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RESEARCH ARTICLE

An intervention study examining the effectiveness of loving kindness meditation in reducing depressive symptoms: Compassionate coping as a mediator?

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Abstract: Aim: To explore whether the LKM intervention has the potential to decrease depression and increase self-compassion. Self-compassionate coping was examined as a mediating variable. **Methods**: A sample of 57 university students underwent a pretest-posttest design. Self-compassion was measured with the Self-Compassion Scale, depression with the Patient Health Questionnaire – 9, and self-compassionate coping was assessed using the Self-Compassionate Coping Measure. Participants completed all measures at both pre and posttest. Between both measurement moments there were 12 days in which participants followed either the LKM or a control exercise daily. Repeated measures ANOVAs and a simple mediation analysis were performed. **Results**: Over time, both groups decreased in their depression and increased in their self-compassion scores. Assignment to the LKM condition did not result in significantly higher self-compassion scores compared to control. We found a significant effect of LKM for depressive symptoms only when controlling for successfully completed homework exercises. Self-Compassionate coping did not emerge as significant mediator in our statistical analysis. **Conclusion**: The results indicate a mixed picture regarding the efficacy of LKM in reducing depression and increasing self-compassion. Both conditions were possibly too similar and involved helpful elements. Further research into the antidepressant utility of LKM is warranted to understand the exact mechanisms of action.

Keywords: loving kindness meditation, depression, Self-Compassion, coping styles, focused imagery

1 Introduction

Each day we are interacting with our environment and monitoring the outcomes of these interactions. There are considerable individual differences regarding the way we behave towards ourselves when we fall short of our expectations. Some people tend to criticize themselves, while others are approaching their shortcomings with a more accepting and compassionate attitude. This latter attitude is one of three components that constitute self-compassion. According to Neff (2003a) [1], self-compassion involves (1) self-kindness, *i.e.* an approach towards oneself characterized by kindness and understanding, (2) common humanity, *i.e.* feeling part of a larger human experience, and (3) mindfulness, *i.e.* noting difficult thoughts and feelings rather than over-identifying with them. Self-compassion is opposite of self-judgment, isolation from the larger human experience, and overidentification with one's thoughts and feelings. In line with mindfulness being just one out of six components, research shows that self-compassion is an even more important predictor than mindfulness [2, 3]. In the literature, there is growing interest in studying self-compassion. While there have been about 1600 studies containing "self-compassion" in their title in 2018, at the time of the present research this number has risen to 5660 studies [4] – a clear indication of exponential growth in articles published on this topic.

This dynamic development is likely spurred by several meta-analyses highlighting the beneficial impact of self-compassion. One of the earliest meta-analysis, conducted by MacBeth and Gumley (2012) [5], reported a large and inverse relationship of -0.54 for self-compassion and a general psychopathology score consisting of anxiety, depression, and stress symptoms. This indicates that as individuals report being more self-compassionate, they also report less symptoms indicative of mental disorders. This finding is important especially regarding the occurrence of depression as this disorder has a huge economic impact [6]. More recent meta-analyses [7, 8] have replicated the results of the MacBeth and Gumley (2012) [5] meta-analysis. With these three meta-analyses, a solid evidence base for an inverse association between self-compassion and negative, psychopathological symptoms has been established. Extending these findings, Zessin et al. (2015) [9] showed how self-compassion is also associated with positive indices of well-being (r = 0.47). Moreover, in a smaller subsample, they were able to demonstrate that

self-compassion had a causal effect on individual's well-being. Self-compassion appears to not only inversely correlated to negative symptoms but also positively correlated to an individual's well-being.

Interventions aimed at increasing self-compassion come in many ways. Common to all these programmes is that they view self-compassion as a skill that anyone can learn and improve on. Self-Compassion programmes reliably help individuals to be more self-compassionate, mindful, to increase their well-being, and lower their psychopathological symptoms [10–12]. Based on the many advantages of being self-compassionate, researchers continue to be interested in how to enhance self-compassion on a broader scale. For example, mobile-based interventions [13] are a cost-effective way that allows for broad distribution of an self-compassion interventions. However, there is not a single intervention to increase self-compassion for everyone. Egan et al. (2021) [7] comment that while there often is a general interest in self-compassion interventions, the application of these interventions needs to be available in many forms to address the considerable diversity between individuals. Fortunately research shows that there are multiple pathways to enhancing self-compassion and interventions come in many forms, so that they can be adapted to individual needs.

Given the significant benefits associated with increased self-compassion as well as the relative ease with which it can be increased, the exploration of new interventions aimed at increasing self-compassion is a worthwhile pursuit. Our study directly relates to this cause by examining whether a specific form of meditation, called loving kindness meditation (LKM), may work as intervention to increase self-compassion. LKM is derived from Buddhist practises, which are aimed at generating unconditional, positive feelings towards others and eventually the self (Lee et al., 2012). Generally, this meditation involves repeating kind wishes and intentions towards others silently in one's mind. Preventing the increase of depressive symptoms or directly decreasing them through LKM is of great societal importance. The high prevalence of depression is a major economic burden, with costs in the United States amounting to 326 billion dollars in 2020 alone [6]. There is also a considerable impact on the individual: Once depressed, there is a higher likelihood to experience another depressive episode in one's lifetime [14, 15]. An intervention, such as LKM, that may help with depression through the utilization of self-compassion can be a valuable contribution in tackling the issue of depression.

A great deal of research has already been conducted on LKM. Studies on LKM interventions have been able to demonstrate a wide array of beneficial effects on psychopathology such as: symptoms of schizophrenia [16] depression, anxiety and stress [17], both positive and negative affect [18], and the regulation of anger [19]. More general effects of LKM have been identified in systematic reviews and meta-analyses. Galante et al. (2014) [20] conducted a meta-analysis on kindness-based meditations and report that they show moderate effect sizes in reducing depression, and increasing mindfulness, compassion, and self-compassion. In a later review, Shonin et al. (2015) [21] state that participants engaging in LKM display improvements in: (1) positive and negative affect, (2) psychological distress, (3) positive thinking, (4) interpersonal relations, and (5) empathic accuracy. They conclude that the practice of LKM may be useful in the treatment of various psychopathologies. Despite the many studies, there still is a great need to improve the methodological quality of research conducted on LKM. The most prominent shortcomings are (a) the lack of a universally agreed protocol for the meditation, (b) differing outcome variables used in the literature, and (c) differing intensities and durations of the intervention.

While the primary aim of LKM is to cultivate compassion for others, there is considerable evidence that this intervention is also suitable to foster self-compassion. According to Buddhist philosophy, by generating compassion for others, we increase and learn how to be compassionate towards our self [22]. This view is supported by research showing that LKM interventions appear to be effective in increasing participants self-compassion scores [23, 24]. These improvements were maintained for up to 8 weeks following the intervention, indicating lasting changes. These findings are in line with the meta-analysis by Galante et al. (2014) [20] which shows significant gains in self-compassion following kindness-based meditations (Hedge's $g = 0.45$). However, some of these positive findings should be consumed with caution as often the studies lack a rigorous methodology or an active control group. Kirby and Laczko (2017) [25] have used an active control group implementing a so-called "focused imagery" exercise which closely mimics the LKM intervention. This has the benefit that control and experimental group only differ in the active ingredient contained in the LKM intervention. The focused imagery exercise involves imagining other people and their physical appearance without the generation of unconditional, positive wishes for them. Within the present study, we want to improve on previous literature and replicate this more conservative test of the LKM intervention.

Besides increasing self-compassion, the LKM intervention appears to be promising in reducing depression as well [26]. The reductions in depressive symptoms seem to be of stable

nature with gains maintained for 3 months [23] and even up to 1-year follow-up [27]. This is especially impressive given that the intervention was compromised of only five sessions each lasting 60 minutes. In line with these findings, a meta-analysis by Galante et al. (2014) [20] showed moderate effect sizes for reductions in depression (Hedge's g = -0.61). There is a solid body of evidence showing the antidepressant effect of LKM interventions, yet the exact mechanisms by which this effect occurs remain vague.

In explaining the relationship between engaging in LKM and experiencing reductions in depression, self-compassion is a promising candidate. Much of the research focuses on self-compassion as a dispositional trait. Given the considerable follow-up times of self-compassion interventions [23,24], one can argue that the state-like effects achieved during interventions turn into trait-like effects that last beyond the end of an intervention. A meta-analysis by MacBeth and Gumley (2012) [5] highlights how trait self-compassion is highly and inversely correlated (-0.52) with depression with later research continuing to support this association [28,29]. Krieger et al. (2013) [30] report a difference in trait self-compassion levels between depressed and never-depressed individuals which has since been replicated [31]. The notion that a lack of self-compassion may pose a risk factor has been widely examined in research [3]. Self-compassion is involved not only in the development but also in the maintenance of depression [32]. Again, these studies refer to self-compassion as a dispositional coping strategy. In longitudinal studies, Zeller et al. (2015) [3] and Carvalho et al. (2020) [2] examined self-compassion as protective factor. Their results indicate that self-compassion is a significant predictor of depression with up to 1-year follow-up. However, by which mechanism increased self-compassion aids depressed individuals is not entirely clear.

Increasing self-compassion may potentially lead to reductions in depression because it presents an effective coping strategy for common stressors. Here, we refer to self-compassion as a coping strategy that can be learnt and may eventually lead to an increase in state self-compassion. In a study by Johnson and O'Brien (2013) [33], for example, individuals had to recall a shameful experience and those who wrote about it self-compassionately had reduced depressive symptoms at 2-week follow-up compared to participants who simply expressed their feelings in writing. Additional evidence comes from neuroscientific research highlighting the neural systems related to emotion regulation are enhanced by kindness-based meditations [34]. In line with this, Bakker et al. (2019) [35] demonstrated that the protective effect of self-compassion against depression relies on the use of emotion regulation strategies commonly associated with depression. They suggest that self-compassion facilitates the weakening of ruminative patterns with additional evidence for this coming from Diedrich et al. (2017) [36]. Closely related to rumination, Zhang et al. (2019) [37] examined the impact of self-compassion on repeated self-criticism. Their mediation analysis showed that self-compassion can partially account for the undesirable impact of self-criticism on depression which is consistent with previous research [29]. While there is no consensus in the scientific literature by which exact mechanisms self-compassion helps with depression, the research converges on one point: Self-Compassion enables individuals to cope more effectively with the struggles they experience. The Self-Compassionate Coping Measure [38] is intended to measure the extent to which individuals display a self-compassionate coping style. For example, one item asks individuals to rate themselves on a scale ranging from 1 to 5 regarding the statement "I say friendly things to myself". This directly ties in with the research previously presented on self-criticism. As such, a coping style characterized by greater self-compassion may potentially mediate the link between engaging in LKM and depression.

We are interested in contributing to the research on LKM and depression. Based on several studies implicating self-compassion as an emotion regulation strategy helpful for depression [35–37], we will examine whether self-compassion emerges as a mediator in the relationship between LKM and depression. Our first question regards potential group differences between LKM and control in their self-compassion scores. We expect participants in the LKM condition to display greater self-compassion compared to control. Secondly, we ask whether depression scores differ depending on group allocation. Here, we expect those in the LKM condition to have lower depression scores compared to controls. Lastly, we are interested in the mechanism by which LKM potentially leads to reduced depressive symptoms. For this, we will conduct a mediation analysis testing self-compassionate coping as mediator between engaging in LKM and displaying reduced depressive symptoms.

2 Methods

2.1 Participants

A sample of 57 participants (89% female) was achieved after applying the exclusion criteria to the 73 participants sampled. Participants ranged in age from 17 to 32 with an average

age of 19.87 (SD = 2.94). More than two thirds of the sample (77.19%) were of Dutch nationality while remaining participants have been either German (5.26%) or of other nationality (17.54%). The sample consisted almost exclusively of bachelor students (98.24%), with the exception of one master student. The majority of participants had entered the study through the SONA environment of Leiden University (85.96%) while seven individuals participated in the study based on recommendations of friends. Random allocation led to 27 participants in the experimental condition and 30 participants in the control condition.

2.2 Procedure

The data collection occurred completely online within the SONA environment of Leiden University and the associated Qualtrics environment. Approval for the study was obtained from the Ethics Committee of Leiden University and the data was dealt with in confidentiality according to the prescribed guidelines. Potential participants were able to enrol themselves in the study through the SONA environment. Besides being visible online, the study was also advertised orally to students with the request to recommend this research to their friends. If students were participating through the SONA environment, they were eligible to be granted a total of 8 SONA credits for the full completion of our research. Participants were provided with a link to a Qualtrics survey that presented them with an information and informed consent sheet. Only when providing their consent were participants allowed to continue with the survey. The survey was programmed in such a way that it automatically and evenly assigns participants to either the LKM condition or the control condition. Upon their agreement to participate in the present research, they were first presented with all the pretest measures included in this study. The order in which participants were presented with the questionnaires was randomized to prevent any order effects. After filling out the survey, participants were informed that they have reached the end of this first part and will now receive another link via e-mail containing their first homework assignment. In the upcoming 11 days, participants received an e-mail in the morning containing the exact same audio file with the instruction of completing this mental exercise as part of their daily homework. These e-mails were scheduled by an automated workflow programmed in Qualtrics. On day 12, participants have had the chance to listen to their respective audio file for a total of 12 times. On the last day, participants also received a link containing the same measures they have already been presented with at pretest. After answering these, they were presented with a debriefing form and thanked for their participation. Throughout the study, we checked whether participants spend a sufficient amount of time on their homework daily. When participants completed the homework in less than 12 minutes, it was graded as failed as the audio file itself was lasting 14 minutes already. When participants have spent above 20 minutes on the survey, their homework was graded as passed but highlighted as irregular. When a single participant showed an irregular or incomplete pattern of doing his homework for more than 2 days, we contacted this participant highlighting that this is a common strategy in which students try and receive their SONA points without properly completing their homework.

2.3 Design

We set up our RCT so that participants completed all measures twice. First, participants completed the measures at pretest after which they started with the intervention lasting for 12 days. When they completed their last homework assignment, participants were given all measures again at posttest.

2.4 Materials

2.4.1 Assessment of Self-Compassion

We assessed self-compassion using the short form (SCS-SF [39]) of the Self-Compassion Scale(SCS [40]). This measure includes 12-items intended to capture the same six-factor structure that the original Self-Compassion Scale shows. The six dimensions of self-compassion are: (1) self-kindness, (2) common humanity, (3) mindfulness, (4) self-judgement, (5) isolation, and (6) over-identification. Raes et al. (2011) report good internal consistency (Cronbach's alpha = 0.86) in a study designed to validate the SCS-SF. The internal consistency of the SCS-SF in our study was good at pretest (Cronbach's alpha = 0.83) and at posttest (Cronbach's alpha = 0.86). Moreover, the short form version has demonstrated a nearly perfect correlation of 0.97 with the long form across all samples in previous research (Cronbach's alpha above 0.86 in all samples [39]). Using factor analysis, the team of researchers were also able to show that the six-factor structure of the original version was maintained with self-compassion emerging as single higher-order factor.

2.4.2 Assessment of depression

Participant's depressive symptoms were measured using the Patient Health Questionnaire 9 (PHQ-9 [41]). The instrument is based on the nine DSM-IV criteria indicative of depression. Participants were asked to rate themselves on each symptom ranging from either 0 (not at all) to 3 (nearly every day). This resulted in a total score representing depression severity. While validating the PHQ-9, Kroenke et al. (2001) [41] report excellent internal reliability (Cronbach's alpha = 0.89). In the present study, the PHQ-9 shows adequate internal reliability with a Cronbach's alpha of 0.81 at pretest and 0.76 at posttest.

2.4.3 Assessment of Self-Compassionate coping

The degree to which participants cope in a self-compassionate way was assessed using the Self-Compassionate Coping Measure (SCCM [38]). The SCCM is a 4-item measure that participants answer based on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always). The resulting total score is representative of the degree of self-compassionate coping, with higher scores referring to more self-compassionate coping. Garnefski and Kraaij (2019) [38] investigated the psychometric features of the SCCM and report an excellent alpha reliability (0.91). With an alpha reliability of 0.87 at both pre and posttest, the measure displays good internal reliability in our sample. The SCCM has a Pearson correlation of 0.63 with the total score of the Self-Compassion Scale [1,40] and thus represents a reliable and valid measure of self-compassion during coping behaviour.

2.5 Interventions

2.5.1 Loving kindness meditation

The LKM condition used in this research was closely based on the usual components present in such meditations. Participants were instructed to generate warm and loving feelings starting with someone they feel positive towards. Then they moved on to a neutral person followed by a person they have difficulties with. At the end of the meditation, they were instructed to imagine themselves as a child and themselves in the present moment. With each person, they were asked to imagine them in their mind and then repeat the following wishes in their mind silently: "May you live with ease, may you be happy, may you be free of suffering". Throughout the meditation, they were reminded of the commonality that each person wants experience pleasure and avoid pain – just like them. A full transcript of the meditation is available in the appendix and the audio file may be provided upon request.

2.5.2 Focused imagery

The focused imagery exercise served as control condition to the LKM. This control condition is inspired by previous research successfully using it as comparison to a LKM intervention [25]. It is especially suitable because it closely mimics the LKM condition in two ways: (1) participants create a mental image of loved, neutral, and difficult persons including themselves, and (2) participants close their eyes and listen to guided instructions by a calm voice. In comparison to the LKM condition, participants are not asked to send loving wishes to the imagined persons but are asked to recall the physical appearance, especially facial features. In this way, the crucial difference between control and experimental condition is the conscious generation of feelings of loving kindness towards the imagined people. A transcript of the control audio file can be found in the appendix and the full audio file may be provided upon request.

2.6 Data analysis

We first presented basic information regarding the sample such as descriptive statistics. All questions have been studied with the open-source statistical package JASP [42] which was developed by a team of researchers at University of Amsterdam. An intent to treat analysis was conducted with the last observation carried forward method. The questions regarding our first two hypotheses have been tested with repeated measures ANOVAs. Significant within-between subject interactions would confirm our predictions. Our third question concerns a potential mediating role of self-compassionate coping across the whole sample and has been tested with a simple mediation analysis using difference scores for the mediating and dependent variable. Here, a significant indirect effect, as indicated by significant beta-values, would confirm our hypothesis.

We performed the statistical analysis based on only those participants who have completed enough homework assignments. Participants were excluded from statistical analysis when they have done less than 6 homework assignments. Additionally, participants were given the chance

to indicate whether their data is valid and may be used for our research, without consequences for them, at the end of their 12-day period. While the large part of our sample reported that their data is valid (78.08%), some participants (n = 14 let us know that we should not use their data for our research.

3 Results

A total of 73 participants completed the study and were thus asked to indicate whether their data is meaningful. Of these participants, 57 (78.08%) reported that their data is valid while 12 (16.43%) participants reported that their data is invalid and should not be used for further analysis. Because of too little homework exercises completed (defined as >6), a total of 4 (5,47%) participants were excluded from statistical analysis. On average, participants completed 10.69 (SD = 1.43) homework assignments. Approximately 70% of the sample reported that they had no issues or even found it easy to follow the instructions provided. The scheduled reminders were perceived as highly helpful (4.52 of 5) and only slightly annoying (1.96 of 5). There was no significant difference in the self-reported focus of participants before and after their respective exercise. There were no significant group differences regarding the dependent variables at pretest (see Table 1). This indicates that randomization has successfully equalized the experimental and control group regarding their scores on outcome variables. The correlations of instruments used were highly significant in the expected directions (see Table 2). Each measure is highly and positively associated from pre to posttest. The SCS-SF and SCCM scores correlate positively as expected since both instruments cover aspects of self-compassion. Additionally, both the SCS-SF and SCCM show negative correlations with the PHQ-9.

Table 1 Pretest and posttest scores for outcome variables split by group

Outcome	Loving Kindness Meditation (M (SD))		Control Group (M (SD))	
	Pretest	Posttest	Pretest	Posttest
SCS-SF	2.96 (0.67)	3.29 (0.65)	2.84 (0.56)	3.22 (0.72)
PHQ-9	18.11 (4.69)	15.22 (3.89)	17.26 (5.27)	16.40 (4.36)
SCCM	12.85 (3.12)	13.55 (2.69)	12.30 (3.31)	13.36 (3.83)

Note: M = Mean; SD = Standard Deviation; SCS-SF = Self-Compassion Scale; PHQ-9 = Patient Health Questionnaire – 9; SCCM = Self-Compassionate Coping Measure

Table 2 Correlation matrix for outcome variables at pre- and posttest

Outcome	SCS-SF Pre	PHQ-9 Pre	SCCM Pre	SCS-SF Post	PHQ-9 Post	SCCM Post
SCS-SF Pre	-					
PHQ-9 Pre	-0.48***	-				
SCCM Pre	0.63***	-0.54***	-			
SCS-SF Post	0.68***	-0.48***	0.57***	-		
PHQ-9 Post	0.36***	0.62***	-0.46***	-0.50***	-	
SCCM Post	0.50***	-0.56***	0.77***	0.76***	-0.52***	-

Note: *** $p < 0.001$

3.1 Question 1: Does LKM Increase Self-Compassion Compared to the Control Group?

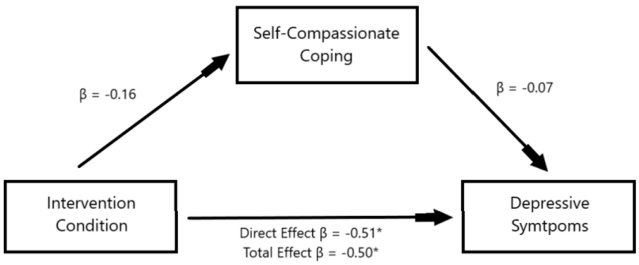
The repeated measures ANOVA testing the interaction between time and condition was non-significant (F (1,1) = 0.13, p = 0.72, η_p^2= 0.002). There was no significant difference between the two conditions (F (1,1) = 0.366, p = 0.54, η_p^2= 0.007). A significant main effect for the within-subjects variable time was present (F (1,1) = 25.98, p = < 0.001, η_p^2= 0.032). Participants increased in their self-compassion scores over time, independent of group assignment.

3.2 Question 2: Does LKM Reduce Depressive Symptoms Compared to the Control Group?

The interaction effect between time and condition was non-significant (F (1,1) = 3.76, p = 0.057, η_p^2= 0.06) although a trend towards significance is visible. The between-subjects variable group was non-significant (F (1,1) = 0.02, p = 0.88, η_p^2= 0.00). All participants had significantly reduced their depressive symptoms over the course of time (F (1,1) = 12.99, p = < .001, η_p^2= 0.19). Since the interaction effect is approaching significance, we decided to perform another repeated measures ANOVA which included the number of successfully completed homework assignments as covariate. Here, the interaction effect of time and condition was significant (F (1,1) = 4.55, p = 0.03, η_p^2= 0.08).

3.3 Question 3: Does Self-Compassionate Coping Mediate the Relationship of LKM and Depressive Symptoms?

We proposed a mediation model (see Figure 1) in which self-compassionate coping mediates the effect of the loving kindness condition on depressive symptoms. Both self-compassionate coping and depressive symptoms have been entered into the analysis using difference scores by subtracting pretest from posttest scores (T2-T1). We used the bias-corrected bootstrap method with 1.000 samples to compute our analysis. The 95% confidence interval for the indirect effect (0.04) did include zero (-0.15 to 0.73), which indicates no support for a model in which self-compassionate coping (partially) mediates the relationship between LKM and depression. A significant direct effect (B = -2.06; $p = 0.04$) of LKM on depressive symptoms was found.



Note: * $p < 0.05$. Self-Compassionate Coping and Depressive Symptoms have been entered into the meditation analysis using difference scores (T2-T1).

Figure 1 Mediation model used for analysis

4 Discussion

Within the present study, our aim was to contribute to the research on LKM and depression. We were interested in whether the LKM intervention is able to increase participant's self-compassion scores and reduce their depressive symptoms compared to a control condition. Those in the LKM condition did not display higher self-compassion after the intervention compared to the control group. Participants increased in their self-compassion scores over time, independent of their group assignment. Both groups reduced their depression scores over time, yet with no significant difference between the experimental conditions. However, there was a trend towards the LKM group displaying a greater reduction of depressive symptoms. However, we did find a significant effect indicating that those in the LKM intervention significantly reduced their depressive symptoms compared to the control group when controlling for the number of homework assignments that participants had successfully completed. We did not find evidence for self-compassionate coping being a significant mediator in the relationship between engaging in LKM and reduced depressive symptoms. Despite this, the mediation analysis confirmed that the LKM condition has a significant effect on depression.

While much of the previous literature reports increases in participant's self-compassion scores after engaging in LKM [23, 24, 43], our data does only partially supports a trend like that. Within our sample, participant's self-compassion scores increased over time, irrespective of their assigned group. This potentially indicates that the control condition used in our study resembles the experimental group too closely or contains helpful elements as well. There may be components shared by both conditions which result in the generally increased self-compassion scores we observe. Knowing that both conditions produced effects in the desired direction may further inform the development of the LKM intervention by allowing for carefully selected comparisons in future studies. We intended to maintain the conscious generation of feelings of loving kindness as the only difference between both groups. However, imagining loved ones may automatically trigger warm feelings adding to an undesired overlap between the LKM and focused imagery exercise. In future studies, it may be helpful to further discriminate control and experimental group, e.g. by removing the aspect of imaging loved ones, so that the design enables the researchers to discern what the active ingredients of the LKM intervention may be.

In contrast to prior studies showing an antidepressant effect of LKM superior to that of control conditions [20, 26, 27], participants assigned to the LKM condition within our study did display reductions in depressive symptoms, yet not significantly different to those observed in the control group. Only when we included the number of successfully completed homework, the results indicated a statistically significant difference between both groups. Fredrickson et al. (2017) [44] were able to display a significant dose-response relationship between the duration of meditation practice and positive emotions. Similarly, the frequency of meditation and positive emotions are also in a dose response relationship. The lack or complete absence

of positive emotions is a hallmark of depression. Importantly, within individuals, these dose response relationships were even stronger for the LKM compared to other forms of meditation. This potentially indicates that duration and frequency of engaging in LKM have important implications in the reduction of depressive symptoms. However, in an earlier meta-analysis concerning the effect of LKM on positive emotions, Zeng et al. (2015) [45] report that the duration and frequency did not affect their effect sizes. Yet studies without a didactic component to the LKM intervention did result in smaller effect sizes [45]. This implies that it is advisable to implement didactic components to an LKM intervention, especially when participants are novice meditators. Regarding improved homework adherence and motivation, Suárez et al. (2019) [46] have identified intrinsic motivation, the perceived homework utility, and the personal homework attitude as significant predictors of the behavioural engagement of students. The attitudes of participants concerning the assigned homework is unlikely to be subject of change within a 12-day intervention. Often the participation in research is extrinsically rewarded which has been shown to undermine intrinsic motivation [47]. Collecting samples in which individuals participate due to their own internal motivation raises difficulties with the external validity of the research results. Moreover, explaining the utility of homework exercises potentially threatens the internal validity of the experiment as participants may not be blind to their condition anymore.

Self-Compassionate coping did not achieve significance as potential mediator in the relationship between engaging in LKM and reduced depressive symptoms. However, the mediation analysis did further support the antidepressant effect of LKM on depression through a direct path. Meta-analyses have implied the crucial role that self-compassion plays regarding depressive symptomology [21, 35]. Johnson and O'Brien (2013) [33] were even able to display the antidepressant effect of self-compassionate coping with difficult experiences directly. In our study, allocation to the LKM condition did not result in significantly greater self-compassion scores compared to control. This likely contributes to self-compassionate coping emerging as a non-significant mediator within our analysis. Despite the non-significant finding of our study, this line of reasoning should be further pursued with a research design including an intervention and control condition which together manage to induce significant group differences regarding participant's self-compassion scores.

5 Limitations

Most of our statistical tests did not reach significance, yet it is uncertain what factors this can be attributed to. A prominent explanation for the non-significance of findings is that the intervention has been administered in a dosage that is too low in intensity or duration to produce a large enough effect. Alternatively, the control condition may have been too closely matched to the intervention, so that significant group differences could not emerge. In our study, participants were instructed to follow the LKM for a maximum of 12 sessions. This relatively short time may be insufficient to build up a statistically detectable effect [44]. Additionally, our study was conducted online thus deviating from how LKM interventions are usually administered. Moreover, we used a control group that mimicked the LKM intervention closely. The small discrepancy between experimental and control group further increases the difficulty to display statistically significant differences between both groups. Perhaps the active ingredient that produces the effects we observe in LKM was also present in the control condition. While adherence to the homework exercises was good (M =10.69, SD = 1.43), we cannot exclude the possibility that participants missed homework sessions systematically. As Robiner (2005) [48] points out, the adherence of participants has a significant impact on detecting differences between experimental conditions. Perhaps participants did not complete their homework on days during which they felt extraordinarily bad. While this arguably holds true for participants in both conditions, those in the LKM condition may gain greater benefit from doing their homework on difficult days. Especially on these days, self-compassion would be necessary and for participants in the LKM group these days would provide the learning opportunity necessary to implement self-compassionate coping into their everyday routine.

Furthermore, the use of intent to treat analyses is controversial with some experts suggesting that statistical analyses including only data from cooperative participants provides superior accuracy compared to the intent to treat analysis approach [49].

Lastly, the implementation of compassion-based interventions may pose to be problematic for certain groups. Gilbert et al. (2011) [50] report that individuals which are overly self-critical often struggle with self-compassionate feelings and may be fearful of them. This fear of self-compassion is strongly associated with depression as depressed patients are often highly self-critical (Gilbert, 2014) [51]. This could imply that the effect of LKM weakens as participant's depression scores rise, indicating a potential moderation effect. Thus, it may be necessary to address fear of self-compassion prior to the LKM intervention, for example as part

of the didactic components.

6 Recommendations for future research

Future research would benefit from developing a universally agreed upon LKM protocol consistent in length, content, and administration. This would increase the comparability of studies as interventions become more similar. Here, there should be a debate held about how much of the Buddhist origin of LKM should be incorporated into a potential protocol. Zeng et al. (2016) [52] conducted a confirmatory factor analysis of the Self-Compassion Scale [40] which was not replicated in both a Buddhist and a general population sample. The understanding that Buddhists have of self-compassion seems to differ from the way it is conceptualized within the Self-Compassion Scale. These different notions of self-compassion should be considered when attempting to create a universally valid LKM protocol. Moreover, it appears that didactic components of some LKM interventions are especially important to achieve an effect and should thus be an integral part of future protocols [45]. Thus, in order to create a protocol for LKM, more research is needed to determine the core ingredients of this interventions. Besides using more similar interventions, the field should implement the use of active control groups to provide thorough tests of the LKM intervention. Our research suggests that the focused imagery control group may be too close to the LKM intervention which is in line with Kirby and Lackzo (2017) [25], yet further studies are needed before conclusions should be drawn. The implementation of a wait-list control group to the design of our study would allow for a comparison of what occurs to self-compassion and depression scores of participants when no intervention is applied. Ultimately, our interest should be in determining by which mechanisms LKM exerts its effects. For example, Mantzios et al. (2021) [53] were able to display that a loving kindness colouring exercise had the same effect as the LKM. This indicates that there may be different modalities in which loving kindness may be generated that do not necessarily differ in their outcomes. Extracting the crucial ingredients will facilitate the further refinement and implementation of this promising intervention.

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