

Impact of an online mindfulness intervention on psychological wellbeing and quality of life in chronic stroke survivors: a pilot randomized control trial

Marika Demers

`marika.demers@umontreal.ca`

University of Montreal

Francesco Pagnini

Catholic University of the Sacred Heart

Deborah Phillips

Harvard University

Julie Schwertfeger

Louisiana State University

Steven Miller

Rosalind Franklin University of Medicine and Science

Alvin So

University of Southern California

Carolee Winstein

University of Southern California

Ellen Langer

Harvard University

Research Article

Keywords: Stroke, mindfulness, wellbeing, rehabilitation, self-management

Posted Date: September 1st, 2025

DOI: <https://doi.org/10.21203/rs.3.rs-6810402/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Objectives

This study aimed to determine the impact of an online mindfulness intervention, compared to a waitlist control, on improving quality of life and psychological well-being among stroke survivors.

Methods

In this pilot randomized control trial, participants were randomized to a three-week online mindfulness intervention or a waitlist control. Measures of psychological well-being and quality of life were administered at baseline, post-intervention, and at one-month follow-up. Two baselines administered two months apart were used for participants in the waitlist group. Non-parametric longitudinal data analysis was used to analyze the relative treatment effects on psychological well-being and quality of life measures.

Results

A total of 20 participants were recruited and randomized (11 in the mindfulness group and 9 in the waitlist group). The retention rate was 80.0%. Study procedures were well accepted by participants and no related adverse events occurred. The only baseline difference was depression, which was higher in the waitlist group. Sleep significantly improved after the mindfulness intervention and a moderate to large improvement was seen in reducing anxiety, lowering stress, and increasing quality of life, with changes maintained one-month post-intervention.

Conclusions

This study provides the foundation for a larger planned randomized control trial. Further research is necessary to determine the impact of mindfulness on psychological well-being and quality of life in stroke survivors.

Trial registration:

NCT04553679 (date: 08-13-21)

1. Background

Life after stroke can be challenging, as stroke survivors often face persistent disability even after having received multidisciplinary rehabilitation (Skolarus et al., 2014). Stroke survivors often report diminished

perceived physical health (Patel et al., 2006) and high levels of life dissatisfaction, which are associated with limitations in activity and restricted participation at one year post-stroke (Hartman-Maeir et al., 2007). The prevalence of anxiety and depression is high among this population, correlating with adverse clinical outcomes (Ayerbe et al., 2013; Campbell Burton et al., 2013; Liu et al., 2023). These findings underscore the importance of providing support and intervention after stroke survivors are discharged from the initial bout of rehabilitation.

Mindfulness is a promising intervention for stroke recovery to address psychological wellbeing, reduce stress, help cope with the different facets of a chronic condition and develop the capability to accept one's own condition (Pagnini & Philips, 2015). Multiple health benefits are associated with mindfulness interventions for stroke survivors, including a better control over negative thoughts and emotions (Jani et al., 2018); a reduction in the perceived impact of stroke on one's life (Doshi et al., 2017), fatigue (Ulrichsen et al., 2016), and spasticity (Wathugala et al., 2019); and an increase in psychological well-being (Doshi et al., 2017). Mindfulness is also well aligned with a self-management approach to stroke recovery, an approach that has shown great benefits for stroke survivors (Fryer et al., 2016; Jones & Riazi, 2011; Lennon et al., 2013). While multiple approaches to mindfulness exist (Pagnini & Philips, 2015), mindfulness is defined here as the process of actively making new distinctions about a situation and its environment or its current context. Given the favorable results from small pilot studies with stroke survivors, we developed an online mindfulness intervention tailored to stroke survivors and caregivers. Our preliminary results confirmed that a remote assessment and delivery of a three-week mindfulness intervention was feasible and well-accepted (Demers et al., 2022). However, we did not include a group control, limiting our ability to draw meaningful conclusions on interventions' effectiveness. To inform the development of a large randomized control trial, this pilot study aimed to determine the extent to which a three-week online mindfulness intervention improves quality of life and psychological well-being for chronic stroke survivors compared to a waitlist control. Our primary hypothesis was that participants in the mindfulness group would demonstrate greater improvement in quality of life and psychological well-being post-intervention compared to waitlist control participants (hypothesis 1). We also hypothesized that the waitlist condition could have an effect on our outcomes (hypothesis 1a). Our secondary hypothesis was that the improvements would persist at one-month post-intervention (hypothesis 2).

2. Methods

2.1. Study design: This pilot study used a pragmatic two-arm randomized control trial design. The first arm was a three-week self-directed mindfulness intervention, whereas the second arm was a two-month waitlist control. Regardless of the group assignment, all participants were offered the mindfulness intervention either after enrollment (mindfulness group) or after a two-month wait period (waitlist group).

2.2. Participants: Community-dwelling chronic stroke survivors were recruited through a combination of existing laboratory and medical center databases, website advertisement and local support groups from September 2021 to July 2023. Participants were included if they were fluent in English and had access to

the Internet. Individuals with severe language impairments or those who participated in regular meditation or a mindfulness program in the past three months were excluded. We also recruited caregivers, but due to the low recruitment number ($n = 7$), the results of this caregiver group will not be presented here. This study was approved by the Institutional Review Board at the University of Southern California (HS-11-00413) and pre-registered (NCT04553679). All participants provided informed consent, in the form of a signed electronic consent form completed on the REDCap platform. Due to the pilot nature of this study, a sample of ten participants per intervention arm was targeted.

2.3. Randomization: Stroke survivors were randomized (1:1 ratio, blocks of 6) either to the mindfulness intervention group or the waitlist control group. Randomization was done using a random number sequence generator placed in sealed envelopes by a third party.

2.4. Intervention: The intervention consisted of a daily, self-directed mindfulness exercises, which was based on the non-meditative Langerian approach and offered online for three weeks. The Langerian approach focuses on attention to variability and provides easily accessible cognitive exercises, inducing openness, cognitive flexibility, and creativity (Pagnini et al., 2016). The detailed description of the intervention was previously reported (Demers et al., 2022). Every day, participants connected to an online platform (D2L, Kitchner, Canada) to complete short cognitive exercises and receive educational information about mindfulness. Written information and audio tracks were available for each exercise and education materials.

2.5. Waitlist: Participants in the waitlist control were informed they would receive the mindfulness intervention after a two-month wait period. A waitlist control was selected to allow provision of the intervention and control for the effect of time and repeated testing. After the two-month wait period, participants received the same mindfulness intervention as participants in the intervention group.

2.6. Procedures: All participants had three online visits comprised of 1) a baseline assessment, 2) a post-intervention assessment, and 3) a one-month follow-up assessment. Participants in the waitlist group took part in an additional baseline assessment, two months post-enrollment and before the start of the mindfulness intervention (see Fig. 1 for assessment timeline). All online visits were done via the HIPAA-compliant Zoom platform (Zoom Video Communications, Inc, San Jose, CA). During each visit, participants completed a battery of assessments about psychological well-being and quality of life, and any adverse events were noted. Participants were guided step-by-step on how to navigate the mindfulness platform using their own device. Written instructions with reminders on how to navigate were provided. Participants were instructed to connect to the mindfulness platform a minimum of five days/week for three weeks to optimize participation. Follow-ups with participants were done after the first 48 hours and every week thereafter. Participants were also able to contact a member of the research team if they experienced any difficulties.

2.7. Outcome measures: Demographic information, stroke characteristics and expectations of the mindfulness intervention were captured in a short interview. During the baseline assessment, participants were asked to rate their confidence they would be able to implement mindfulness strategies in their daily life at the end of the study using a visual analogue scale (0: not confident, 10: extremely confident). The abbreviated version of the Montreal Cognitive Assessment (mini version 2.1) was

administered to capture cognitive status because it is valid and reliable to administer remotely (Wong et al., 2015). The assessor was not blind to the group allocation. Feedback about the mindfulness intervention was collected post-intervention in the form of an exit survey. At each assessment timepoint, we asked participants if they experienced any adverse events or change in their medical status. All information collected during this study was coded to assure confidentiality.

Four outcome measures were collected at each timepoint using REDCap surveys: 1) quality of life: Stroke Specific Quality of Life (SSQoL) (Williams et al., 1999), 2) anxiety and depression: Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983), 3) perceived stress: National Institutes of Health Perceived Stress Survey (PSS) (Kupst et al., 2015), and 4) sleep quality: Single-Item Sleep Quality Scale (Snyder et al., 2018). The SSQoL includes 49 items organized in 12 domains about the impact of stroke on health and life (Williams et al., 1999). Each question is scored from 1 (total help) to 5 (no trouble at all). Higher scores indicate higher functioning. The HADS is a 14-item scale with 7 items each for anxiety and depression subscales (Zigmond & Snaith, 1983). Each item is scored from 0 to 3, with higher scores indicating higher anxiety or depressive symptoms. The PSS includes 10 items about the occurrence of life stressors scored from 0 (never) to 4 (very often) (Kupst et al., 2015). Higher scores indicate higher perceived stress. The Single-Item Sleep Quality Scale (SISQ) includes an 11-point visual analogue scale about sleep quality in the past week (0: poor, 10: excellent sleep quality) (Snyder et al., 2018).

2.8. Data Analysis: The data analysis was performed by a member of the research team blinded to group assignment, using a per protocol analysis. We estimated descriptive statistics on all outcomes; for normally distributed data, we present the mean and standard deviation (SD), and for skewed distributions, we present the median and interquartile range (IQR). Binary and categorical variables are presented using counts and percentages.

Intervention analyses were completed in R and R Studio (*R: The R Project for Statistical Computing*, n.d.) and the non-parametric longitudinal data (npard) software package version 4.2.2 (Noguchi et al., 2012). The npard method was used because it allows for relative treatment effects (RTE) analysis by using rank means on small data samples. The npard rank means effects provides a nonparametric equivalent of the classic ANOVA test in longitudinal factorial data sets that lack parametric properties.

Effect of treatment: The RTE of the mindfulness intervention was assessed using the npard model to capture changes over time between pre- to post-intervention to the mindfulness intervention and between both baselines for the waitlist group.

Effect of timing: A second set of npard analyses compared the RTE in the waitlist group to the intervention group. This analysis controls for the differences in timing and number of assessments between those who completed three assessments (intervention group) compared to four assessments (waitlist group).

RTE was calculated using paired sample t-tests to compute Cohen’s d and rank biserial correlation for baseline to post-intervention (intervention group) and baseline 1 versus baseline 2 (waitlist group). Rank biserial correlation effect sizes were also used to calculate treatment effect sizes using rank means, which was indicated due to the small sample size and ordinal data in this study. Persistent effects were assessed with paired comparisons using Jamovi statistical software (Jamovi Project, n.d.) for each variable pre to post intervention and post to one-month follow-up.

3. Results

3.1 Participant characteristics

Overall, 20 participants were enrolled in this study (see Fig. 2 for flow diagram), with 11 randomized to the mindfulness group and 9 assigned to the waitlist control. In the mindfulness group, two participants dropped out after the initial assessment but before starting the intervention, and another one dropped after the third day of the intervention due to a lack of time. In the waitlist group, one participant dropped after the baseline 2 assessment but before starting the mindfulness intervention due to change in health status. All other participants remained in their randomized groups, for a retention rate of 80.0%. Participants were on average 56.5 years old (range: 32.4 to 71.7 years) and 7.0 years post-stroke (range: 0.8 years to 20.3 years). A subset of participants (35%) had previous experience with mindfulness, but they all considered themselves novice and none practiced mindfulness regularly prior to this study. Participants were confident (mean score of 8.2/10) in their ability to apply the mindfulness strategies in their daily lives. Participants’ key expectations included enhanced memory, self-awareness and communication skills, decreased stress, and overall improved quality of life. At baseline, participants from both groups did not differ in their scores for the SSQoL, the HADS Anxiety Scale, the PPS and the SISQ. However, participants in the waitlist group had higher HADS depression scores at baseline (waitlist: 8.22, mindfulness: 6.27; $p < 0.05$).

Insert Table 1 around here

Table 1
Participant characteristics

	Mindfulness group (n = 11)	Waitlist control group (n = 9)	Baseline group comparison (p-value)
Variable	Mean ± SD or N (%)	Mean ± SD or N (%)	
Age	56.5 ± 10.6	58.4 ± 9.3	0.912
Gender (women)	8 (72.7%)	3 (33.3%)	0.398
Ethnicity (Hispanic)	2 (18.2%)	4 (44.4%)	0.288
Race			0.288
White or Caucasian	1 (9.1%)	5 (55.6%)	
More than one Race	3 (27.3%)	3 (33.3%)	
Asian	4 (36.4%)	0 (0.0%)	
Black or African American	2 (18.1%)	0 (0.0%)	
Native Hawaiian or Pacific Islander	0 (0.0%)	1 (11.1%)	
Duration Since Stroke Onset (years)	6.4 ± 4.1	7.8 ± 6.1	0.813
Type of Stroke (ischemic)	8 (72.7%)	5 (55.6%)	0.681
Affected Hemisphere (Left)	5 (45.5%)	5 (55.6%)	1.000
Living situation (alone)	3 (27.3%)	4 (44.4%)	0.288
Mini Montreal Cognitive Assessment – telephone version (median and IQR, /15)	13 (12–14)	13 (12–14)	0.787

3.2 Treatment effect on anxiety, depression, sleep, quality of life and stress

Table 2 shows the nparLD ANOVA that assessed the RTE between the two groups based on the difference in number and timing of assessments. Collapsing across groups, time points differed significantly for anxiety ($p = 0.001$). The change score across time did not vary significantly in anxiety as a function of having one versus two baseline assessments ($p = 0.29$; Fig. 3 displays the individual and average scores for both groups). These results indicate that anxiety scores changed similarly in both groups following the mindfulness intervention. Depression, quality of life and perceived stress did change over time for both groups. For sleep, the group by time interaction was significant ($p = 0.61$), suggesting that the sleep quality of participants in the mindfulness intervention improved compared to those in the waitlist group.

Table 2
Treatment effect

	$F_{(1,\infty)}$	p
Anxiety		
Group	1.94	0.16
Time	10.48	0.001
Group:Time	1.11	0.29
Depression		
Group	3.97	< .05
Time	2.17	0.14
Group:Time	1.09	0.30
Sleep		
Group	0.14	0.71
Time	0.26	0.61
Group:Time	4.98	0.03
Quality of life		
Group	3.34	0.07
Time	2.27	0.13
Group:Time	0.23	0.63
Stress		
Group	1.84	0.18
Time	2.51	0.11
Group:Time	0.97	0.32

Insert Table 2 around here

3.3. Timing effects on anxiety, depression, sleep, quality of life and stress

Hypothesis

a addresses a methodological artifact in our study by comparing the time points immediately before and after the intervention for both groups (see Table 3). Collapsing across time points, there was no difference between groups in change scores for anxiety, depression, sleep, quality of life and stress.

When collapsing across groups, however, time points differed significantly in change scores for anxiety, sleep, quality of life and stress, but not for depression. The magnitude of change over time in anxiety, sleep, quality of life, and stress scores did not differ significantly between groups.

Table 3
Timing effect

	<i>F</i> _(1,∞)	<i>p</i>
Anxiety		
Group	1.94	0.16
Time	10.48	0.001
Group:Time	1.11	0.29
Depression		
Group	2.03	0.15
Time	2.51	0.11
Group:Time	0.16	0.69
Sleep		
Group	0.39	0.53
Time	4.88	0.03
Group:Time	0.22	0.64
Quality of life		
Group	0.65	0.42
Time	4.60	0.03
Group:Time	0.08	0.78
Stress		
Group	0.68	0.41
Time	9.10	0.002
Group:Time	0.09	0.76

Insert Table 3 around here

3.4. Persistent effects

For anxiety, paired comparisons differed significantly after the mindfulness intervention ($p = 0.004$, $r = 0.87$) and at the one-month follow-up ($p = 0.034$, $r = 0.64$). There was a large reduction in anxiety

following the mindfulness intervention and a further moderate to large decrease in anxiety one-month later. For quality of life and stress, paired comparisons differed significantly or were marginally significant after the mindfulness intervention (quality of life: $p = 0.053$, $r = -0.58$, stress: $p = 0.014$, $r = -0.71$), but not at one-month post-intervention ($p = 0.061$, $r = -0.52$ and $p = 0.494$, $r = -0.21$, respectively). This finding suggests that improvements in quality of life and stress were maintained one month after the intervention. For depression and sleep quality, paired comparisons did not differ significantly after the mindfulness intervention or the follow-up assessment.

Insert Table 4 around here

Table 4
Persistent effects analyses

Variable, Time points	Statistic		<i>p</i>	Cohen's <i>d</i>	Rank biserial
Anxiety	Student's <i>t</i>	3.92	0.001	0.95	
T1 vs T2	Wilcoxon <i>W</i>	98.00	0.004		0.87
Anxiety	Student's <i>t</i>	2.47	0.025	0.60	
T2 vs T3	Wilcoxon <i>W</i>	86.00	0.034		0.64
Depression	Student's <i>t</i>	1.22	0.239	0.30	
T1 vs T2	Wilcoxon <i>W</i>	52.00	0.315		0.33
Depression	Student's <i>t</i>	1.52	0.149	0.37	
T2 vs T3	Wilcoxon <i>W</i>	100.00	0.096		0.47
Sleep	Student's <i>t</i>	-1.99	0.064	-0.48	
T1 vs T2	Wilcoxon <i>W</i>	7.00	0.073		0.69
Sleep	Student's <i>t</i>	-1.36	0.194	-0.33	
T2 vs T3	Wilcoxon <i>W</i>	17.00	0.300		-0.38
Quality of life	Student's <i>t</i>	-2.22	0.041	-0.54	
T1 vs T2	Wilcoxon <i>W</i>	25.50	0.053		-0.58
Quality of life	Student's <i>t</i>	-1.15	0.265	-0.28	
T2 vs T3	Wilcoxon <i>W</i>	36.50	0.061		-0.52
Stress	Student's <i>t</i>	2.58	0.020	0.63	
T1 vs T2	Wilcoxon <i>W</i>	116.00	0.014		0.71
Stress	Student's <i>t</i>	-0.95	0.358	-0.23	
T2 vs T3	Wilcoxon <i>W</i>	47.50	0.494		-0.21
Legend: Degrees of freedom for all statistics: numerator = 16.0, denominator=∞. T0 = pre-waiting period assessment, T1 = pre-intervention/post-waiting period assessment, T2 = post-intervention.					

3.5. Adverse events, adherence and participants' feedback

Two unrelated adverse events occurred during the study. One participant had aches and pain due to polymyalgia rheumatica and another had high hypertension, with consequent changes to his medication. On average, participants completed 18.5 days (standard deviation: 6.2) of exercises out of 21 total days and 80.0% of participants who started the intervention completed the program daily. Participants in both

groups expressed general enjoyment with the intervention. They appreciated the option to read or listen to the content of the intervention, but many experienced challenges to navigate the online platform. Multiple participants reported they incorporated the mindfulness intervention in their daily routine to maintain adherence.

4. Discussion

This pilot study aimed to preliminarily investigate the effect of a three-week online mindfulness intervention compared to a waitlist control on quality of life and psychological well-being for chronic stroke survivors. Sleep quality significantly improved post-intervention for participants assigned to the mindfulness group compared to the waitlist group. However, contrary to our hypotheses, changes in anxiety, depression, quality of life, or stress did not differ in either group. Nevertheless, immediately post-intervention, the mindfulness intervention showed a moderate to large effect size in reducing anxiety, quality of life and stress, with changes being maintained one-month post-intervention. This pilot study confirmed that study procedures and the mindfulness intervention were safe and well tolerated by participants. Adherence to the program was excellent. While participants were instructed to complete a minimum of five days of exercises per week, 80.0% of participants completed the exercises every day. These findings will provide the foundations for a larger, statistically powered randomized control trial.

The lack of significant group differences for most outcomes may be attributed to the size of our sample. The baseline difference in depression between groups may also have been a potential factor. This pilot study was not powered adequately to detect group difference, but was designed to provide useful information on the operationalization of all the elements of a randomized control trial (Tickle-Degnen, 2013). We observed a significant improvement in sleep quality and a moderate to large effect size on three key outcomes, which suggest that mindfulness may decrease anxiety and stress and improve sleep quality and stroke-related quality of life. Further investigation of the effect of mindfulness on anxiety, stress and quality of life is warranted. Previous work has shown that mindfulness-based interventions can improve some aspects of stroke-specific quality of life (Moustgaard et al., 2007; Wang et al., 2020; Wathugala et al., 2019), and decrease stress (Joo et al., 2010; Wang et al., 2020) and anxiety (Joo et al., 2010; Moustgaard et al., 2007). However, important differences between studies (e.g., designs, type of mindfulness, delivery format) limit between-study comparisons (Lawrence et al., 2013). The impact of mindfulness on sleep quality remains to be tested in a larger sample, ideally using actigraphy to record the impact of mindfulness on sleep duration instead of a subjective measure of sleep quality, which may be subject to recall bias (Harvey & Tang, 2012). Our findings may help guide the selection of a primary outcome measure and estimate sample size for a larger planned randomized control trial.

The mindfulness intervention was offered entirely remotely, in an asynchronous mode. The minimal therapist involvement and the ability to reach participants that may not be able to travel to the clinical site has potential to greatly facilitate the scalability of such an intervention. The retention rate post-intervention and at follow-up was 80.0% and of this number, 20.0% did not complete the exercises daily.

The use of multiple strategies to maximize adherence (i.e., tutorial on how to access the platform, frequent follow-up, dedicated study personnel to answer questions) may have contributed to this high adherence rate. The ability for participants to access the platform and perform the mindfulness exercises when needed offered flexibility over a closed group format. The intervention was also aligned with a self-management approach to stroke care, empowering stroke survivors to take an active role in managing their health and recovery and enhancing the individual's ability to cope with the physical, emotional, and cognitive challenges that arise after a stroke (Jones & Riazi, 2011; Lennon et al., 2013).

Despite changes made to the online platform used to host this intervention following our feasibility study (Demers et al., 2022), usability challenges to navigate the online platform remained. We used a continuing education platform designed for higher-level education. This platform may not be suited for stroke survivors with low computer literacy or associated language and cognitive impairments. A simple, user-friendly online platform tailored to the needs of stroke survivors could facilitate remote participation and should be considered in future studies.

This study is not without limitations. While our study included a diverse sample of stroke survivors (gender, race and ethnicity), our participants were younger than the average age of stroke survivors in the US (Tsao et al., 2022) and had no to mild cognitive impairments, limiting the generalizability of our results to the entire stroke population. Moreover, the assessor was not blind to group allocation, as this person was also in charge of monitoring adherence and resolving technical issues. The use of online self-reported surveys and a person blinded to group allocation for data analysis may have helped reduce this potential bias.

5. Conclusion

The study provided support for a large, appropriately powered, planned randomized control trial, as the study procedures were well accepted by participants, the retention rates were high, and no severe adverse events occurred. A remote and asynchronous intervention offered multiple benefits for the scalability of the intervention, if deemed effective. Future work is needed to conclude on the effectiveness of Langerian mindfulness on psychological well-being and to understand how mindfulness interventions affect stroke survivors.

Declarations

Author Contribution

M.D.: conception and design, intervention development, collection of data, analysis and interpretation of data, manuscript preparation-writing; F.P., D.P. and E.L.: conception and design, intervention development, manuscript preparation-reviewing and editing; J.S.: participant recruitment, data analysis, data visualization, manuscript preparation-writing; S.M.: data analysis, manuscript preparation-reviewing and

editing; A.S.: data collection, manuscript preparation-writing; C.W.: conception and design, intervention development, interpretation of data, manuscript preparation-reviewing and editing.

Acknowledgement

The authors acknowledge the contribution of Alison McKenzie for her help in securing IRB approval at Chapman University and participants' recruitment, Celine Dong for participants' randomization, Joseph Saba and Brianna Chang for participants' recruitment.

Data Availability

The dataset generated and/or analyzed during the current study is not publicly available but is available from the corresponding author on reasonable request.

References

1. Ayerbe, L., Ayis, S., Wolfe, C. D. A., & Rudd, A. G. (2013). Natural history, predictors and outcomes of depression after stroke: Systematic review and meta-analysis. *The British Journal of Psychiatry*, 202(1), 14–21. <https://doi.org/10.1192/bjp.bp.111.107664>
2. Campbell Burton, C. A., Murray, J., Holmes, J., Astin, F., Greenwood, D., & Knapp, P. (2013). Frequency of anxiety after stroke: A systematic review and meta-analysis of observational studies. *International Journal of Stroke*, 8(7), 545–559. <https://doi.org/10.1111/j.1747-4949.2012.00906.x>
3. Demers, M., Pagnini, F., Phillips, D., Chang, B., Winstein, C., & Langer, E. (2022). Feasibility of an Online Langerian Mindfulness Program for Stroke Survivors and Caregivers. *OTJR: Occupational Therapy Journal of Research*, 42(3), 228–237. <https://doi.org/10.1177/15394492221091266>
4. Doshi, K., Henderson, S. L., Sugumar, L., Low, A. Y., Thilarajah, S., & De Silva, D. A. (2017). A pilot study investigating the impact of mindfulness based interventions on the psychosocial well-being of stroke survivors. *Journal of the Neurological Sciences*, 381, 410–411. <https://doi.org/10.1016/j.jns.2017.08.3372>
5. Fryer, C. E., Luker, J. A., McDonnell, M. N., & Hillier, S. L. (2016). Self management programmes for quality of life in people with stroke. *Cochrane Database of Systematic Reviews*, 8. <https://doi.org/10.1002/14651858.CD010442.pub2>
6. Hartman-Maeir, A., Soroker, N., Ring, H., Avni, N., & Katz, N. (2007). Activities, participation and satisfaction one-year post stroke. *Disability and Rehabilitation*, 29(7), 559–566. <https://doi.org/10.1080/09638280600924996>
7. Harvey, A. G., & Tang, N. K. Y. (2012). (Mis)perception of sleep in insomnia: A puzzle and a resolution. *Psychological Bulletin*, 138(1), 77–101. <https://doi.org/10.1037/a0025730>

8. Jamovi Project. (n.d.). *Jamovi* (Version 2.5) [Computer software]. Retrieved September 10, 2024, from <https://www.jamovi.org/>
9. Jani, B. D., Simpson, R., Lawrence, M., Simpson, S., & Mercer, S. W. (2018). Acceptability of mindfulness from the perspective of stroke survivors and caregivers: A qualitative study. *Pilot and Feasibility Studies*, 4(1), 57. <https://doi.org/10.1186/s40814-018-0244-1>
10. Jones, F., & Riazi, A. (2011). Self-efficacy and self-management after stroke: A systematic review. *Disability and Rehabilitation*, 33(10), 797–810. <https://doi.org/10.3109/09638288.2010.511415>
11. Joo, H. M., Lee, S. J., Chung, Y. G., & Shin, I. Y. (2010). Effects of Mindfulness Based Stress Reduction Program on Depression, Anxiety and Stress in Patients with Aneurysmal Subarachnoid Hemorrhage. *Journal of Korean Neurosurgical Society*, 47(5), 345–351. <https://doi.org/10.3340/jkns.2010.47.5.345>
12. Kupst, M. J., Butt, Z., Stoney, C. M., Griffith, J. W., Salsman, J. M., Folkman, S., & Cella, D. (2015). Assessment of stress and self-efficacy for the NIH Toolbox for Neurological and Behavioral Function. *Anxiety, Stress, & Coping*, 28(5), 531–544. <https://doi.org/10.1080/10615806.2014.994204>
13. Lawrence, M., Booth, J., Mercer, S., & Crawford, E. (2013). A Systematic Review of the Benefits of Mindfulness-Based Interventions following Transient Ischemic Attack and Stroke. *International Journal of Stroke*, 8(6), 465–474. <https://doi.org/10.1111/ijss.12135>
14. Lennon, S., McKenna, S., & Jones, F. (2013). Self-management programmes for people post stroke: A systematic review. *Clinical Rehabilitation*, 27(10), 867–878. <https://doi.org/10.1177/0269215513481045>
15. Liu, L., Xu, M., Marshall, I. J., Wolfe, C. D., Wang, Y., & O'Connell, M. D. (2023). Prevalence and natural history of depression after stroke: A systematic review and meta-analysis of observational studies. *PLOS Medicine*, 20(3), e1004200. <https://doi.org/10.1371/journal.pmed.1004200>
16. Moustgaard, A., Bédard, M., & Felteau, M. (2007). Mindfulness-based cognitive therapy (MBCT) for individuals who had a stroke: Results from a pilot study. *J Cogn Rehabil*, 25, 4–10.
17. Noguchi, K., Gel, Y. R., Brunner, E., & Konietzschke, F. (2012). nparLD: An R Software Package for the Nonparametric Analysis of Longitudinal Data in Factorial Experiments. *Journal of Statistical Software*, 50, 1–23. <https://doi.org/10.18637/jss.v050.i12>
18. Pagnini, F., Bercovitz, K., & Langer, E. J. (2016). Perceived Control and Mindfulness: Implications for Clinical Practice. *Journal of Psychotherapy Integration*, 26(2), 91–102. <https://doi.org/10.1093/acprof:oso/9780190257040.003.0006>
19. Pagnini, F., & Philips, D. (2015). Being mindful about mindfulness. *The Lancet Psychiatry*. [https://doi.org/10.1016/S2215-0366\(15\)00041-3](https://doi.org/10.1016/S2215-0366(15)00041-3)
20. Patel, M. D., Tilling, K., Lawrence, E., Rudd, A. G., Wolfe, C. D. A., & McKeivitt, C. (2006). Relationships between long-term stroke disability, handicap and health-related quality of life. *Age and Ageing*, 35(3), 273–279. <https://doi.org/10.1093/ageing/afj074>
21. R: The R Project for Statistical Computing. (n.d.). Retrieved September 5, 2024, from <https://www.r-project.org/>

22. Skolarus, L. E., Burke, J. F., Brown, D. L., & Freedman, V. A. (2014). Understanding Stroke Survivorship. *Stroke*, 45(1), 224–230. <https://doi.org/10.1161/STROKEAHA.113.002874>
23. Snyder, E., Cai, B., DeMuro, C., Morrison, M. F., & Ball, W. (2018). A new single-item sleep quality scale: Results of psychometric evaluation in patients with chronic primary insomnia and depression. *Journal of Clinical Sleep Medicine*, 14(11), 1849–1857. <https://doi.org/10.5664/jcsm.7478>
24. Tickle-Degnen, L. (2013). Nuts and bolts of conducting feasibility studies. *American Journal of Occupational Therapy*, 67(2), 171–176. <https://doi.org/10.5014/ajot.2013.006270>
25. Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Alonso, A., Beaton, A. Z., Bittencourt, M. S., Boehme, A. K., Buxton, A. E., Carson, A. P., Commodore-Mensah, Y., Elkind, M. S. V., Evenson, K. R., Eze-Nliam, C., Ferguson, J. F., Generoso, G., Ho, J. E., Kalani, R., Khan, S. S., Kissela, B. M., ... on behalf of the American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2022). Heart Disease and Stroke Statistics—2022 Update: A Report From the American Heart Association. *Circulation*, 145(8), e153–e639. <https://doi.org/10.1161/CIR.0000000000001052>
26. Ulrichsen, K. M., Kaufmann, T., Dørum, E. S., Kolskår, K. K., Richard, G., Alnæs, D., Arneberg, T. J., Westlye, L. T., & Nordvik, J. E. (2016). Clinical Utility of Mindfulness Training in the Treatment of Fatigue After Stroke, Traumatic Brain Injury and Multiple Sclerosis: A Systematic Literature Review and Meta-analysis. *Frontiers in Psychology*, 7. <https://www.frontiersin.org/article/10.3389/fpsyg.2016.00912>
27. Wang, X., Li, J., Wang, C., & Lv, J. (2020). The effects of mindfulness-based intervention on quality of life and poststroke depression in patients with spontaneous intracerebral hemorrhage in China. *International Journal of Geriatric Psychiatry*, 35(5), 572–580. <https://doi.org/10.1002/gps.5273>
28. Wathugala, M., Saldana, D., Juliano, J. M., Chan, J., & Liew, S.-L. (2019). Mindfulness Meditation Effects on Poststroke Spasticity: A Feasibility Study. *Journal of Evidence-Based Integrative Medicine*, 24, 2515690X19855941. <https://doi.org/10.1177/2515690X19855941>
29. Williams, L. S., Weinberger, M., Harris, L. E., Clark, D. O., & Biller, J. (1999). Development of a stroke-specific quality of life scale. *Stroke*, 30(7), 1362–1369. <https://doi.org/10.1161/01.STR.30.7.1362>
30. Wong, A., Nyenhuis, D., Black, S. E., Law, L. S. N., Lo, E. S. K., Kwan, P. W. L., Au, L., Chan, A. Y. Y., Wong, L. K. S., Nasreddine, Z., & Mok, V. (2015). Montreal Cognitive Assessment 5-Minute Protocol Is a Brief, Valid, Reliable, and Feasible Cognitive Screen for Telephone Administration. *Stroke*, 46(4), 1059–1064. <https://doi.org/10.1161/STROKEAHA.114.007253>
31. Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica*, 67(6), 361–370. <https://doi.org/10.1111/j.1600-0447.1983.tb09716.x>

Figures

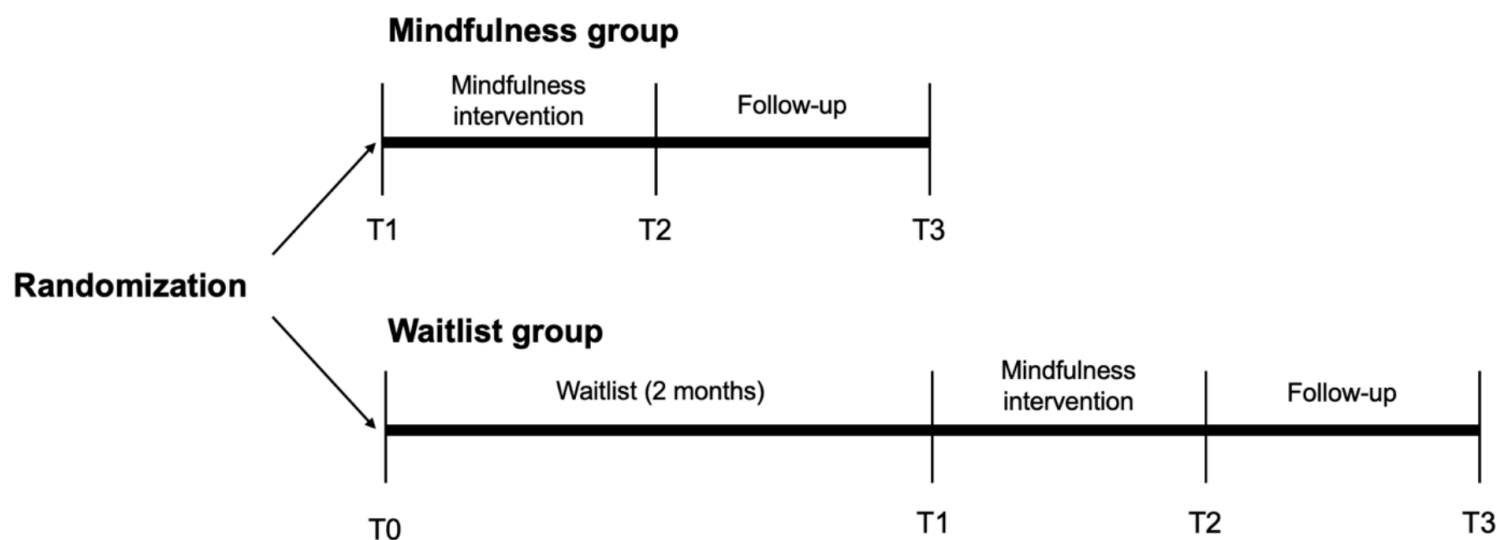


Figure 1

Assessment timeline

Design of the two-arm randomized controlled trial. T0 = pre-waiting period assessment, T1 = pre-intervention/post-waiting period assessment, T2 = post-intervention, T3 = 1-month post-intervention assessment.

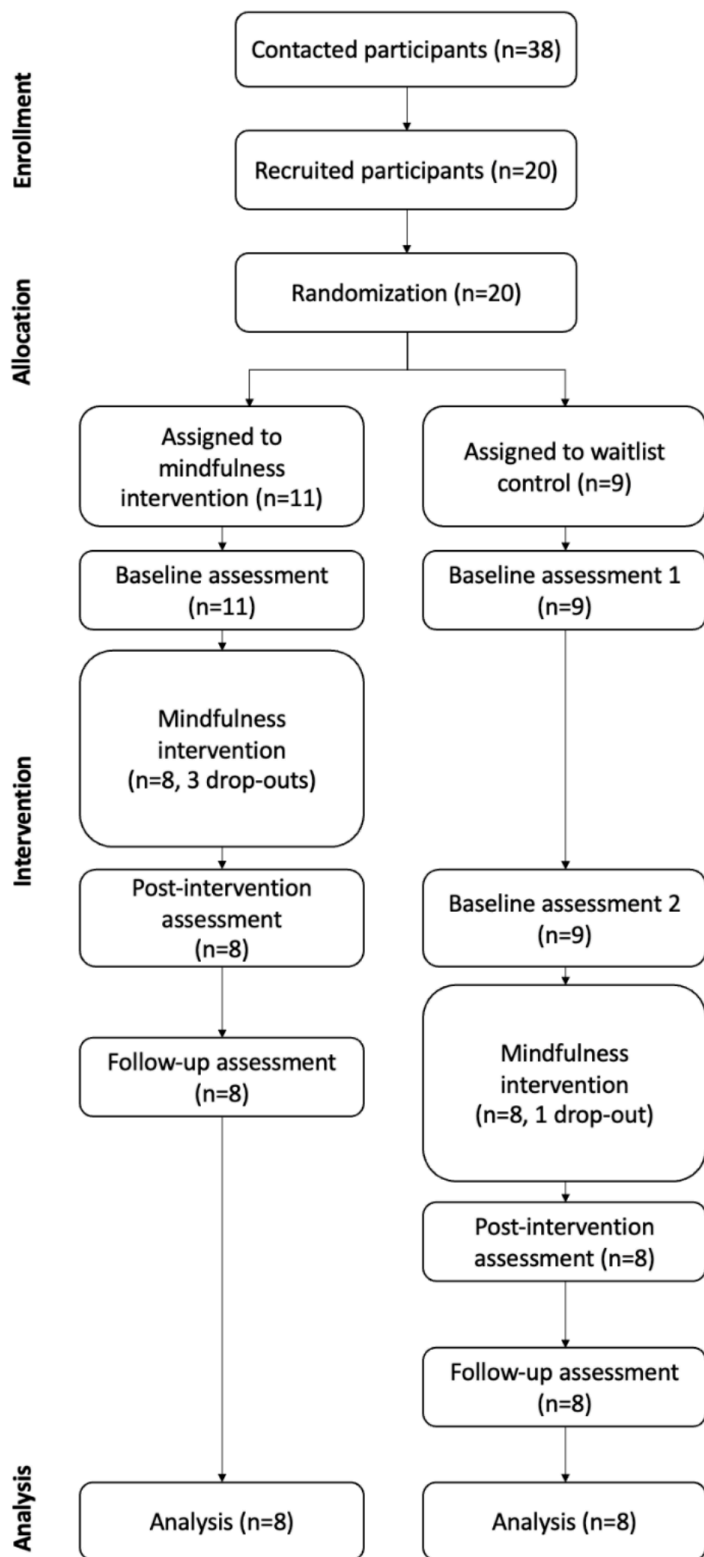


Figure 2

Flow diagram

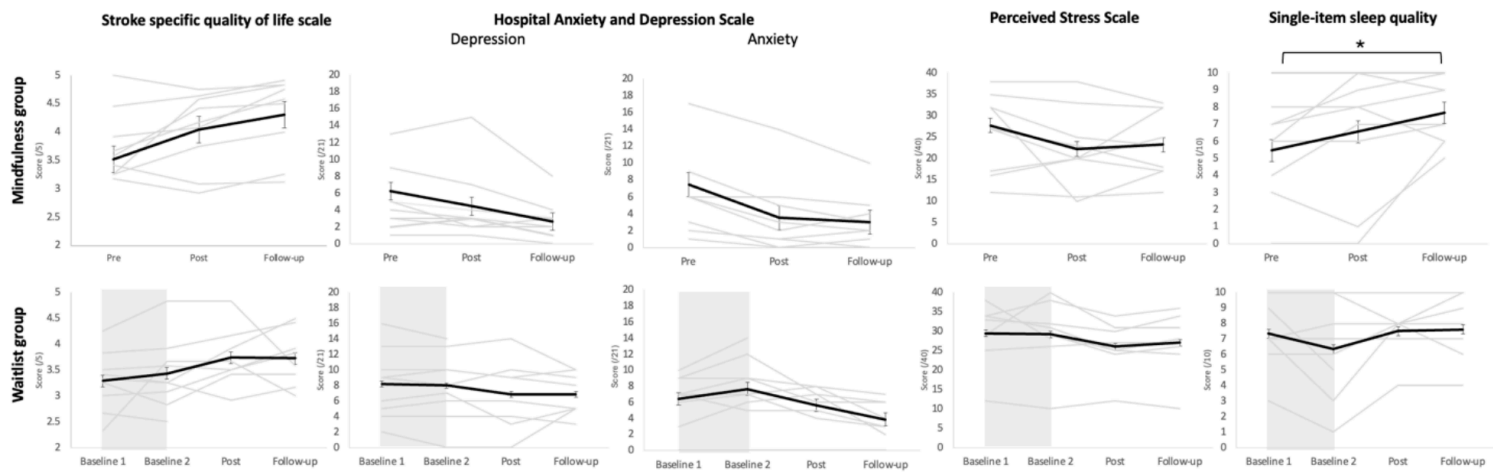


Figure 3

Effect of the mindfulness intervention on the quality of life, depression, anxiety, stress and sleep quality

Individual and mean scores for each of the outcome measures at each time point for participants in the mindfulness group (top panels) and the waitlist group (bottom panels). Thicker lines are mean scores with standard error. Thin pale lines are individual scores. The grey area indicates the wait list period. The * indicates a significant time by group interaction (significance level $p > 0.05$).