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ORIGINAL PAPER

An Effectiveness Study of a Digital Mindfulness-Based Program for Upper Secondary Education Students

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Abstract

Objectives Mindfulness-based programs/interventions (MBPs) are emerging as treatments for anxiety and stress for adults and adolescents. MBPs can also be helpful as universal interventions for healthy subjects. Few studies have looked at how beneficial MBP effects transfer to digital MBPs.

Methods The study was a randomized controlled trial with 1349 participants aged mostly 16–19. We compared a digital MBP vs. a waitlist condition. Online questionnaire data were collected pre-program, post-program, and at 3-month follow-up.

Results Completing the MBP resulted in a small-to-moderate reduction in anxiety ($F_{1,681} = 13.71$, $p < .01$, $d = .26$), a small reduction in depression ($F_{1,686} = 8.54$, $p < .01$, $d = .15$), and a small increase in psychological quality of life ($F_{1,708} = 3.94$, $p = .05$, $d = .16$). Attrition rate for the MBP was 41.5%.

Conclusions The results suggest that digital MBPs can be successful in delivering at least some of the benefits characteristic of face-to-face MBPs.

Keywords Mindfulness · Mindfulness-based program (MBP) · Digital · Depression · Anxiety

The effects of mindfulness-based programs and mindfulness-based interventions (hereafter both are referred to as MBPs) on mental and physical suffering have been a focus of intense interest in recent years. Best available evidence in the field now indicates that MBPs are effective in treating recurrent depression and possibly effective in alleviating anxiety and stress (e.g., de Vibe et al. 2017; Goyal et al. 2014; Kuyken et al. 2015). In addition to combating adversity, MBPs can also enhance well-being, e.g., via improving meditators' overall quality of life and physical functioning (de Vibe et al. 2017; Goyal et al. 2014). MBPs can thus be studied both as treatments for specific mental health issues (e.g., depression, anxiety) and as universal well-being interventions. MBPs can benefit participants when delivered face-to-face. However, less evidence exists for the efficacy of online or digital MBPs. A particularly underrepresented group in digital MBP studies are children and adolescents. Researchers have also recently argued that MBPs for adolescents would benefit from being supplemented with smartphone-based ecological momentary intervention (EMI) components (Lucas-Thompson et al. 2019).

The most common group MBPs are the MBSR and the MBCT (mindfulness-based stress reduction and mindfulness-based cognitive therapy; Kabat-Zinn 1990; Teasdale et al. 2000). The duration of these interventions is 8 weeks and they involve daily home practice. Recently, smartphone apps and online resources have played an ever greater role as an entry point to mindfulness practice (Mani et al. 2015). Ever more mindfulness apps exist by the year, with the evidence base yet to catch up with app innovation.

MBPs can also be delivered online. Study of digital MBPs is an emerging field, but early meta-analytic evidence indicates small to moderate effects on depression, anxiety, and well-being with possibly a larger effect on stress (Spijkerman et al. 2016). Because of their near-universal reach, smartphone apps and the internet are convenient channels for disseminating evidence-based programs. This would make digital MBPs, if evidence-based and low-risk, seem very cost-effective as well, given associated costs are very small when compared with how easily programs reach many

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participants. There is evidence that whether people develop a mindfulness practice on a face-to-face MBP or without one, their formal practice frequency is the same (Birtwell et al. 2019).

Meta-analytic evidence suggests that MBPs may be effective in treating depression, anxiety, and stress in children and adolescents, and that they are most effective for older adolescents (Carsley et al. 2018; Kallapiran et al. 2015; Zoogman et al. 2015). With children and adolescents, it is possible that MBPs work particularly well in clinical populations (Zoogman et al. 2015). Age-appropriate MBPs have also been designed for and taught in schools. The MBPs are typically taught in the classroom by a specifically trained instructor (often the teacher). Universal prevention effects of MBPs on adolescents and children have been studied much less than in adult populations, though some single studies indicate positive effects (e.g., Crescentini et al. 2016).

Around a fifth of Finnish students in upper secondary education report seeking help for depression (Finnish School Health Survey 2013). More than a tenth of students have reported anxiety and school burnout (a severe form of stress, which is on the rise in the Finnish upper secondary education student population), respectively (Finnish School Health Survey 2013; Finnish School Health Survey 2015). Many more students present with milder emotional problems. Given the prevalence of mental health issues in secondary education, the use of universal MBPs for early prevention, as well as intervention into existing problems, appears warranted (Compas et al. 1993; Harrington et al. 1990; Keenan-Miller et al. 2007; Woodward and Fergusson 2001).

Among the more common and studied classroom-based MBPs are the MindUP (sample participant ages between 9 and 11; Schonert-Reichl et al. 2015) and Kindness Curriculum (preschool sample; Flook et al. 2015) in Canada and the USA and the .b ("dot b"; Kuyken et al. 2013) in the UK. Available evidence from meta-analysis suggests beneficial effects of school-based MBPs on cognitive function, stress, and resilience (Zenner et al. 2014). However, as the field is just emerging, meta-analyses have to rely on a sparse literature and suboptimal methodology in original studies (Felver et al. 2016). In addition to the effects mentioned, individual studies of school-based MBPs have hinted at benefits in well-being and executive function, as well as decreased depression (Flook et al. 2010; Kuyken et al. 2013). Digital MBPs for children and adolescents have thus far seen very little research.

The aim of the present study was to examine the effectiveness of a digital MBP in a population of Finnish upper secondary education students. Based on earlier MBP literature and pilot data on the particular program at hand, we hypothesized that (1) taking part in the digital MBP would have a small to moderate between-group effect on student well-being, seen through lower anxiety, depression, school burn-out, and higher psychological well-being (psychological quality of life, and secondary variables, e.g., self-compassion and happiness), and that (2) the magnitude of acquired benefit would be contingent upon the frequency and amount of practice, so that students practicing more would benefit more (as reported by, e.g., Carmody and Baer 2008; Huppert and Johnson 2010). Based on earlier literature, we expect those with more mental health problems to benefit more (Zoogman et al. 2015).

Method

Participants

Participants (final sample $n = 1349$) were upper secondary education students in Finland. Participants were recruited from every upper secondary education institution in Finland ($k = 554$). School contacts were obtained from the Finnish National Board of Education. Participants were recruited via email (see Fig. 1 for program and study procedure). Altogether 1600 unique emails registered to take part in the MBP. Of these emails 22 were determined to be likely multiple registrations by one person and removed (criteria for likely duplicates: the same first and last name in two or more email addresses). Out of the remaining 1578 email accounts 1412 logged in at the MBP website at least once. Out of these 1412 people 1349 answered the study questionnaire on at least one time point and were thus considered the study sample. Age was measured categorically with a baseline ($n = 1218$; 23 N/A) median at 17 years (response options [number of respondents]: under 15 [0], 15 [29], 16 [266], 17 [405], 18 [261], 19 [40], 20–24 [73], 24+ [144]). 85.7% ($n = 1147$) of questionnaire respondents were female (174 males, 17 other, 9 N/A; percentage out of 1340). 73.4% ($n = 984$) of participants were upper secondary school students and 26.6% ($n = 356$) were vocational institution students (9 N/A; percentages out of 1340). 27.4% ($n = 367$) of participants were 1st year students, 45.2% ($n = 605$) 2nd year, 24.1% ($n = 323$) 3rd year, and 3.2% ($n = 43$) had studied for more than 3 years (11 N/A; percentages out of 1338). As the sample size was very large (both groups $n > 300$), power was deemed clearly sufficient for the analyses.

Procedure

Participants responded to a program advertisement briefly describing mindfulness, the program, and possible benefits from practice, and volunteered to participate. The course was extracurricular with no affiliation to upper secondary educational institutions and no credit promised. Some schools later voluntarily credited some students for participating on the course. We did not encourage any schools to credit students and did

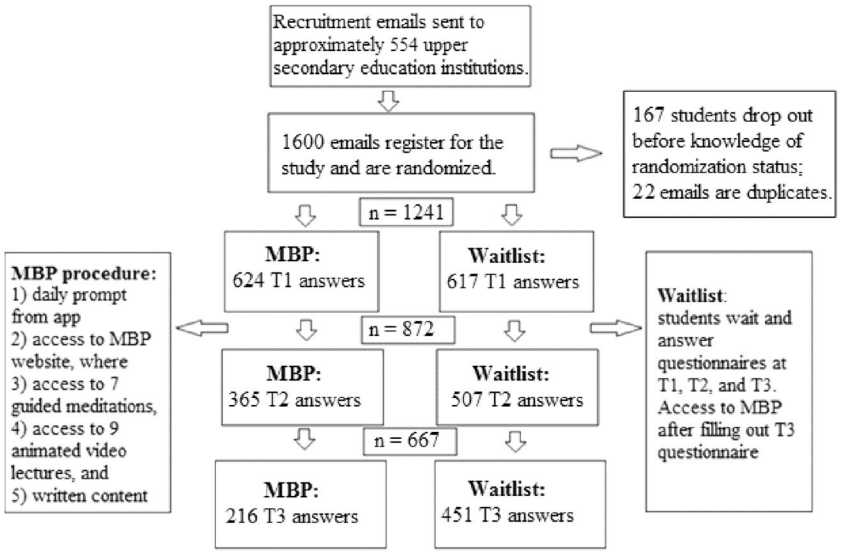

Fig. 1 Program and study procedure

not collect data on which ones eventually did. However we did supply diplomas to students who asked for one. Out of 1412 participants, 6.8% ($n = 96$) asked for a diploma to apply for credit at their educational institution.

Upon registering online on the study website, participants were randomized to treatment or waitlist conditions by an algorithm embedded on the MBP website. Students were informed of their assignment status only *after* they had answered the T_1 baseline questionnaire in its entirety. Block randomization, in blocks of two, was employed to maintain similar sizes for the groups (Altman & Bland, 1999). This precaution was taken as we did not know from the outset how big a sample we would be able to obtain. The 1600 program registrations were allocated between two conditions (800 in each). The study sample comprised 1349 (waitlist: 682; MBP: 667) students. Out of the 1349, 1241 (waitlist: 617, MBP: 624) students answered the baseline questionnaire at T_1. After the program, 872 (waitlist: 507, MBP: 365) students answered the post-program questionnaire at T_2, and 667 (waitlist: 451; MBP: 216; Fig. 1) the follow-up questionnaire at T_3. There was thus considerable dropout in the treatment arm: 252 participants at T_2 and a further 149 at T_3, whereas 110 (T_2) and 56 (T_3) participants dropped out in the waitlist arm.

The MBP A digital MBP, "*Tita*", was offered as the treatment condition. The waitlist were promised and granted access to Tita once follow-up data had been collected. Tita is short for "tietoisuustaitopohjainen hyvinvointikurssi," which translates to "mindfulness-based well-being course". Tita is an 8-week MBP devised by the first author. It consists of 7 downloadable guided mp3-meditations (5, 10, and 20 min sitting meditations, a 20 min body scan, short audio instructions for a walking meditation, a 12 min loving-kindness meditation (titled "compassion meditation"), and a 5 min self-compassion meditation) and 9 video lectures (8–20 min each) on mindfulness, (self-)compassion, stress management, and developing everyday routines that support well-being, released on a video per week basis. On each Sunday for 8 weeks, participants received a newsletter email informing them that a new video lecture was now online. On the fifth Sunday, due to human error, the newsletter email did not go out to participants. Topics of the video lectures were as follows: (1) mindfulness, acceptance, and attention; (2) mindfulness, acceptance, and attention 2; (3) thoughts, body, and emotions 1; (4) thoughts, body, and emotions 2; (5) thoughts, body, and emotions 3; (6) thoughts, emotions, and body 4; (7) compassion; (8) managing stress; (9) happiness and balance.

The range of practices was designed to mostly correspond to those found in MBSR/MBCT and also to include elements from compassion training. Practices were designed to be shorter and instructions more clear-cut and frequent than in MBSR/MBCT because of the age of the target population. Criteria for characterizing MBPs by Crane et al. (2017) came out after the program had been designed, but aligned with their analysis, an aim behind designing Tita was to employ both empirical science and contemplative practice to relieve suffering and enhance well-being. Similarly, we hoped to achieve this through helping students develop a new relationship to present experience. Although the MBP material was strictly secular, our analysis of human suffering drew its core from contemplative tradition.

The lectures put especial focus on mindful cognition and in this respect resemble MBCT-type content. The first author was responsible for developing and performing written and spoken materials for Tita. At the time of designing the intervention, his most relevant MBP teacher competencies were (1) 500–600 h of samatha/vipassana meditation experience (approx. 40 h on intensive silent retreat); (2) having trained as a .b teacher; (3) having taken MBSR, Mindful Self-Compassion (MSC; Neff

and Germer 2013), and other available MBPs; and (4) being a licensed psychologist. Program content was tested and commented on by psychologists, other professionals, and research assistants in the research team. In addition, 27 upper secondary school volunteers piloted a previous version of the program. Data on the pilot trial indicated the program was well liked and acceptable for the target population. Participant feedback was used to further refine the MBP.

Our aim was to structure the program in a way to from the very outset underline the importance of practice: (1) by giving instructions for meditations as short as 1–5 min to lower threshold for daily practicing; (2) by making guided meditation audio files among the first course materials that appear on the accompanying website to make meditations as accessible as possible; (3) communicating on various occasions, in video lectures and the website text, that formal meditations essentially *are* the program and possible results largely depend on practicing; (4) to make habit-formation a core emphasis by repeatedly encouraging daily or near-daily very short practice sessions; and (5) asking participants daily, via a smartphone app, whether and for how many minutes they practiced on the day before, to serve as a reminder to practice. This proactive stance on (preferably daily) practice could be contrasted with, for instance, only "showing up" to watch or listen to lectures.

Measures

Primary outcome data were collected on three measurement points: (1) pre-program, (2) post-program, and (3) at a 3-month follow-up. On each occasion, participants had a 3-week window for answering the questionnaire: immediately before program at T_1, immediately after the program at T_2, and immediately after the 3 month mark after the program T_3. These data were collected using an online tool originally developed for another secondary education well-being project at the University of Turku. For data collection purposes, students in the treatment arm were instructed to download an ecological momentary assessment data collection app, Paco, on their smartphones (Google Commerce Ltd 2014). Subjects in the treatment arm of the study were prompted to answer two sets of questions: one daily and one once a week. These prompts were also meant to serve as reminders for participants to meditate daily. At least 457 students in the Tita arm downloaded the app and answered one or more questions. Results from the app data were published in a separate paper (Lahtinen and Salmivalli 2020). The study protocol was registered with the Open Science Forum after baseline measurement but prior to post-program measurement (Lahtinen and Salmivalli 2017).

Anxiety Anxiety was measured with the brief generalized anxiety measure, the GAD-7 (Spitzer et al. 2006). It measures anxiety over the last 2 weeks with seven items (e.g., asking participants how often they have been bothered by "Not being able to stop or control worrying"), each with four answer options ranging from 0 ("not at all") to 3 ("nearly every day"). Scores for GAD-7 range from 0 to 21. Minima for all of our scales on the questionnaires were 1 (e.g., GAD-7 items ranged from 1 to 4) and the scales were later centered to start from 0. Anxiety was measured on T_1, T_2, and T_3 (unless otherwise stated, this is the case for all scales below). The scale was internally consistent (ω 95% CI = .87 [.86, .89]).

Depression Depression was measured with the Finnish modification of the two-factor Revised Beck Depression Inventory (R-BDI; Kaltiala-Heino et al. 1999). The Finnish R-BDI has 13 items, but a suicidality item was left out, as we did not have capacity to assist students potentially reporting suicidality. Maximum score for the scale was thus 48 (instead of 52). The items consist of collections of five statements such as "How do you see the future?" with options ranging from 0 ("I am hopeful about the future") to 4 ("The future feels hopeless to me") (ω = .89 [.88, .90]).

School Burn-out School burnout was measured with the nine-item, three-factor (exhaustion, cynicism, and inadequacy) Finnish School Burn-out Inventory (Salmela-Aro et al. 2009). Items (e.g., "I feel overwhelmed by my schoolwork.") are answered on a scale from 0 ("completely disagree") to 5 ("completely agree"). The scale has a possible range from 0 to 45 (ω = .89 [.87, .90]; unidimensional, since subscales not used in the study).

Psychological Quality of Life Participants' psychological quality of life was measured with the psychological quality of life subscale from the short-form World Health Organization Quality of Life measure (WHOQoL-BREF; Whoqol group 1998). The scale comprises six items (e.g., "To what extent do you feel your life to be meaningful?") with options ranging from 0 ("not at all") to 4 ("very much"). The scale has a possible range from 0 to 24 (ω = .85 [.83, .86])

Satisfaction with Life Life satisfaction was measured with the unidimensional Satisfaction with Life Scale (SWLS; Diener et al. 1985). The scale consists of five items (e.g., "So far I have gotten the important things I want in life") with response options ranging from 0 ("completely disagree") to 4 ("completely agree") and has a possible range from 0 to 20 (ω = .83 [.82, .85])

Mindfulness Mindfulness was measured with the single-factor Child and Adolescent Mindfulness Measure (CAMM; Greco et al. 2011). CAMM consists of ten items (e.g., "I keep myself busy so I don't notice my thoughts or feelings") with options ranging from 0 ("never true") to 4 ("always true"). In this study, our wording for the extremes of the scale was "never true / very rarely true" and

"always true / almost always true" to make the extremes of the scale less absolute. The scale ranges from 0 to 40 with a high score indicative of a lack of mindfulness. The measure is known to be positively correlated with academic achievement and social skills and negatively with externalizing and internalizing problems (Greco et al. 2011) ($\omega = .83$ [.82, .85]).

Self-Compassion Self-compassion was measured with the Self-Compassion Scale–Short Form (SCS–SF; Raes et al. 2011). The scale comprises 12 items (e.g., "I'm kind to myself when I'm experiencing suffering") with options ranging from 0 ("almost never") to 4 ("almost always"), and has a possible range from 0 to 48. The SCS-SF has been negatively correlated with depression and anxiety and positively correlated with life satisfaction (Neff and Germer 2013) ($\omega = .82$ [.80, .84]).

Sleep Problems Five Likert scale items measured how well participants slept, whether they felt tired (Basic Nordic Sleep Questionnaire; 2 items; options from 0 (item 1:"well", item 2:"less than once a month") to 4 ("poorly", "daily or almost daily"); Partinen and Gislason 1995), their trouble with sleeping, waking up in the middle of the night (2 items; options from 0 ("never") to 5 ("almost every night"); Jenkins et al. 1988), and whether they had or were affected by nightmares (1 item; options from 0 ("I haven't had nightmares during the last month") to 3 ("three times a week or more often"), Sandman, 2017). Each item was transformed to range from 0 to 4 and the items were combined into a composite sleep problem index with a resultant range of 0–20. We also had an additional item about daytime effects of nightmares and two items that asked about hours of sleep during schooldays and holidays (Partinen and Gislason 1995), which were not part of the index ($\omega = .75$ [.73, .77]).

Happiness Happiness was measured with a global happiness item from UN's World Happiness Report. Participants were asked to rate their quality of life on a scale from 0 to 10 (Helliwell et al. 2018).

Frequency of Practice Meditation practice frequencies were assessed by asking the participants in the treatment arm questions about their practice at the post-program and follow-up measurements. Participants were asked how often they practiced overall and also how often they did specific practices (e.g., sitting meditation). Response options were "Not at all", "1-4 times (1-6 times on follow-up)", "Approximately once a week", "Almost daily", and "Daily or more often". All participants were also asked whether they had previous experience with mindfulness. Frequency of practice was measured on T_2 and T_3.

Data Analyses

Separate 2-way ANOVAs (time*treatment) were run for each outcome variable, comparing the treatment and waitlist conditions over time. Cohen's *d*s were obtained by subtracting pre-post differences between groups and dividing by pooled post-SD (procedure adopted from a Campbell Collaboration systematic review by de Vibe et al. 2017) and they were thus not based on the *F*-ratios obtained from the ANOVAs. We evaluated the effect of practice frequency by running regression analyses for each outcome variable, regressing outcome at T_2 on frequency of practice (5-point scale, see Method) and outcome at T_1 (covariate). Baselines were also compared for MBP completers and dropouts to see whether dropout was related to study variables. Analyses were conducted in R (omega calculations) and SPSS (all other analyses). In addition, to estimate the effects of attrition, separate intention-to-treat analyses were run by first imputing T_1 and T_2 missing values with multiple imputation (5 imputations; in SPSS), and then rerunning all ANOVAs.

Results

MBP Completers vs. Waitlist Results

Correlations and descriptives (means, 95% confidence intervals, and standard deviations) are displayed in Tables 1 and 2. For participants who completed the MBP (i.e., answered the T_2 questionnaire) vs. the waitlist, out of the four primary outcomes, anxiety (decrease: $F_{1,681} = 13.71$, $p < .01$, $d = .26$) was most affected by the program relative to the waitlist group (Table 2, Fig. 2; sum scores are averaged item scores multiplied by number of scale items). Percentage-wise, the reduction in anxiety was 16.1% more than in the waitlist. There was a small decrease in depression relative to waitlist ($F_{1,686} = 8.54$, $p < .01$, $d = .15$). School burnout was not impacted (decrease: $F_{1,711} = 1.84$, $p = .18$, $d = .05$) but there was a small increase in psychological quality of life ($F_{1,708} = 3.94$, $p = .05$, $d = .16$).

Out of the secondary outcomes, satisfaction with life remained unchanged in the MBP group relative to controls ($F_{1,727} < 1$). There were small effects on all other secondary outcomes: mindfulness (decrease, inverse scale: $F_{1,699} = 10.43$, $p < .01$, $d = .15$) self-compassion ($F_{1,697} = 9.30$, $p < .01$, $d = .14$), and happiness ($F_{1,679} = 9.50$, $p < .01$, $d = .22$) increased, whereas sleep problems decreased ($F_{1,681} = 8.20$, $p < .01$, $d = .11$).

Frequency of Practice

Before the program, 61.0% ($n = 356$ out of 584 answers) of MBP participants had no prior experience of mindfulness or

Table 1 Zero-order correlations

	GAD	BDI	SBI	QoL	SWLS	CAMM	SCS	Sl. pr.	Happiness
GAD									
BDI	.62								
SBI	.53	.54							
QoL	− .56	− .84	− .52						
SWLS	− .43	− .66	− .38	.71					
CAMM	.57	.56	.49	− .54	− .44				
SCS	− .51	− .67	− .42	.67	.54	− .53			
Sleep pr.	.50	.61	.39	− .47	− .36	.40	− .37		
Happiness	− .50	− .72	− .41	.72	.66	− .44	.52	− .41	

$p < .01$ for all correlations

meditation and 91.3% ($n = 533$) had no ongoing meditation practice. 7.7% ($n = 45$) said they practiced every now and then and 1.0% ($n = 6$) had a regular practice. After the program, 97.1% ($n = 304$ out of 313 answers) of reached participants reported having practiced at least a little, ranging from 1 to 4 times total to practicing daily. 72.5% ($n = 227$) of participants reported practicing at least once a week, and 39.0% ($n = 122$) reported practicing near-daily ($n = 119$) or daily ($n = 3$). Participants reported that a typical daily practice was 0–10 min ($n = 221$ out of 313 answers; 70.6%), with 14.1% ($n = 44$) of respondents reporting no practice on almost all or all days. 12.8% ($n = 40$) reported 10–20 min, 1.9% ($n = 6$) 20–30 min, and 0.3% ($n = 1$) 30–60 min and more than 60 min, each.

Regression analyses were run using frequency of practice (range: 1–5) to predict outcomes at T_2 while controlling for outcome baseline at T_1. Frequency of practice was predictive of lower anxiety (standardized $b = -.10$, $p = .05$), depression ($b = -.09$, $p = .02$), and sleep problems ($b = -.14$, $p < .01$) as well as higher mindfulness (inverse scale, $b = -.11$, $p = .02$) and happiness ($b = .17$, $p < .01$).

Attrition

Out of the 624 participants allocated to take part in the MBP, that answered the pre-program survey (T_1), 326 responded to the post-program survey (T_2). In addition, 39 participants lacking data on T_1 responded on T_2. The attrition rate for Tita was thus 41.5%, estimated on the basis of number of respondents per measurement occasion. For the MBP participants that dropped out, most baselines were not considerably different from those that completed the course ($|t| < 2$, $p > .05$) with the exception of psychological quality of life ($t(605) = 2.08$, $p = .04$). Most well-being baselines were slightly lower (that is "worse") for the MBP dropouts, except psychological quality of life which was higher for dropouts, and school burnout which was higher for the completers. When predicting for T_2 attrition from the baselines, psychological quality of life (inverse: $\beta = -.08$, $p = .04$) and school burnout (inverse: $\beta = -.10$, $p = .05$) were only variables clearly predictive of attrition.

Follow-up (3 Months)

On the 3-month follow-up, 42.1% ($n = 75$) of respondents reported having practiced at least 1–6 times after the program and 41.0% ($n = 73$) reported not having practiced once. 16.9% ($n = 30$) reported practicing at least once a week, and 2.2% ($n = 4$) participants reported practicing near-daily ($n = 3$) or daily ($n = 1$). Between-group differences between the post-program measurement and follow-up (Table 3) remained essentially unchanged, with the largest change registered for anxiety (increase: $F_{1,520} = 2.84$, $p = .09$), as scores for the MBP group reverted back towards baseline (Fig. 2).

Intention-to-Treat Analyses

Imputation Procedure To determine whether the effects were contingent on the attrition pattern, missing values for primary and secondary outcomes were multiply imputed for T_1 and T_2. As the MBP group was missing most of its follow-up data, T_3 data imputation was rejected as unfeasible. Imputation was done in two stages to ensure that missing values for participants were imputed from data for participants who have received approximately corresponding doses of the active ingredient, that is, exposure to the MBP. The stages were:

1. MBP completers (MBP participants with T_2 data, $n = 365$): Five multiple imputations were run in a set of MBP participants who answered the T_2 survey to account for missing values in this group.
2. Waitlist ($n = 682$) + MBP dropouts ($n = 302$): We made the conservative assumption MBP dropouts would most resemble participants in the waitlist condition, i.e., that they had no exposure to the MBP at all. The missing

Table 2 Descriptives for outcomes by time point: MBP completers (above), waitlist (below)

MBP		T_1 ($n = 624$)			T_2 ($n = 365$)			T_3 ($n = 216$)	
	M	95% CI	SD	M	95% CI	SD	M	95% CI	SD
Primary:									
Anxiety	7.81	[7.41, 8.22]	5.00	5.94	[5.43, 6.45]	4.62	6.25	[5.48, 7.02]	5.26
Depression	15.51	[14.83, 16.20]	8.42	14.00	[13.08, 14.92]	8.38	13.57	[12.28, 14.83]	8.84
Burn-out	19.57	[18.81, 20.34]	9.60	18.68	[17.60, 19.76]	10.08	19.00	[17.57, 20.43]	10.17
Psych. q of l	12.85	[12.50, 13.19]	4.37	14.08	[13.61, 14.56]	4.46	13.90	[13.26, 14.54]	4.57
Secondary:									
Satisfaction	11.61	[11.28, 11.95]	4.20	12.14	[11.70, 12.59]	4.18	12.33	[11.72, 12.94]	4.42
Mindfulness	17.69	[17.13, 18.24]	6.92	15.66	[14.84, 16.48]	7.57	15.24	[14.15, 16.32]	7.58
SCompassion	22.89	[22.20, 23.58]	8.57	24.86	[23.92, 25.81]	8.71	25.68	[24.37, 26.99]	9.15
Sleep pr.	8.03	[7.71, 8.34]	3.85	7.49	[7.09, 7.88]	3.59	7.09	[6.53, 7.66]	3.85
Happiness	6.89	[6.75, 7.02]	1.67	7.36	[7.20, 7.53]	1.46	7.25	[7.02, 7.49]	1.61
Waitlist		T_1 ($n = 617$)			T_2 ($n = 507$)			T_3 ($n = 453$)	
	M	95% CI	SD	M	95% CI	SD	M	95% CI	SD
Primary:									
Anxiety	7.94	[7.52, 8.35]	5.07	7.31	[6.86, 7.77]	5.02	7.37	[6.90, 7.84]	4.99
Depression	15.37	[14.73, 16.02]	7.88	15.12	[14.40, 15.84]	7.93	15.06	[14.27, 15.85]	8.34
Burn-out	20.44	[19.67, 21.22]	9.56	20.07	[19.22, 20.91]	9.45	20.17	[19.27, 21.08]	9.69
Psych. q of l	12.94	[12.60, 13.27]	4.17	13.47	[13.09, 13.86]	4.28	13.40	[12.98, 13.81]	4.42
Secondary:									
Satisfaction	11.33	[10.99, 11.66]	4.18	11.61	[11.24, 11.97]	4.08	11.66	[11.26, 12.05]	4.23
Mindfulness	17.97	[17.43, 18.51]	6.67	17.01	[16.38, 17.64]	6.97	17.45	[16.80, 18.10]	6.93
SCompassion	22.92	[22.23, 23.60]	8.42	23.65	[22.88, 24.41]	8.46	23.08	[22.26, 23.89]	8.63
Sleep pr.	8.09	[7.76, 8.42]	4.01	8.14	[7.77, 8.51]	4.06	7.83	[7.44, 8.21]	4.03
Happiness	6.88	[6.75, 7.02]	1.67	7.03	[6.88, 7.17]	1.63	6.99	[6.83, 7.16]	1.74

values for MBP dropouts were thus imputed from the waitlist values. This was done to ensure an uninflated effect for the MBP after imputation. Five multiple imputations were run for a set of participants ($n = 984$) comprising everyone on the waitlist and the MBP participants who did not answer the questionnaire at T_2.

The two data files were then combined into a multiple imputation data file with 5 imputation sets. This resulted in an imputed sample of 1349 participants with outcome data for 1326 participants (657 MBP, 669 waitlist; imputation failed for 23 participants lacking most or all data for T_1 and T_2). Descriptives and *F*-ratios were evaluated for the data and results then pooled (Table 4). Compared with the MBP, the waitlist was missing fewer values and its imputed values were close to its unimputed values. Thus only MBP descriptives after imputation are reported.

Intention-to-Treat Results ANOVAs for imputed data indicated small decreases in anxiety ($F_{1,1324} = 8.01$, $p = .01$, $d = .15$) and depression (decrease: $F_{1,1324} = 5.59$, $p = .04$, $d = .10$), and no clear effects on school burnout (decrease: $F_{1,\ 1324} = .703$, $p = .46$) or psychological quality of life (increase: $F_{1,1324} = 2.04$, $p = .34$). Percentage-wise, the reduction in anxiety was 10.0% more than in the imputed waitlist. For secondary outcomes, there were small increases in happiness ($F_{1,1324} = 5.63$, $p = .05$, $d = .12$) and self-compassion ($F_{1,1324} = 5.31$, $p = .06$, $d = .10$), and no clear effect on satisfaction with life ($F_{1,1324} = .64$, $p = .63$), mindfulness (decrease, inverse scale: $F_{1,1324} = 4.18$, $p = .23$), and sleep problems (decrease: $F_{1,1324} = 2.58$, $p = .19$) (see Table 4 for intention-to-treat means, CIs, and SDs).

Discussion

Upper secondary education students participating in the Tita program experienced a small-to-moderate reduction in anxiety. In addition, participants who completed the program experienced a small decrease in depression and a small increase in psychological quality of life. The magnitude of these improvements was dependent on the amount of mindfulness practice reported retrospectively at post-test. Most participants quit or reduced their meditation practice after the 8-week period and did not gain in well-being after the period. However, even after reducing practice, participants mostly held onto the

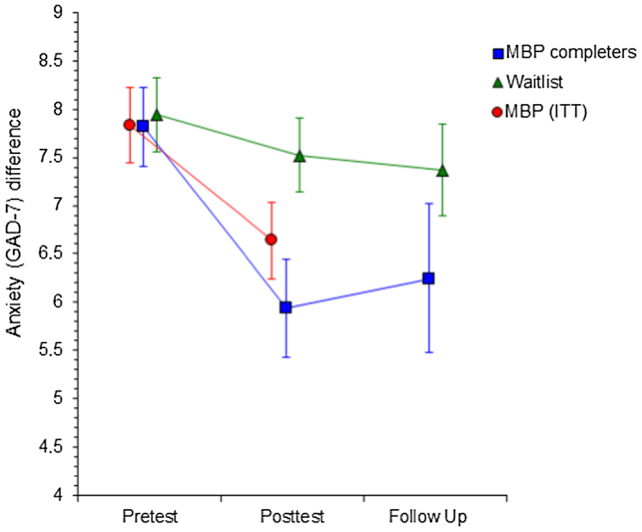

Fig. 2 Anxiety: group means and 95% confidence intervals at pre-, post-, and follow-up measurement

gains made when they were practicing. In terms of secondary outcomes, MBP participants experienced small improvements in self-compassion, mindfulness, sleep problems, and happiness.

The digital MBP had a larger effect on anxiety than on other study outcomes. It can be asked why the MBP would affect anxiety in particular, but not school burnout for instance. The result with anxiety is in line with earlier research on MBPs with adolescents and digital MBPs (Kallapiran et al. 2015; Spijkerman et al. 2016). Depression and burnout are associated with longer-term somatic changes, e.g., exhaustion and disruptions in sleep and diet and may thus require larger dosage than a light MBP (Salmela-Aro et al. 2009). Anxiety is characterized by an emotional and cognitive style of worrying with less pervasive somatic symptomology. It may be more susceptible to changes induced by even briefer meditation practices.

The studied MBP was universal and the study sample mostly subclinical. It is possible the MBP might impact a sample with more clinical characteristics differently. The program materials instructed participants with a depression that had a substantial impact on their lives to seek help from health-care professionals before participating on the MBP. This is not to say that all participants suffering from depression necessarily took that step and data indicate some participants had high GAD-7 and R-BDI scores during measurement occasions. For "clinical" participants (R-BDI > 20 points

Table 3 Group differences between MBP and waitlist (above); effect of practice on outcomes (below)

Group differences	T_1*T_2 ($n = 365$)		T_2*T_3 ($n = 216$)	
	F	*p*	*F*	*p*
Primary:				
Anxiety	13.71	< .01	2.84	.09
Depression	8.54	< .01	.01	.91
Burn-out	1.84	.18	.90	.34
Psych. q of 1	3.94	.05	.33	.57
Secondary:				
Satisfaction	.05	.82	.30	.58
Mindfulness	10.43	< .01	.10	.75
SCompassion	8.66	< .01	.04	.85
Sleep pr.	8.70	< .01	.22	.64
Happiness	9.50	< .01	.66	.80
Benefit from practice	T_2			
	b	*p*		
Primary:				
Anxiety	−.10	.05		
Depression	−.09	.02		
Burn-out	−.05	.30		
Psych. q of 1	.07	.14		
Secondary:				
Satisfaction	.06	.14		
Mindfulness	− .11	.02		
SCompassion	.02	.67		
Sleep pr.	− .14	< .01		
Happiness	.17	< .01		

Table 4 Intention-to-treat outcomes by time point: MBP group

Outcome	T_1 ($n = 621$)			T_2 ($n = 507$)		
	M	95% CI	SD	M	95% CI	SD
Primary:						
Anxiety	7.83	[7.44, 8.22]	5.05	6.62	[6.23, 7.01]	5.12
Depression	15.52	[14.87, 16.16]	8.45	14.84	[14.21, 15.46]	8.15
Burn-out	19.65	[18.90, 20.40]	9.80	18.98	[18.21, 19.75]	10.08
Psych. q of 1	12.88	[12.54, 13.21]	4.38	13.56	[13.22, 13.89]	4.35
Secondary:						
Satisfaction	11.66	[11.33, 11.99]	4.26	11.84	[11.51, 12.16]	4.27
Mindfulness	17.68	[17.13, 18.22]	7.09	16.30	[15.71, 16.89]	7.67
SCompassion	22.90	[22.23, 23.57]	8.73	23.85	[23.16, 24.54]	8.98
Sleep pr.	8.08	[7.77, 8.38]	3.97	7.90	[7.58, 8.22]	4.18
Happiness	6.86	[6.73, 6.99]	1.69	7.14	[7.02, 7.27]	1.67

at T_1, $n = 294$), the reduction vs. waitlist was 2.4 points which is double the reduction vs. waitlist for all MBP completers.

The participant mindfulness practice rates for Tita were a relative success and possibly were responsible for the program effects given the program was light on material other than guided meditations. Importance of regular practice was emphasized in program materials, but daily smartphone prompts may have been a factor in participants developing and upholding regular meditation practice. After the 8 weeks the prompts ceased and gradually the participants mostly stopped practicing. This is a crucial future challenge for Tita and similar programs: supporting participants in upholding practice after the initial program ends.

This study adds to existing literature by reporting results from a pre-registered large-sample RCT of a digital MBP. The study employed smartphone technology and collected follow-up data. The results of the ecological momentary assessment portion of our study have been reported elsewhere (Lahtinen and Salmivalli 2020). We examined a universal MBP in an ecologically valid setting. The MBP in question is now in use in upper secondary education institutions throughout the country. When Felver et al. (2016) reviewed the field of MBPs in schools studies they found the average sample size to be 121.9 students per study (largest sample size was $n = 522$). Spijkerman et al. (2016) reviewed the field of digital MBPs and found sample sizes ranging between $n = 49$–551. None of the studies of digital MBPs involved upper secondary school/high school students. Even though there are thousands of published MBP studies, largest sample sizes for MBP RCTs (for adults) have ranged between 300 and 400 (Creswell 2017; de Vibe et al. 2017). The sample size for the present study ($n = 1349$) thus possibly exceeds those of all previously published MBP studies. Felver et al. (2016) also found that only little over a half of reviewed studies employed control groups and roughly a third randomly assigned participants. 29% of studies reported follow-up data.

Mindfulness research has been under critical evaluation of late (Van Dam et al. 2018) with many aspects of poor methodology coming under scrutiny. A particular liability for MBP efficacy research comes in the form of reporting bias. Coronado-Montoya et al. (2016) found evidence for publication bias in MBP studies with 1.6 times too many positive trials being reported (however, de Vibe et al. (2017) found only small bias). Bias may also enter in the form of researchers leaving out or switching primary and secondary outcomes post-hoc, after viewing the results, or choosing analysis strategies based on the results they yield (Azar et al. 2015). Much of this can be avoided with study pre-registration. Of the MBP RCTs they reviewed, Coronado-Montoya et al. (2016) found that 17% had pre-registered their trial and out of these 62% remained unpublished after 30 months. The present study was registered when the intervention was on its fifth week (registration approved in the sixth week). The timing was not optimal but still ensures improved transparency in outcome designation and analysis.

Limitations and Future Research Directions

First, the 41.5% of MBP participants who were unreachable for T_2 measurement represent a challenge. We had a volunteer sample from all over Finland and reaching some participants via email was a challenging task. Most answers came within an initial 1–2 week window, but it was extended to 3 weeks to allow maximum reach. The relatively broad time window slightly limits the immediacy of self-reports. The attrition rate by itself is perhaps unsurprising considering rates of dropout in the only digital MBP RCT of comparable size. Morledge et al. (2013) reported attrition rates of 59% and 56% for their

8-week digital MBP. Dropouts by and large did not differ from MBP completers in terms T_1 well-being, and thus it is unlikely any particular characteristic of the MBP was a major cause for attrition. Tita was extracurricular and no credit for completion was offered, unless students had personally negotiated credit with their school. Had Tita been offered as part of standard curriculum, the attrition rate would also likely have been lower.

Second, there have been calls in the field for studies to use active control conditions (e.g., Felver et al. 2016; MacCoon et al. 2012). Our study employed a waitlist control condition, which is a limitation, as this does not allow us to determine which part of the beneficial MBP effects derive from treatment and which from just taking part in any intervention or participant expectation bias.

Third, the gender distribution in our sample was seriously skewed towards females. This was due to the sample consisting of volunteers. The sample is nationally representative of volunteers for digital MBPs in Finland, given every available upper secondary education institution was included in the recruitment pool. It is imperative for programs like Tita to find ways to reach males better.

Fourth, as all of the study outcomes were measured via questionnaires, it is possible the results suffered from common method bias. This bias can result from using lengthy questionnaires to measure related but distinct outcomes like anxiety and depression, where filling in a questionnaire with items reflecting nine somewhat related outcomes starts to produce uniform response patterns in the participant.

Fifth, Tita is quite a lean MBP with "completion" defined (for research purposes) by just answering the T_2 questionnaire at 8 weeks. We learned that during the 8 weeks, most students will have practiced mindfulness meditation at least weekly and a fifth of respondents near-daily. Many will also have viewed the program's weekly animated online lectures. The leanness of Tita, however, is also a liability: on a face-to-face MBP like MBSR/MBCT participants can talk to a teacher who supplies real-time instructions, guidance, and support. Tita, arguably along with mindfulness apps like Headspace, essentially constitutes a collection of easy-to-access audio guided meditations without the human interaction element of face-to-face MBPs. Given that, at least extensive, mindfulness practice can also result in unwanted, difficult experiences (Lindahl et al. 2017; Van Dam et al. 2018), digital MBPs and mindfulness apps may need to look at how to offer adequate support for participants in need of it. Tita is an asynchronous MBP, with content and delivery not tied to a time and space, contrary to many face-to-face and digital MBPs, meaning that Tita lacks teacher-student interaction and group inquiry. This is due to the program's massive scale and limited resources. Future studies should look at relative merits and liabilities of (1) having a very large scale and possibly forgoing some interactive elements and (2) including more interactive components in the MBP and possibly making it more resource-intensive and costly. The implications of what exactly (e.g., efficacy, costs, accessibility) is lost or gained when offering interactive MBPs or asynchronous MBPs is an empirical question to be examined in future studies.

Contributions OL designed the study, collected the data, conducted the analyses, and wrote the manuscript.

CS supervised OL's work and offered comments on the manuscript. These two sentences should be on the same line.

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Compliance with Ethical Standards

Conflict of Interest The first author developed the MBP that was studied. The authors declare no other potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval Ethical review of the study plan was conducted by the University of Turku Ethics Committee. The Committee approved the plan with minor suggestions to improve the protocol. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. Informed consent to participate in the study was obtained from all subjects.

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References

Altman, D. G., & Bland, J. M. (1999). How to randomise. *British Medical Journal, 319*(7211), 703–704. https://doi.org/10.1136/bmj.319.7211.703.

Azar, M., Riehm, K. E., McKay, D., & Thombs, B. D. (2015). Transparency of outcome reporting and trial registration of randomized controlled trials published in the Journal of Consulting and Clinical Psychology. *PLoS One, 10*(11), e0142894. https://doi.org/10.1371/journal.pone.0142894.

Birtwell, K., Williams, K., van Marwijk, H., Armitage, C. J., & Sheffield, D. (2019). An exploration of formal and informal mindfulness practice and associations with wellbeing. *Mindfulness, 10*(1), 89–99. https://doi.org/10.1007/s12671-018-0951-y.

Carmody, J., & Baer, R. A. (2008). Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction

program. *Journal of Behavioral Medicine, 31*(1), 23–33. https://doi.org/10.1007/s10865-007-9130-7.

Carsley, D., Khoury, B. & Heath, N.L. (2018). Effectiveness of mindfulness interventions for mental health in schools: a comprehensive meta-analysis. *Mindfulness, 9,* 693–707. https://doi.org/10.1007/s12671-017-0839-2.

Compas, B. E., Orosan, P. G., & Grant, K. E. (1993). Adolescent stress and coping: Implications for psychopathology during adolescence. *Journal of Adolescence, 16*(3), 331–349. https://doi.org/10.1006/jado.1993.1028.

Coronado-Montoya, S., Levis, A. W., Kwakkenbos, L., Steele, R. J., Turner, E. H., & Thombs, B. D. (2016). Reporting of positive results in randomized controlled trials of mindfulness-based mental health interventions. *PLoS One, 11*(4), e0153220. https://doi.org/10.1371/journal.pone.0153220.

Crane, R. S., Brewer, J., Feldman, C., Kabat-Zinn, J., Santorelli, S., Williams, J. M. G., & Kuyken, W. (2017). What defines mindfulness-based programs? The warp and the weft. *Psychological Medicine, 47*(6), 990–999. https://doi.org/10.1017/S0033291716003317.

Crescentini, C., Capurso, V., Furlan, S., & Fabbro, F. (2016). Mindfulness-oriented meditation for primary school children: effects on attention and psychological well-being. *Frontiers in Psychology, 7*, 805. https://doi.org/10.3389/fpsyg.2016.00805.

Creswell, J. D. (2017). Mindfulness interventions. *Annual Review of Psychology, 68*, 491–516. https://doi.org/10.1146/annurev-psych-042716-051139.

de Vibe, M. F., Bjørndal, A., Fattah, S., Dyrdal, G. M., Halland, E., & Tanner-Smith, E. E. (2017). Mindfulness-based stress reduction (MBSR) for improving health, quality of life and social functioning in adults: a systematic review and meta-analysis. *Campbell Systematic Reviews, 13*(11). https://doi.org/10.4073/csr.2017.11.

Diener, E. D., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13.

Felver, J. C., Celis-de Hoyos, C. E., Tezanos, K., & Singh, N. N. (2016). A systematic review of mindfulness-based interventions for youth in school settings. *Mindfulness, 7*(1), 34–45. https://doi.org/10.1007/s12671-015-0389-4.

Finnish School Health Survey 2013.

Finnish School Health Survey 2015.

Flook, L., Smalley, S. L., Kitil, M. J., Galla, B. M., Kaiser-Greenland, S., Locke, J., Ishijima, E., & Kasari, C. (2010). Effects of mindful awareness practices on executive functions in elementary school children. *Journal of Applied School Psychology, 26*(1), 70–95. https://doi.org/10.1080/15377900903379125.

Flook, L., Goldberg, S. B., Pinger, L., & Davidson, R. J. (2015). Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness curriculum. *Developmental Psychology, 51*(1), 44. https://doi.org/10.1037/a0038256.

Google Commerce Ltd. (2014). *Paco* (Version 4.2.30) [Mobile application software]. Retrievable from https://play.google.com/store/apps/details?id=com.pacoapp.paco

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., Berger, Z., Sleicher, D., Maron, D. D., Shibab, H. M., Ranasinghe, P. D., Linn, S., Saha, S., Bass, E. B., & Haythornthwaite, J. A. (2014). Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA Internal Medicine, 174*(3), 357–368. https://doi.org/10.1001/jamainternmed.2013.13018.

Greco, L. A., Baer, R. A., & Smith, G. T. (2011). Assessing mindfulness in children and adolescents: development and validation of the Child and Adolescent Mindfulness Measure (CAMM). *Psychological Assessment, 23*(3), 606-614. https://doi.org/10.1037/a0022819.

Harrington, R., Fudge, H., Rutter, M., Pickles, A., & Hill, J. (1990). Adult outcomes of childhood and adolescent depression: I. Psychiatric status. *Archives of General Psychiatry, 47*(5), 465–473. https://doi.org/10.1001/archpsyc.1990.01810170065010.

Helliwell, J., Layard, R., & Sachs, J. (2018). *World happiness report 2018.* New York: Sustainable Development Solutions Network.

Huppert, F. A., & Johnson, D. M. (2010). A controlled trial of mindfulness training in schools: the importance of practice for an impact on well-being. *The Journal of Positive Psychology, 5*(4), 264–274. https://doi.org/10.1080/17439761003794148.

Jenkins, C. D., Stanton, B. A., Niemcryk, S. J., & Rose, R. M. (1988). A scale for the estimation of sleep problems in clinical research. *Journal of Clinical Epidemiology, 41*(4), 313–321. https://doi.org/10.1016/0895-4356(88)90138-2.

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness.* New York: Delta.

Kallapiran, K., Koo, S., Kirubakaran, R., & Hancock, K. (2015). Effectiveness of mindfulness in improving mental health symptoms of children and adolescents: a meta-analysis. *Child and Adolescent Mental Health, 20*(4), 182–194. https://doi.org/10.1111/camh.12113.

Kaltiala-Heino, R., Rimpelä, M., Rantanen, P., & Laippala, P. (1999). Finnish modification of the 13-item Beck Depression Inventory in screening an adolescent population for depressiveness and positive mood. *Nordic Journal of Psychiatry, 53*(6), 451–457. https://doi.org/10.1080/080394899427700.

Keenan-Miller, D., Hammen, C. L., & Brennan, P. A. (2007). Health outcomes related to early adolescent depression. *Journal of Adolescent Health, 41*(3), 256–262. https://doi.org/10.1016/j.jadohealth.2007.03.015.

Kuyken, W., Weare, K., Ukoumunne, O. C., Vicary, R., Motton, N., Burnett, R., Cullen, C., Hennelly, S., & Huppert, F. (2013). Effectiveness of the Mindfulness in Schools Programme: non-randomised controlled feasibility study. *The British Journal of Psychiatry, 203*(2), 126–131. https://doi.org/10.1192/bjp.bp.113.126649.

Kuyken, W., Hayes, R., Barrett, B., Byng, R., Dalgleish, T., Kessler, D., Lewis, G., Watkins, E., Brejcha, C., Cardy, J., Causley, A., Cowderoy, S., Evans, A., Gradinger, F., Kaur, S., Lanham, P., Morant, P., Richards, J., Shah, P., Sutton, H., et al. (2015). Effectiveness and cost-effectiveness of mindfulness-based cognitive therapy compared with maintenance antidepressant treatment in the prevention of depressive relapse or recurrence (PREVENT): a randomised controlled trial. *The Lancet, 386*(9988), 63–73. https://doi.org/10.1016/S0140-6736(14)62222-4.

Lahtinen, O., & Salmivalli, C. (2017). *Assessing the efficacy of a mindfulness-based online program for students in upper secondary education.* Retrieved from osf.io/axm6y. Accessed 14 July 2020.

Lahtinen, O., & Salmivalli, C. (2020). The relationship between mindfulness meditation and well-being during 8 weeks of ecological momentary assessment. *Mindfulness, 11*(1), 255–263. https://doi.org/10.1007/s12671-019-01248-x.

Lindahl, J. R., Fisher, N. E., Cooper, D. J., Rosen, R. K., & Britton, W. B. (2017). The varieties of contemplative experience: a mixed-methods study of meditation-related challenges in Western Buddhists. *PLoS One, 12*(5), e0176239. https://doi.org/10.1371/journal.pone.0176239.

Lucas-Thompson, R. G., Broderick, P. C., Coatsworth, J. D., & Smyth, J. M. (2019). New avenues for promoting mindfulness in adolescence using mHealth. *Journal of Child and Family Studies, 28*(1), 131–139. https://doi.org/10.1007/s10826-018-1256-4.

MacCoon, D. G., Imel, Z. E., Rosenkranz, M. A., Sheftel, J. G., Weng, H. Y., Sullivan, J. C., Bonus, K. A., Stoney, C. M., Salomons, T. V., Davidson, R. J., & Lutz, A. (2012). The validation of an active control intervention for mindfulness based stress reduction

(MBSR). *Behaviour Research and Therapy, 50*(1), 3–12. https://doi.org/10.1016/j.brat.2011.10.011.

Mani, M., Kavanagh, D. J., Hides, L., & Stoyanov, S. R. (2015). Review and evaluation of mindfulness-based iPhone apps. *JMIR mHealth and uHealth, 3*(3). https://doi.org/10.2196/mhealth.4328.

Morledge, T. J., Allexandre, D., Fox, E., Fu, A. Z., Higashi, M. K., Kruzikas, D. T., Pham, S. V., & Reese, P. R. (2013). Feasibility of an online mindfulness program for stress management—a randomized, controlled trial. *Annals of Behavioral Medicine, 46*(2), 137–148. https://doi.org/10.1007/s12160-013-9490-x.

Neff, K. D., & Germer, C. K. (2013). A pilot study and randomized controlled trial of the mindful self-compassion program. *Journal of Clinical Psychology, 69*(1), 28–44. https://doi.org/10.1002/jclp.21923.

Partinen, M., & Gislason, T. (1995). Basic Nordic Sleep Questionnaire (BNSQ): a quantitated measure of subjective sleep complaints. *Journal of Sleep Research, 4*(s1), 150–155. https://doi.org/10.1111/j.1365-2869.1995.tb00205.x.

Raes, F., Pommier, E., Neff, K. D., & Van Gucht, D. (2011). Construction and factorial validation of a short form of the self-compassion scale. *Clinical Psychology & Psychotherapy, 18*(3), 250–255. https://doi.org/10.1002/cpp.702.

Salmela-Aro, K., Kiuru, N., Leskinen, E., & Nurmi, J. E. (2009). School burnout inventory (SBI) reliability and validity. *European Journal of Psychological Assessment, 25*(1), 48–57. https://doi.org/10.1027/1015-5759.25.1.48.

Sandman, N. (2017). *Nightmares: Epidemiological studies of subjective experiences.* Annales Universitatis Turkuensis, ser. B. 439. Doctoral dissertation. University of Turku.

Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). Enhancing cognitive and social–emotional development through a simple-to-administer mindfulness-based school program for elementary school children: a randomized controlled trial. *Developmental Psychology, 51*(1), 52-66. https://doi.org/10.1037/a0038454.

Spijkerman, M. P. J., Pots, W. T. M., & Bohlmeijer, E. T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: a review and meta-analysis of randomised controlled trials. *Clinical Psychology Review, 45*, 102–114. https://doi.org/10.1016/j.cpr.2016.03.009.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine, 166*(10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092.

Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology, 68*(4), 615-623. https://doi.org/10.1037/0022-006X.68.4.615.

Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., Meissner, T., Lazar, S. W., Kerr, C. E., Gorchov, J., Fox, K. C., Field, B. A., Britton, W. B., Brefczynski-Lewis, J. A., & Meyer, D. E. (2018). Mind the hype: a critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science, 13*(1), 36–61. https://doi.org/10.1177/1745691617709589.

Whoqol Group. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological Medicine, 28*(3), 551–558.

Woodward, L. J., & Fergusson, D. M. (2001). Life course outcomes of young people with anxiety disorders in adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*(9), 1086–1093. https://doi.org/10.1097/00004583-200109000-00018.

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools—a systematic review and meta-analysis. *Frontiers in Psychology, 5*, 603. https://doi.org/10.3389/fpsyg.2014.00603.

Zoogman, S., Goldberg, S. B., Hoyt, W. T., & Miller, L. (2015). Mindfulness interventions with youth: a meta-analysis. *Mindfulness, 6*(2), 290–302. https://doi.org/10.1007/s12671-013-0260-4.

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