrt{n}}\right|$
*$p<0.05$; **$p<0.01$; ***$p<0.001$

Mindfulness and Perceived Stress

Second, changes in mindfulness and perceived stress from T1 to T2 were compared with a control group. Mixed ANOVAs were performed to examine the effects simultaneously avoiding multiple testing and the related accumulation of type one error. Group was included as between-subjects factor (MC, MBOC, control group) and time as within-subjects factor (T1, T2). Effectiveness was examined by means of interaction effects (group x time). In case of significance, post-hoc tests were applied with Bonferroni-corrections to identify which groups differed significantly from each other. All means and standard deviations as well as the interaction effects are reported in Table 3. For the sake of comprehensiveness, group and time effects are reported too.

There was a significant interaction effect (group x time) with moderate effect size for the *overall mindfulness* factor, $F(2,44)=4.66$, $p=.015$, partial $\eta^2=.18$. Interaction effects in the post-hoc tests were not significant, although the MC group recorded a significant increase ($F(1,14)=5.93$, $p=.029$, partial $\eta^2=.30$) while students of the MBOC and the control group did not. Group effects were not significant.

Regarding the mindfulness subscales, significant interaction effects were found for *nonreactivity* ($F(2,44)=6.30$, $p=.004$, partial $\eta^2=.22$) and *non-judging* $F(2,44)=4.22$, $p=.021$, partial $\eta^2=.16$. All groups recorded an increase in *nonreactivity,* yet the increase was only significant among the MC students, $F(1,14)=16.28$, $p=.001$, partial $\eta^2=.54$. With regard to the subscale *non-judging*, MC students increased significantly in *non-judging* ($F(1,14)=5.33$, $p=.037$, partial $\eta^2=.28$) while students of the MBOC did not. No significant interaction effects were found for the subscales *acting with awareness*, *describing* and *observing*. Group effects were not significant.

Given the fact, that the MC did better in comparison with the control group for *nonreactivity* and compared to MBOC for *nonreactivity* and *non-judging,* the MC seemed to be more effective with respect to changes in mindfulness.

With respect to perceived stress (see Table 4), neither for the overall stress nor for the subscales *joy*, *worries*, *tension* significant interaction effects were found. For the subscale *demands* however the interaction effect was significant, $F(2,44)=6.58$, $p=.003$, partial $\eta^2=.23$. MC and the control group recorded a significant increase in *demands* from T1 to T2 (MC: $F(1,14)=5.34$, $p=.037$, partial $\eta^2=.28$; CG: $F(1,13)=10.76$, $p=.006$, partial $\eta^2=.45$) while the MBOC students did not.

Furthermore, there was a significant time effect on the overall PSQ in the control group indicating an increase of perceived stress in this group, $F(1,13)=5.72$, $p=.033$, partial $\eta^2=.31$. No significant group effects were found.

In summary, these results reveal that all students faced growing demands across the semester except those of the MBOC group.

Discussion

MBIs are effective stress reduction interventions among students (Dawson et al., 2019; Halladay et al., 2019; Lynch et al., 2018; Ramler et al., 2016). The implementation into regular teaching is a promising approach to reach more students. This is of importance as many students experience high stress levels (Grützmacher et al., 2018; Herbst et al., 2016; Williams et al., 2018) but do not receive the opportunity to participate in stress management interventions at universities (Auerbach et al., 2016; Ebert et al., 2019; Herbst et al., 2016). MBIs with different formats are effective (Dawson et al., 2019; Halladay et al., 2019; Howarth et al., 2019) and can thus be differently implemented into teaching. The present study is, to our knowledge, the first study that developed and comparatively evaluated two MBIs varying in delivery mode and intensity: a MBI as a separate course and a brief MBI at the beginning of another course. Due to its comparative design, the study aimed to advance knowledge on the acceptance and effectiveness of formats

Table 3 Interaction effects (group x time) of mindfulness (FFMQ-D): Descriptive statistics and mixed ANOVA with post- hoc tests

Measures	MC ($n=15$)		MBOC ($n=18$)		CG ($n=14$)		Mixed ANOVA	Post-hoc tests (Bonferroni correction)		
	M (*SD*)		*M* (*SD*)		*M* (*SD*)		η_p^2	η_p^2		
	T1	T2	T1	T2	T1	T2	CG, MC, MBOC	MC vs. MBOC	MC vs. CG	MBOC vs. CG
Overallmindfulness[a]	3.31 (0.39)	3.50 (0.54)	3.34 (0.49)	3.30 (0.56)	3.44 (0.38)	3.40 (0.34)	.18*	.17	.18	.00
Non-reactivity	2.85 (0.78)	3.30 (0.72)	2.95 (0.61)	2.99 (0.56)	3.17 (0.50)	3.23 (0.58)	.22**	.25**	.20*	.00
Non-judging	3.38 (0.78)	3.74 (0.80)	3.50 (0.77)	3.36 (0.77)	3.47 (0.69)	3.33 (0.79)	.16*	.18*	.17	.00
Acting with awareness	3.37 (0.57)	3.24 (0.66)	3.23 (0.59)	3.22 (0.72)	3.36 (0.59)	3.20 (0.58)	.03			
Describing	3.58 (0.50)	3.68 (0.55)	3.62 (0.59)	3.59 (0.66)	3.74 (0.48)	3.83 (0.43)	.03			
Observing	3.51 (0.63)	3.70 (0.47)	3.66 (0.63)	3.80 (0.47)	3.67 (0.45)	3.52 (0.61)	.07			

$\eta_p^2 = \frac{SSEffect}{(SSEffect+SSFehler)}$

[a]items of the observing-scale are not included (see text for details)

*$p<0.05$; **$p<0.01$; ***$p<0.001$

Table 4 Interaction effects (group x time) of perceived stress (PSQ): Descriptive statistics and mixed ANOVA with post-hoc tests

Measures	MC ($n=15$)		MBOC ($n=18$)		CG ($n=14$)		Mixed ANOVA	Post-hoc tests (Bonferroni correction)		
	M (*SD*)		*M* (*SD*)		*M* (*SD*)		η_p^2	η_p^2		
	T1	T2	T1	T2	T1	T2	CG, MC, MBOC	MC vs. MBOC	MC, vs. CG	MBOC vs. CG
Overall perceived stress	2.49 (0.56)	2.74 (0.73)	2.61 (0.70)	2.58 (0.65)	2.65 (0.70)	2.90 (0.72)	.06			
Demands	2.49 (0.65)	3.31 (0.69)	2.83 (0.72)	2.89 (0.47)	2.73 (0.67)	3.46 (0.59)	.23**	.22*	.00	.29**
Joy	3.73 (0.51)	3.55 (0.63)	3.73 (0.64)	3.70 (0.80)	3.80 (0.90)	3.73 (0.73)	.01			
Worries	2.67 (0.89)	2.61 (0.91)	2.68 (0.74)	2.67 (0.92)	2.87 (0.94)	3.14 (0.99)	.04			
Tension	2.52 (0.60)	2.58 (0.94)	2.66 (0.91)	2.67 (0.77)	2.79 (0.76)	3.04 (0.78)	.04			

$\eta_p^2 = \frac{SSEffect}{(SSEffect+SSFehler)}$

*$p<0.05$; **$p<0.01$; ***$p<0.001$

which are differently implemented within regular university course teaching.

The primary research question was whether the MBIs are accepted in regular teaching and whether differences between the two formats can be found. This is particularly important, when implemented into regular teaching instead of as an elective course. Corresponding to previous research on MBIs in addition to regular courses or implemented into university course teaching (Bamber & Schneider, 2020; Miller et al., 2017) wide acceptance for the intervention was found. Moreover, the direct comparison of the two formats showed that MBIs implemented into university course teaching are accepted unaffected by the delivery mode and intensity: Students in both MBI formats rated mindfulness in general as important, confirmed their interest, would recommend the intervention to a friend and gave it a good to very good final grade.

Another indicator of acceptance and the suitability of MBIs in regular university course teaching were the high participation rates: Only one person assigned to the MC group decided not to participate in the intervention and therefore changed to the control group. This was due to personal reasons that were not further specified. The other students of the MC group participated in three to four sessions. Similarly, the students of the MBOC participated nearly always although they had the opportunity to attend the statistics course afterwards. This is noteworthy because they actually rated the importance of MBIs at universities as well as their participation significantly lower than those of the MC group. It additionally underlines the low-threshold access of this format. In general, the high participation rates are promising as evidence suggests that many students in need do not receive adequate treatment (Auerbach et al., 2016; Ebert et al., 2019; Herbst et al., 2016)). It can be assumed that both formats reached students who elsewise would not have attended an additional MBI or a stress management intervention. The high and comparable acceptance recommends MBIs as a separate course with extensive theory and practice as well as a brief mindful beginning of another course. The results underline that MBIs can be selected and adapted to match the particular curriculum and staff.

The secondary research question was how effective the two MBI formats are. According to subjective ratings of the students regarding benefits, increase in interest, the additional use in leisure time and the intention to continue, both formats were effective. In comparison, however, the MC was again rated a little better in some aspects. The MC group rated their intervention to be significantly more helpful, they indicated a larger increase in interest and to deal with mindfulness more frequently in their leisure time. They seemed to engage more with the theory and practice of mindfulness. With respect to benefits and the intention to continue practicing both MBIs did not differ. Personal and university-related benefits were rated high in both groups. As universities aim to develop a student's personality and employability, this is a very important effect (Kultusministerkonferenz [KMK], 2017). A recent review of qualitative research on students' perceptions on mindfulness-based interventions found similar effects: Students described the MBIs as beneficial tools for future careers (Bamber & Schneider, 2020). Additionally, 80% of the MC students and 55% of the MBOC students stated that they plan to continue the practice after the intervention. This is consistent with the results of a MBI for medical students in Mainz showing that the students frequently used the learned mindfulness strategies one year after the training (*MediMind,* Kuhlmann et al., 2016). The authors concluded that mindfulness practices can be easily integrated into students' everyday life. Positive effects beyond the intervention time are to be expected but need to be further investigated, for example by follow up assessments. Nevertheless, the subjective ratings of effectiveness were already encouraging for both formats.

In addition, changes in mindfulness and perceived stress were examined in comparison to a control group. First, effects on mindfulness were tested as proximal objective of MBIs (Shankland et al., 2021). The MC did better in increasing *non-reactivity* compared to the control group. This is in line with the results of de Vibe et al. (2013) reporting a significant effect of a MBI in universities on *non-reactivity,* too. This effect however could not be confirmed for the MBOC. The MC moreover was better in increasing *non-reactivity* and *non-judging* in comparison to the MBOC. This was surprising as previous research showed brief and less intense MBIs to be as effective as more intense ones (Carmody & Baer, 2009; Dawson et al., 2019; Halladay et al., 2019). At the same time, however, the pattern of results fits the assumption that first year students may be extraordinarily open and receptive to a MBI (Miller et al., 2017): The MC was attended by students of the first semester, while the MBOC by those of the third semester. This may also explain why no differences between the MBOC and the control group (first semester) were found.

Second, effects on stress were examined as more distal objectives of MBIs. A recent mediation analyses showed changes in mindfulness completely mediating the effect of MBIs on changes in stress (Shankland et al., 2021). Consequently, stress in the MC group should have decreased or at least increased less due to higher scores in mindfulness in comparison to the control group. Results however did not confirm this. Stress in terms of *demands* rather increased in both groups which could be interpreted as ineffectiveness of the MC. At the same time, however, it could be an expression of effectiveness as MBIs aim to improve the ability of noticing present feelings and sensations (Michalak et al., 2012). The high stress levels could therefore indicate a mindful mind of the MC participants and their ability to

recognize stress earlier. No more precise statement can be made.

Instead, the results suggest that the brief MBOC intervention was more effective in stress reduction: The interaction effect on perceived *demands* was significant among the MBOC group and the CG, and among the MBOC group and the MC group. The MBOC group did not record any increase in stress, but already started with a higher level of workload than the control group at T1. Yet, to comprehend this, the subscale *demands* and the group assignment needs to be considered. The subscale *demands* measures the perception of external stressors, whereas the other subscales of the PSQ measure internal stressors (Fliege et al., 2001). The *demands,* in this context, include among others the university-related workload of the students. As mentioned earlier, students in the third semester were assigned to the MBOC group and students in the first semester were assigned to the MC and the control group. Therefore, study conditions and experiences of the study requirements might have differed between the two cohorts. The differences in stress reduction between the two intervention groups can therefore not be clearly attributed to the intervention formats but may also result from these differences. To be able to make more precise statements about the intervention effect on stress, studies with a higher internal validity are needed (i.e., without such a confounding difference between the study groups).

For further interpretation, the following methodical limitations must be taken into account. First, the drop-out rate was high and associated with group allocation and stress level at T1. As systematic drop-out can affect the results and lead to an under- or overestimation of the effects this has to be discussed. Students with high stress levels at T1 might have missed the last session in which the T2 assessment took place due to studying at home for the exams. Since the MBOC group had the highest drop-out rate it cannot be ruled out that its effects on stress were overestimated as the stagnation of the stress level was due to missing data of the extraordinarily stressed students. At the same time, it is clearly shown that high-risk groups benefit more by interventions (McGrady et al., 2012). Therefore, students who would have especially benefited might have been missing in the second assessment. On the other hand, it should be noted once again that the rates of intervention participation were very high in both groups. This is consistent with the findings of Kuhlmann et al. (2016) that a distinction must be made between motivation for the training and for the survey. This is especially visible for the MBOC students. The results therefore do not include all students who attended the MBIs. A small sample size, as a result of the high drop-out, can additionally favor non-significant results (Metzler & Krause, 1997). Effect sizes were therefore calculated and reported.

Second, the assessment of self-reported data always conceals risks for any evaluation. When measuring mindfulness extra problems appear: Items are often ambiguously expressed and can therefore wrongly interpreted and a wrong self-perception may result in an overestimation of one's own mindfulness particularly before an MBI (Michalak et al., 2016). Dealing with mindfulness may sensitize people about their lack of mindfulness and for their perception of stress leading to higher reports on respective scales.

A third limitation relates to our sample of health promotion students. Both intervention groups reported a high interest in mindfulness already before the start of the interventions. This might indicate a specific openness of these students for mindfulness and MBIs. Only further intervention studies on students enrolled in programs not related to health will show whether the results on acceptance and effectiveness are generalizable.

Fourth, the choice of the mindfulness lecturer needs to be discussed. The lecturer was not a qualified mindfulness-teacher so that small deviations from the traditional MBSR cannot be ruled out. However, as there is neither a standardized MBI program nor an official training, this point of criticism applies to many MBIs. For uniform and comparable MBIs a professionalization is needed (Schindler, 2020). In addition, the lecturer had extensive knowledge about mindfulness training. Moreover, choosing her, not only enabled the implementation of MBI in regular university course teaching, but also the implementation of two different formats and their comparative evaluation. The intervention groups were thus natural groups in which self-selection of e.g., highly motivated students can be excluded, which strengthens the external validity of the study.

Despite these limitations, the study is to our knowledge the first one with a comparative design contributing specific evidence on the acceptance and effectiveness of formats which are differently implemented within regular university course teaching. The results show that MBIs with different modes of delivery and intensity could be implemented and were highly accepted as part of regular university course teaching regardless of the format. In addition, the MBIs had positive effects on the participants and only a few differences emerged, speaking for MBIs as a separate course. Changes in mindfulness and perceived stress were only marginal, but the participants perceived various benefits from both MBIs.

The study suggests MBIs implemented in regular university course teaching to be an adequate low threshold approach to sensitize students for the topic of stress and stress management. The format can be selected and adapted to match the particular curriculum and staff situation. Even brief MBIs are a means to reach students at risk who would not attend psychosocial counseling or stress management programs. Based on existing evidence, they can help students in the long run to reduce high levels of stress, and thus the negative consequences on mental and physical health and studying (Dawson et al., 2019; Halladay et al., 2019).

Authors' contribution Both authors made substantial contributions to the conception and design of the study, the analysis and interpretation of data, drafted or revised the manuscript, and approved this version to be published.

Data availability The data supporting the findings of this study are not openly available due to reasons of sensitivity but are available from the corresponding author upon reasonable request. The same applies to the consent forms and further materials.

Declarations

Ethics approval Ethics approval was given by the institutional ethics committee confirming that the study met the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed consent All participants provided written informed consent prior to participating.

Conflict of interest The authors declare that they have no conflict of interest.

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