The Health & Her App is Associated with Improved Symptom Outcomes Among 1,900 Menopausal Women

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Abstract

Background: The Health & Her app provides menopausal women with a means of monitoring their symptoms, symptom triggers, and menstrual periods, and enables them to engage in a variety of digital activities designed to promote health and wellbeing. The aim of the present study was to examine whether sustained weekly engagement with the app is associated with improvements in menopausal symptoms.

Methods: This quasi-experimental study used routinely collected data provided by 1,900 Health & Her app users across a 2-month period. Symptom change from baseline over a period of up to 2 months was the outcome measure. A linear mixed effects model explored whether app engagement was predictive of symptom changes. Secondary analyses explored whether app-usage factors such as total number of days spent logging symptoms, logging triggers, reporting menstrual periods, and using in-app activities were independently predictive of symptom reductions from baseline. Covariates included HRT (Hormone Replacement Therapy) use, hormonal contraceptive use, present comorbidities, age, and dietary supplement use. To examine which types of symptoms were associated with the largest changes in total symptom scores, symptom scores at baseline were evaluated and were split according to specific symptom domains (i.e., psychological, urogenital, vasomotor, and physical).

Results: Findings demonstrated that greater engagement with the Health & Her app for 2-months was associated with greater reductions in symptoms over time. Moreover, daily use of in-app activities and logging symptoms and menstrual periods were each independently associated with symptom reductions. Of the four symptom domains assessed, reporting psychological symptoms at baseline were associated with the greatest reductions in total symptom scores.

Conclusions: This study has demonstrated that greater weekly engagement with the app was associated with greater reductions in symptoms. It is recommended that women be made aware of menopause-specific apps, such as that provided by Health & Her, to support them to manage their symptoms.

Introduction

Menopause is a naturally occurring reproductive phase in which women permanently cease to menstruate. Menopause is associated with a number of symptoms, which in some women, can heavily impact health and quality of life (1).The main treatment for menopausal symptoms is Hormone Replacement Therapy (HRT). Despite menopause encompassing a wide variety of symptom domains, including psychological, cognitive, and gastrointestinal issues, HRT is currently only indicated for alleviating vasomotor and genitourinary symptoms (2). Moreover, HRT is not recommended for women with a history (or familial history) of oestrogen-dependent cancers or blood clots, as it may increase the risk of developing cancer and other illnesses in these individuals (2). Thus, there is a need to identify

alternative interventions to HRT which could support women to manage their health during menopause. Use of freely available mobile health (m-health) apps have been associated with improved health outcomes in women. For example, Zhaunova et al. (3) found evidence that an app, which enabled women to monitor their menstrual periods, was associated with improvements in physical symptoms, mental health and reproductive health knowledge. A study by McCloud et al. (4) demonstrated that an app which provided digital Cognitive Behavioural Therapy (CBT) activities and mood monitoring was associated with improvements in anxiety and depression among university students.

Studies in women experiencing menopausal symptoms suggest that symptom monitoring can improve symptoms, reduce negative emotions, and could heighten health awareness, helping women avoid behaviours which could negatively impact their health (5)(6). Therefore, digital tools which support symptom monitoring may be beneficial for menopausal women. Moreover, among women who choose to use HRT or other interventions for their menopausal symptoms, such as dietary supplements or exercise therapies, adjunct digital tools may be beneficial for helping them track the impact and efficacy of these treatments.

To the authors' knowledge, no m-health apps have been formally evaluated to assess whether they improve symptoms during menopause. The Health & Her app is available from Health & Her via the Apple app store: https://apps.apple.com/gb/app/health-her-menopause-app/id1519199698 and Google Play Store: https://play.google.com/store/apps/details?id=com.healthandher&hl=en_GB&gl=US. This app enables women to track their menopausal symptoms, symptom triggers, and menstrual periods. The app also provides users with a range of activities which can help them manage their menopausal symptoms including CBT, pelvic floor, paced respiration and meditation exercises. The app also signposts users to health and lifestyle articles written by experts such as general practitioners, psychologists, and menopause specialists, as well as products which are designed to support wellness, including own-brand Health & Her dietary supplements, and dietary supplements of external brands.

The primary aim of the present study was to establish whether use of the Health & Her app over a 2-month period was associated with improved symptom outcomes. We present a quasi-experimental study of symptom change over time using the Health & Her iOS and Android mobile phone app. Our study observed whether women reported statistically significant reductions in symptom scores by comparing symptom reports at the point of first app use, with consecutive symptom reports provided throughout 2 months of app use. This study also explored whether increased app engagement was associated with greater reductions in symptoms by grouping participants according to the number of weeks they engaged with the app within the 2-month period. Covariates, such as HRT and dietary supplement use, were included to control for their effects on symptom improvement and heighten statistical accuracy, reduce bias, and enable a more accurate representation of the effects of app engagement. Factors relating to app usage were also assessed to evaluate and control for their independent effects, including daily use of symptom logging, trigger logging, reporting menstrual periods, and use of activities featured within the app.

Hypotheses:

- Participants will report statistically significant reductions in symptoms after 2 months of app usage, in comparison to their first symptom report provided at first use of the app.
- Participants who engage more with the app across the 2-month span will report greater reductions in symptoms over time than those who engage less with the app, after controlling for covariates.

Methods

This study used a mixed between-within quasi-experimental design to measure change in symptom scores across 2-months of app use. We included women who downloaded the Health & Her app and logged their symptoms at baseline and after 2 months. Applying this inclusion criteria to over 150,000 women who had downloaded the app and had answered the onboarding questions (i.e., had answered all prerequisite questions in order to access the app's facilities), we arrived at a final sample of 1,900 women, who collectively provided a total of 31,076 distinct symptom observations. These individuals recorded their symptoms via the app between October 2020 and January 2023. Participants were grouped according to the number of weeks they engaged with the app; engagement was defined as using the app to log a symptom, period, trigger, or to complete an in-app activity. Therefore, levels of engagement ranged from 2 weeks (i.e., they logged symptoms in the first and last week of the 2-month period) to 9 weeks (i.e., they logged symptoms each week of the 2-month period). Thus, this study encompassed 8 distinct app engagement groups: 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 7 weeks, 8 weeks, and 9 weeks. The repeated measures variable was symptom score, which was calculated for each day the participant had logged their symptoms. The dependent variable was symptom change score, which was calculated by subtracting each consecutive symptom score from the baseline symptom score, until the final one provided by all participants at 2-months. As participants varied in the number of days they logged their symptoms via the app, the present study used an unbalanced design. For example, some participants may have provided 62 symptom scores (i.e., they had logged every day of the 2-month period), whereas others may only have 2 symptom scores (i.e., they had logged symptoms at the beginning and end of the 2-month period only). To account for this unbalance, the main analysis involved a linear mixed effects model. Women were made aware of the app through social media adverts, the Health & Her website, word of mouth, the IOS app store, Google Play Store, or through seeing app advertisements on Health & Her brand supplements bought in store or online through a retailer or directly from the Health & Her website. Health & Her advertisements are designed to focus on women of perimenopausal and menopausal age, who have indicated an online interest in menopause, and who live in the United Kingdom. The app is freely available on IOS and android via the app store or Google play store.

The Health and Her app:

After first downloading and opening the app, users are asked to engage with an onboarding process which asks users to provide information on their age, medical history, HRT use, hormonal contraceptive use, menopausal status, dietary supplement usage and current menopausal symptoms. Once all onboarding questions have been answered users are given the opportunity to begin tracking their menopausal symptoms, as well as their symptom triggers and menstrual cycles if they are still experiencing periods. Users are also given the opportunity to create a plan by setting daily goals using digital in-app activities designed to improve menopausal symptoms and heighten psychological wellbeing. Activities include CBT exercises (CBT for loss of sex drive, CBT for low mood, CBT for hot flushes), a guided sleep meditation exercise, a paced-breathing exercise, stress & anxiety meditation exercise, a pelvic floor exercise timer, drink water reminders, and HRT and supplement reminders. Triggers include lifestyle and situational factors which could increase or worsen symptoms, such as stress at work, alcohol consumption, and smoking. The app also provides women with articles to help them learn more about menopause, and strategies they can undertake to help them manage their symptoms. Women are encouraged to return to the app to track their

symptoms, periods, and symptom triggers, or complete digital activities through scheduled push notifications (if the user has enabled notifications on their mobile device). Approximately, 99% of participants in the present study had enabled app notifications on their device,

Symptom improvement:

Health & Her app users are invited to report their menopausal symptoms and concurrent symptom severities using a list of 22 common menopausal symptoms. Symptom severities range from 1 (mild), 2 (moderate), to 3 (severe). Figure 1 shows menopausal symptoms and their frequency distributions in the cohort. Symptom scores were calculated for each instance the user logged their symptoms by multiplying total number of symptoms with their average symptom severity e.g., Hot Flushes (severity=1), Sleeping Problems (severity=2), Night Sweats (severity=3) would result in a total symptom score of =6. A continuous symptom difference score was calculated to examine how symptoms increased or decreased throughout the 2-month app usage period. Therefore, a symptom score was calculated for each instance users input their symptoms into the app, and symptom change scores were calculated by subtracting each consecutive symptom score from the baseline symptom score, up until endpoint at 2-months.

Engagement:

App engagement was quantified by counting the number of distinct weeks users engaged with the app (*Weeks Engaged*) to log symptoms, triggers, periods, or complete in-app activities within the 2-month span. The total number of days women logged their symptoms, logged symptom triggers, logged periods, or completed in-app activities across the 2-month period were examined as continuous variables.

Covariates:

The following covariates were added as dichotomous Yes/No variables: HRT usage, hormonal contraceptive usage, current self-reported medical conditions (e.g., PCOS, fibroids, endometriosis, PMS/PMDD, pre/postnatal depression, gestational diabetes, depression, anxiety, cancer, adenomyosis, autoimmune diseases, premature ovarian failure). Age was added as a continuous variable. As the Health & Her app is advertised alongside the Health & Her brand supplements, it was important to evaluate variances in outcomes among women who used Health & Her supplements. Therefore, supplement use was compared as a factor with 4 levels, Not using any Supplements, External Supplements (i.e., using a brand other than Health & Her's), using Health & Her brand supplements only, and using both Health & Her and External Supplements. It was important to control for the effects of using Health & Her brand supplements in order to account for placebo or expectation effects among Health & Her supplement customers.
To control for individual variations in symptom reporting, baseline symptom scores were added as covariates. However, to evaluate the independent effect of specific symptom types reported at baseline, baseline symptom scores were split according to Physical symptoms at baseline= *Headaches, Digestive Issues, Bloating, Dizziness, Skin Changes, Joint Aches, Period Changes, Palpitations, Weight Gain*; Psychological symptoms at baseline= *Low Mood, Stress & Anxiety, Low Energy, Brain Fog, Memory Loss, Poor Concentration*; Urogenital symptoms at baseline= *Sensitive Bladder, Vaginal Dryness, Painful Sex, Loss of*

Sex Drive; and Vasomotor symptoms at baseline= *Hot Flushes, Night Sweats, Sleeping Problems.*

Data Analyses

Data were examined for missing data the final sample. No data were missing. Analyses were computed via R Studio version 4.02 (7). As the present study used an unbalanced design, the main analysis involved a linear mixed effects model, which was computed using R package 'lme4' (8). To control for individual variances, participant ID was added as a random effect. A forest plot was developed using R package SjPlot (9) to visually assess the direction of the effects of all predictor variables. Using R package 'emmeans' (10), a pairwise comparison plot was computed, which visually depicted symptom changes at the beginning and end of the 2-month period for each weekly engagement group, whilst controlling for the effects of covariates. As it is not recommended to compare CIs side by side in mixed methods designs, comparison arrows were computed to visualise significant within-group differences (10). Frequency counts (N, %) were computed to assess the distribution of menopausal status, menopausal symptoms, app usage variables, current comorbidities, and medication use across the present sample. Differences between weekly app engagement groups in terms of sample characteristics were established via Kruskal-Wallis rank sum tests (for Age, Days Engaged in Symptom logging/ Trigger logging/ Period logging/ use of in-app Activities and Baseline/ Follow-up Symptom Score) and Pearson's Chi-squared tests (for HRT use, Supplement use, and Contraceptive use, and Current Comorbidities) using R package gtSummary (11). Benjamini & Hochberg p-value corrections were applied to control for the effects of multiple comparisons.

Power:

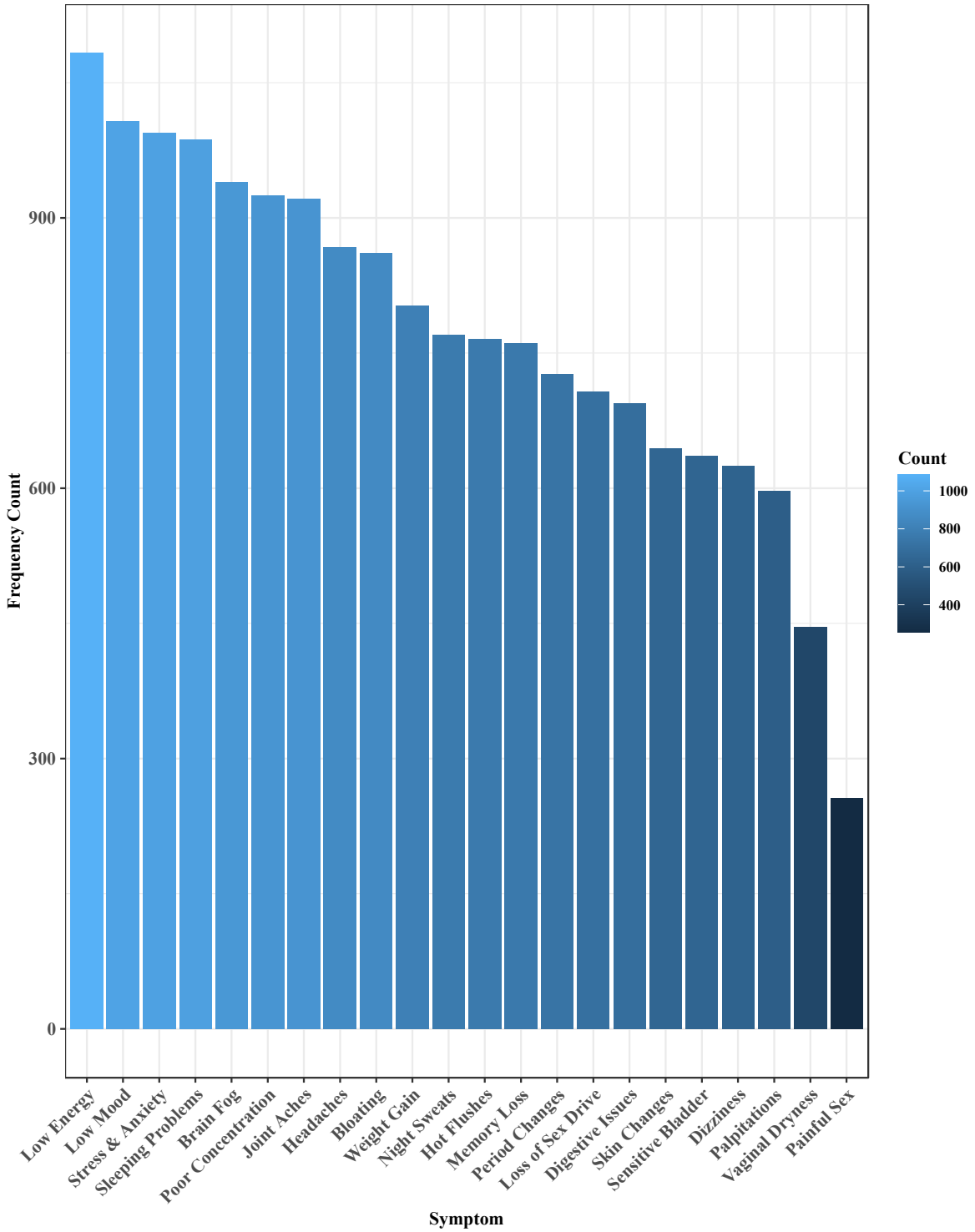
Using R package 'simr' (12) a power analysis was calculated to assess the extent to which the present sample size could accurately detect true significant effects of weekly engagement. This analysis demonstrated that our study had 99.80% (95% CI [99.42, 99.96]) power in detecting the true effects of weekly app engagement.

Results

Sample Characteristics

The mean age of participants was 48 (SD=4.7). Most participants were perimenopausal (n=1402, 74%), 16% (n=298) of participants were unsure of their menopausal status due to using HRT or hormonal contraceptives, 9% (n=181) were menopausal, and a small number were postmenopausal (n=19, <1%). Approximately half reported medical comorbidities (53%) and 53% were not currently using dietary supplements. The average time between first and final symptom log was 60.35 (SD=1.96) days. As shown in Figure 1, the most common menopausal symptoms were Low Energy (65%), Low Mood (59%), Sleeping Problems (58%), Stress & Anxiety (58%), whereas least common symptoms included Painful Sex (16%) and Vaginal Dryness (28%).

Figure 1: Menopausal symptom distributions across the full sample:



Between Group Variances: Table 1 shows the differences in scores between the app engagement groups for the present sample. Participants varied between groups in terms of age: women who engaged with the app for 2 or 3 weeks tended to be older than women who engaged for 4 weeks or more ($p < .001$). The groups also differed in app usage. Frequency of days women logged Symptoms, Periods, Activities, and Triggers increased according to the number of Weeks Engaged ($p < .001$). Final symptom scores were statistically lower as Weeks Engaged increased ($p < .001$). Upon adjustment of multiple comparison testing, participants did not vary in terms of other sample characteristics.

Table 1: Between Group Variances:

Variable	Total Weeks Engaged									q-value[2,3]
	Overall, N = 1,900[1]	**2, N = 495[1]**	**3, N = 253[1]**	**4, N = 171[1]**	**5, N = 170[1]**	**6, N = 137[1]**	**7, N = 132[1]**	**8, N = 129[1]**	**9, N = 413[1]**	
Age	48.1 (4.7)	48.9 (4.8)	48.7 (4.8)	47.6 (4.5)	47.0 (4.9)	47.6 (4.0)	46.5 (5.0)	47.6 (4.7)	48.2 (4.5)	**<0.001**
HRT Use	227 (12%)	72 (15%)	28 (11%)	20 (12%)	18 (11%)	11 (8.0%)	17 (13%)	15 (12%)	46 (11%)	0.5
Contraceptive Use	343 (18%)	102 (21%)	50 (20%)	22 (13%)	27 (16%)	18 (13%)	27 (20%)	19 (15%)	78 (19%)	0.2
Not using Supplements	1,003 (53%)	268 (54%)	142 (56%)	96 (56%)	89 (52%)	73 (53%)	63 (48%)	71 (55%)	201 (49%)	0.3
Current Comorbidities	1,010 (53%)	267 (54%)	143 (57%)	84 (49%)	98 (58%)	73 (53%)	73 (55%)	50 (39%)	222 (54%)	0.061
Symptom Logs	16 (17)	2 (1)	5 (2)	7 (3)	10 (4)	15 (6)	18 (6)	25 (9)	44 (13)	**<0.001**
Trigger Logs	10 (13)	2 (1)	3 (2)	4 (3)	6 (4)	8 (7)	11 (6)	14 (12)	27 (18)	**<0.001**
Activity Logs	4 (10)	1 (1)	2 (3)	2 (6)	2 (5)	4 (9)	5 (11)	5 (10)	10 (17)	**<0.001**
Period Logs	3 (3)	1 (1)	2 (2)	2 (2)	3 (3)	3 (3)	4 (3)	3 (3)	4 (5)	**<0.001**
Baseline Symptom Score	17 (13)	18 (14)	17 (14)	16 (14)	15 (13)	16 (13)	18 (13)	15 (12)	16 (12)	0.2
Final Symptom Score	12 (12)	15 (14)	13 (12)	12 (12)	12 (12)	11 (11)	11 (10)	10 (10)	9 (8)	**<0.001**

[1] Mean (SD) or Frequency (%)

[2] Kruskal-Wallis rank sum test; Pearson's Chi-squared test

[3] Benjamini & Hochberg correction for multiple testing

Linear Mixed Effects Model: Table 2 shows the summary statistics from the linear mixed effects model which examined the effects of Weeks Engaged, app-usage variables, and covariates on symptom changes across the 2-month period.

Table 2: Linear Mixed Effects Model of Predictors of Symptom Change Scores:

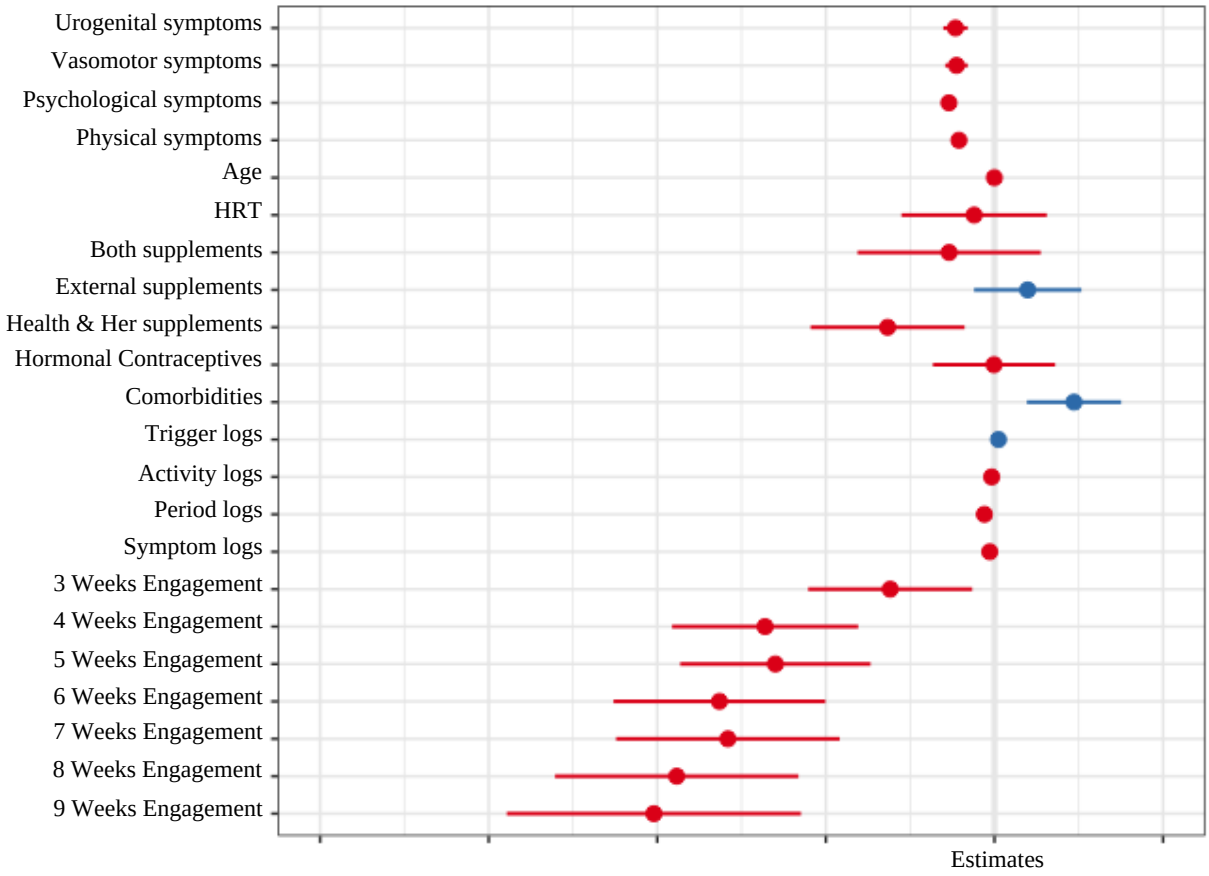
Characteristic	β	95% CI[1]
Urogenital Symptoms	**-0.46**	**-0.61, -0.32**
Vasomotor Symptoms	**-0.45**	**-0.58, -0.32**
Psychological Symptoms	**-0.54**	**-0.62, -0.46**
Physical Symptoms	**-0.42**	**-0.50, -0.34**
Age	0.00	-0.06, 0.06
HRT	-0.24	-1.1, 0.62
Supplements		
None	—	—
Both	-0.54	-1.6, 0.55
External Only	0.39	-0.24, 1.0
Health & Her Only	**-1.3**	**-2.2, -0.35**
Hormonal Contraceptives	-0.01	-0.73, 0.72
Current Comorbidities	**0.94**	**0.38, 1.5**
Trigger Logs	**0.05**	**0.02, 0.08**
Activity Logs	**-0.03**	**-0.06, -0.01**
Period Logs	**-0.12**	**-0.21, -0.03**
Symptom Logs	**-0.06**	**-0.10, -0.01**
Weeks Engaged		
2	—	—
3	**-1.2**	**-2.2, -0.26**
4	**-2.7**	**-3.8, -1.6**
5	**-2.6**	**-3.7, -1.5**
6	**-3.3**	**-4.5, -2.0**
7	**-3.2**	**-4.5, -1.8**
8	**-3.8**	**-5.2, -2.3**
9	**-4.0**	**-5.8, -2.3**

[1] CI = Confidence Interval

These findings indicate that increasing Weeks Engaged is statistically significantly associated with lower symptom total: at 3 weeks, β=-1.2, 95% CI [-2.2, -0.26], 4 weeks β=-2.7 [-3.8, -1.6], 5 weeks β=-2.6 [-3.7, -1.5], 6 weeks β=-3.3 [-4.5, -2.0], 7 weeks β=-3.2 [-4.5, -1.8], 8 weeks β=-3.8 [-5.2, -2.3] and 9 weeks β=-4.0 [-5.8, -2.3]. Beta statistics indicate that app engagement predicted greater reductions in symptoms as the number of Weeks Engaged increased. Reporting a current comorbidity β= 0.94 [0.38, 1.5] and Trigger logging were predictive of increased symptom scores β= 0.05 [0.02, 0.08] whereas Symptom logging β= -

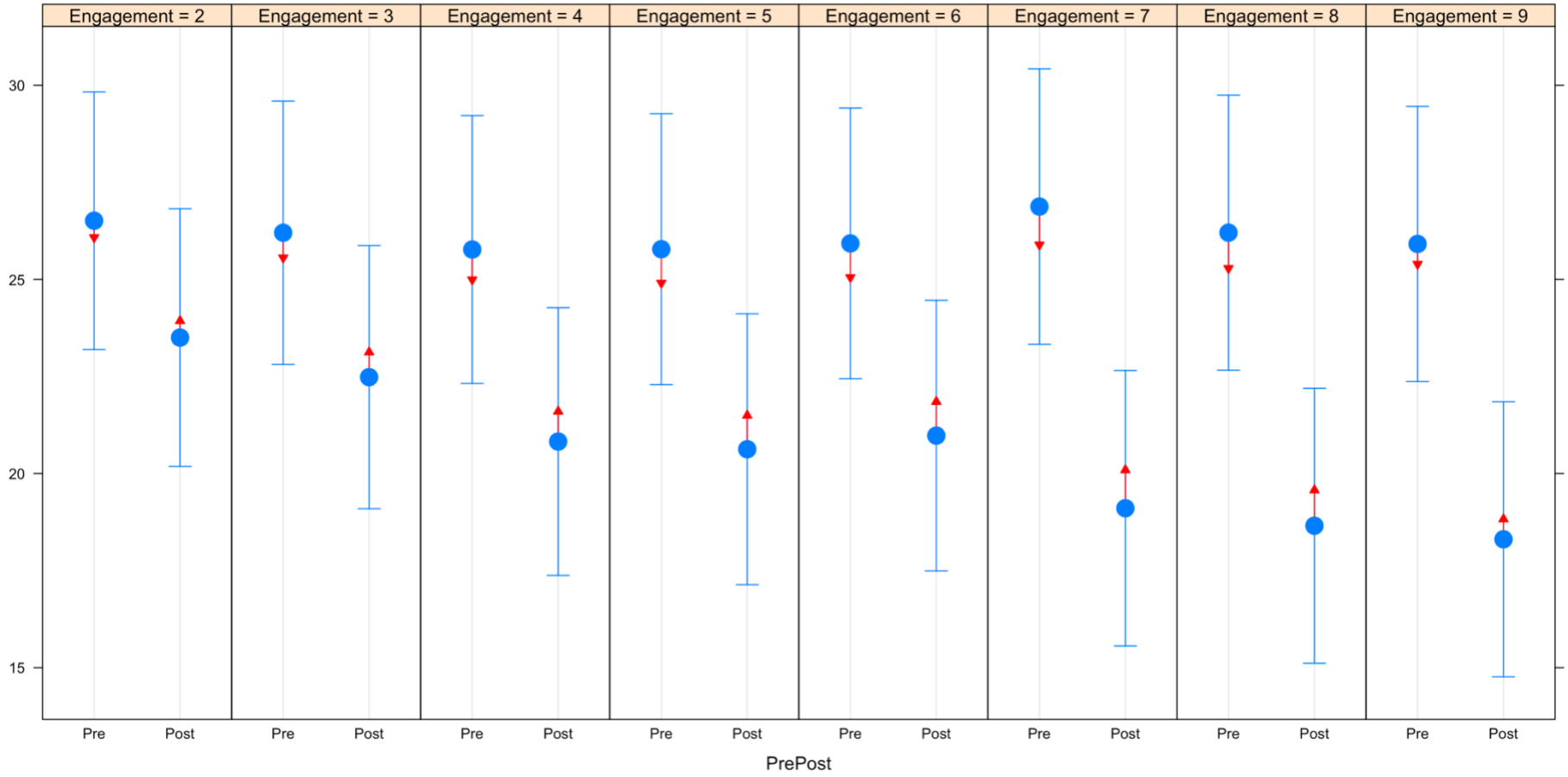
0.06 [-0.10, -0.01], Period logging β= -0.12 [-0.21, -0.03], and completing in-app Activities were related to reduced symptoms β= -0.03 [-0.06, -0.01]. Taking a Health & Her brand supplement was also related to reduced symptoms β= -1.3 [-2.2, -0.35].
Out of the four symptom domains, reporting Psychological Symptoms at baseline was associated with the greatest symptom reductions β= -0.54 [-0.62, -0.46], whereas Physical symptoms at baseline were associated with the smallest effect on symptom reductions β= -0.42 [-0.5, -0.34].
Figure 2 shows the point estimates of the effects of predictors on symptom change scores from baseline. Confidence intervals are wide within the weekly engagement groups, suggesting high variability in symptom scores. The forest plot demonstrates the linear association between Weeks Engaged and reduced symptoms.

Figure 2: Correlation Forest Plot Depicting Effects of all Model Predictors on Symptom Changes:



Pairwise comparisons: Figure 3 demonstrates the differences in symptoms before and after 2-months of app use according to number of weeks women engaged with the app. Within each of the engagement groups there were statistically significant reductions in symptoms after 2-months, indicated by the lack of overlap between the red comparison arrows. As total number of engagement weeks increased, reductions in symptoms after 2-months of app use became larger.

Figure 3: Pairwise Comparisons of Pre/Post Variances in Symptom Scores by Number of Weeks Engaged:



Discussion

These findings demonstrate that use of the Health & Her app for 2-months was associated with reduced menopausal symptoms. Moreover, women who engaged with the app more frequently across the 2-month period reported greater reductions in symptoms than women who engaged for fewer weeks. These findings remained significant after controlling for covariates such as HRT use, hormonal contraceptive use, supplement use, age, and current comorbidities. These findings are in line with prior research in the field of female health which has demonstrated that symptom monitoring during menopause and use of digital health apps which enable period logging and digital health promoting activities are associated with health improvements (5,6,3,4).

Although symptoms significantly decreased regardless of the number of weeks women engaged with the app, reductions were most pronounced among women who engaged with the app every week of the 2-month period. Notably, women who engaged more with the app reported more use of the app's features, suggesting that improvements could be attributed to greater combined utilisation of the app's facilities such as logging periods, triggers, in-app activities, and monitoring symptoms.

In our study, the total number of days spent monitoring symptoms independently predicted symptom reductions. This is in-line with prior research which has demonstrated that symptom monitoring can result in reductions in menopausal symptoms (5,6). However, combined weekly engagement with the app was associated with greater reductions in symptoms than symptom monitoring alone, suggesting that using multiple facets of the Health & Her app can bestow greater benefits to the user.

Of the four symptom domains evaluated, reporting psychological and cognitive symptoms at baseline was associated with the greatest reductions in symptom scores across the 2-month period. This outcome may further evidence findings from Andrews et al's (6) randomised trial, which demonstrated that a daily symptom monitoring intervention was associated with reductions in stress and anxiety, brain fog, low energy, and poor concentration, all of which were assessed as psychological and cognitive symptoms in the present study.
Given that the most frequent symptoms reported in the present sample included low energy, low mood, sleeping problems, and stress and anxiety, this might suggest that app usage is most adhered to by women with predominantly psychological symptoms, and given that many of these symptoms showed the largest benefits from app usage, this may incentivise women with these types of symptoms to continue engaging with the app. As HRT is not currently indicated for improving psychological and cognitive symptoms, this finding may provide support for using the Health & Her app as an adjunct to HRT usage as HRT has shown empirical efficacy in reducing vasomotor and urogenital symptoms during menopause, and use of the app may also provide support for psychological and cognitive symptoms (2).

A notable outcome was that Health & Her brand supplement use was associated with reductions in symptoms. This outcome is likely to be related to the marketing of the Health & Her app. The app is promoted on the packaging of Health & Her brand menopause supplements, to encourage customers to download the app and monitor their symptoms. Therefore, a number of participants may have recently purchased a Health & Her supplement and downloaded the app shortly after to track the supplement's efficacy in reducing their symptoms. This may also explain why HRT and external supplement use was not significantly related to symptom improvements, as HRT and external supplement users may

have been more likely to have been using it for some time before accessing the app, and their symptoms may have already reduced and stabilised prior to app use.
On one hand, improvements relating to the Health & Her brand supplements may be directly related to the beneficial impact of taking these supplements. Certain dietary supplements, such as vitamin D, which is key ingredient of the Health & Her supplements, have been demonstrated among menopausal women (13). Alternatively, this outcome may be related to placebo effects, as individuals who had recently started taking Health & Her supplements may have a positive expectation that the supplement will lead to better health outcomes, and these positive expectations may have manifested as self-reported health improvements (14). Thus, individuals who recently purchased Health & Her supplements may have been more likely to report benefits from doing so. Therefore, future research should assess the impact of Health & Her brand supplements opposite a placebo control group, to determine the true effects on health.

Total number of days women completed in-app activities was significantly associated with reduced symptoms, demonstrating that digital activity use was beneficial. As the data was unavailable for assessment at the time this study took place, it is unclear whether receiving automated notifications encouraging women to engage in certain health-related activities (i.e., drink water reminders, pelvic floor exercise reminders), impacted symptom reduction, as women may have received notifications prompting them to undertake a certain activity and then carried out the activity without the need to record it via the app. Therefore, it is possible that use of activities had a larger impact on symptoms than shown in the present study, as women may have completed activities through notification prompts, foregoing the need to access the app to complete and record their activity completion. This would explain why low engagers reported statistically significant reductions in symptoms after 2-months.
Additionally, it is unclear how the app's provision of articles developed to educate women on menopause and symptom management had impacted their symptoms, and access to these articles may have led to health improvements among women who reported less engagement with the app.

Independently, logging symptom triggers via the app was positively associated with increased symptoms. This was an expected outcome, given that symptom triggers act as a measure of experiences and behaviour, as well as a means of helping app users observe factors which could worsen their health. For example, triggers include alcohol, stress at work, and smoking, and these factors can all negatively influence health and menopausal symptoms, therefore it is logical that increased trigger reports predicted worsened symptoms (15).
However, given that engagement in trigger reporting increased as app engagement weeks increased, and increased app engagement was associated with greater reductions, it is likely that combining trigger logging with the other facets of the app (logging symptoms, logging periods, using in-app activities etc.) contributed to improvements over time because women noted the links between their symptom triggers and symptom outcomes.

There were significant differences in age between the weekly engagement groups. Evidence from the Study of Women's Health Across a Nation (SWAN) suggests that menopausal symptoms increase in terms of severity as women approach the end of their menopause transition (16). This could mean that women with more severe menopausal symptoms are less likely to frequently engage with the Health & Her app. Notably, baseline symptom scores were higher in women who only engaged with the app within two distinct weeks, than women who engaged within more weeks, however these variances were non-significant.

In accordance with outcomes relating to age, logging periods was also associated with symptom reductions, which supports Zhaunova et al's (3) findings. This could suggest that women in the early stage of perimenopause, and therefore still experiencing regular periods, might experience greater benefits from the app than postmenopausal women. Albeit age was not independently associated with changes in symptom scores, however women vary widely in terms of menopause onset, and menopausal symptom durations (16). Menopausal status was not evaluated as a covariate in the present study, as menopausal status groups were highly unbalanced with over 75% of participants reporting themselves to be perimenopausal. Thus, further research is needed to clarify the utilisation and efficacy of the Health & Her app among varying menopausal status groups (i.e., perimenopause, menopause, postmenopause).

Strengths, Limitations & Future Directions:

A key strength of this study was that it utilised a large participant sample (N=1,900) of women with menopausal symptoms, improving the external validity of these findings. The present study showed clear evidence that increased engagement in the Health & Her app was related to improved symptoms, as established by analyses which controlled for multiple factors known to influence symptoms during menopause, and random variances within individual app users.

A limitation was the observational design, which restricted the data to that which participants chose to input into the app. It was also not possible to determine whether participants had any characteristics that were not captured by the app i.e., impact of notifications which remind users to engage in positive health behaviours, reading in-app health articles, recent medical help seeking, use of medications not listed by the app, comorbidities not listed by the app, ethnicity and other demographic variables. Moreover, there was a lack of sample homogeneity in terms of symptom scores in the present study, as demonstrated by wide confidence intervals within the weekly engagement groups. Therefore, a key future direction would be to conduct a controlled study assessing app use with clear parameters in terms of app usage, adherence to app usage, and sampling characteristics. Ideally, participant groups should be balanced in terms of sample size and baseline characteristics such as age and menopausal symptoms. However, given that statistical differences were found in the present study, in the directions expected, this suggests that the benefits of using the Health & Her app to manage symptoms during the menopause transition are robust.

Additionally, because the present sample predominantly reported psychological and cognitive symptoms, and these types of symptoms were associated with larger improvements than the other symptom domains (e.g., physical, urogenital and sexual, vasomotor and sleep), this might suggest that app usage is most effective for, and most adhered to by, women with these symptom characteristics. Therefore, future research should further investigate the impact of Health & Her app usage on specific symptom types to evaluate these outcomes.

The improvements in psychological and cognitive symptoms could be related to the Health & Her app providing women with several activities designed to alleviate stress and psychological symptoms (i.e., digital CBT exercise for low mood, deep breathing exercises, and a stress and anxiety mediation exercise), as well as content designed to empower women during menopause. While out of scope for the present study, subsequent research assessing the Health & Her app will aim to examine the impact of individual activities on symptom reductions.

Health & Her supplement usage was associated with reductions in symptoms. This may suggest that app usage enhanced the effects of taking supplements, or vice versa, as women tracked their symptom changes and recognised the improvements which in turn further

encouraged them to engage with the app. Thus, further research is needed to establish the impact of using the app as an adjunct to menopause-specific treatments, such as dietary supplements and HRT. Therefore, future research could assess women who have started using HRT or supplements and the Health & Her app for the first time, opposite a comparison group of HRT or supplement users who are not using the app, as well as a group of women using the app only and no HRT or supplements. Outcomes will help quantify and compare the effects of combining app usage with menopause-specific treatments.

Conclusions:

This study has demonstrated that use of Health & Her's app for a 2-month period was associated with symptom reductions. Moreover, greater weekly engagement with the app was associated with greater reductions in symptoms. These results support previous findings which have suggested that symptom monitoring and use of digital tools which facilitate period logging, and health-promoting digital activities can be beneficial for improving health outcomes, especially relating to psychological and cognitive complaints (5,6,3,4). However, these findings are limited by the observational study design. Therefore, future research should conduct a fully controlled study to further understand the effects of using the Health & Her app to improve health during menopause, with a focus on exploring the app as an adjunct to menopause-specific treatments.
In light of these findings, it is recommended that women be made aware of the benefits of using digital health apps by health providers treating women in need of support for menopausal symptoms, to help them manage their menopausal symptoms and track the impact of treatments.

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