

An Online, Patient-Guided, Mental Health Tool Improves Anxiety Symptom Scores in Patients With Infertility

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ABSTRACT

Introduction: Patients undergoing infertility evaluation and treatment frequently experience anxiety and depressive symptoms. Easily available and highly accessible online mental health tools have not previously been evaluated using validated screening measures in this population. The objective of this study was to assess whether SilverCloud, an online, self-guided mental health program, is associated with reductions in anxiety and depressive symptom scores among patients experiencing infertility.

Methods: A retrospective cohort study was conducted among female patients undergoing an initial infertility consultation at a single academic center. Patients completed Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) questionnaires and were offered enrollment in SilverCloud at their initial infertility consultation. Baseline PHQ-9 and GAD-7 scores from initial consultations were compared between patients who enrolled in SilverCloud and those who did not. For patients who engaged in SilverCloud, Wilcoxon signed-rank tests were used to compare PHQ-9 and GAD-7 scores before and after completion of SilverCloud modules.

Results: A total of 354 patients were included in the analysis. Fifty-two patients enrolled in SilverCloud, and 32 completed at least 1 module. Baseline data demonstrated that patients who enrolled in SilverCloud had significantly higher GAD-7 scores (0.5 vs 0; $P=.006$). Among patients who completed at least 1 SilverCloud module, PHQ-9 and GAD-7 scores decreased significantly after engagement (PHQ-9: 8.0 vs 6.5; $P<.04$; GAD-7: 12.5 vs 9.5; $P=.02$).

Conclusions: Patients experiencing infertility who utilized SilverCloud experienced significant decreases in PHQ-9 and GAD-7 scores, suggesting improvement in anxiety and depression symptoms.

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INTRODUCTION

Depression and anxiety rates have increased in the general population over the past decade, with women and adults aged 18 to 29 years having the highest prevalence of anxiety and depression (23.8% and 24.6%, respectively).¹ Among individuals experiencing infertility, rates of anxiety and depression are even higher.² The emotional toll of infertility has long been linked to anxiety and depression, with some studies estimating the prevalence of anxiety in women experiencing infertility at 36% and the prevalence of depression at as high as 52%.²

The increased prevalence of anxiety and depression in patients experiencing infertility is likely multifactorial³ and due to a combination of psychological, social, treatment-related, and biological factors.³ Patients experiencing infertility may experience cycles of intense hopefulness and disappointment with each round of fertility treatment, leading to complex feelings of uncertainty regarding their reproductive ability, limited control over their future,

and distress.³ Infertility also affects social well-being, with many patients reporting reduced social support and difficulty interacting with others in settings involving pregnancy, fertility, and children.³ Additionally, commonly used fertility medications, including gonadotropins, leuprolide, and clomiphene, have been linked to symptoms of depression and anxiety.⁴

Depression and anxiety symptoms are commonly assessed using the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) screening tools, respectively.⁵ The

Table. Demographic Data

	SilverCloud User		P value
	No (n=322)	Yes (n=32)	
Median Age (years)	34	35	.738
White	72.4% (233)	78.1% (25)	
African American	12.4% (40)	15.6% (5)	
Asian	9.6% (31)	3.1% (1)	
Hispanic	4% (13)	3.1% (1)	
Other	1.6% (5)	0.0%	
Median no. of months of TTC	22	18	.267
History of prior live birth	24.8% (80)	28.1% (9)	.672
History of at least 1 prior fertility treatment cycle	33.2% (107)	12.5% (4)	.016
Prior mental health diagnosis	29.5% (95)	31.3% (10)	.840
Enrolled in mental health services	9.6% (31)	18.8% (6)	.125

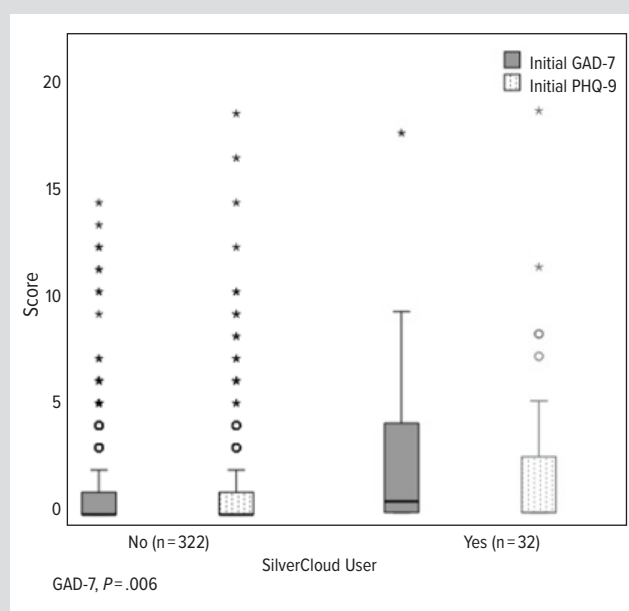
Abbreviation: TTC, time to conception.

validity of these instruments for assessing anxiety and depression in the general population is well established.⁵⁻⁸ Additionally, these screening tools have been validated in patients experiencing infertility.^{5,9} Common interventions for the management of anxiety and depression include psychotherapy and medication management, which have been explored in patients experiencing infertility and shown to be effective in reducing anxiety and depressive symptoms.^{10,11} However, both treatment options often involve long wait times for initial evaluation, are time-intensive, and can be expensive.^{12,13}

Web-based and mobile applications have been explored to assist patients in coping with anxiety and depression symptoms while undergoing infertility treatment,¹⁴ Including guided meditation, sleep support, and online group therapy.¹⁴ However, these programs have not previously incorporated validated screening tools such as the PHQ-9 and GAD-7 to assess their effect on anxiety and depressive symptoms.¹⁴

SilverCloud is an online program based on cognitive behavioral therapy¹⁵ that includes modules designed to help manage anxiety, depression, insomnia, stress, chronic pain, alcohol use, and diabetes. It can be ordered and prescribed by any licensed clinician or psychologist through a platform accessible on computers, tablets, and smartphones.¹⁵ PHQ-9 and GAD-7 scores are collected upon enrollment in the program, every 2 weeks during participation, and upon completion of modules.¹⁵ This program has previously been associated with decreases in GAD-7 and PHQ-9 scores in pilot populations and in university-based groups,^{16,17} but it has not been studied in patients undergoing infertility evaluation and treatment.

The objective of this study was to determine whether patients experiencing infertility demonstrate changes in anxiety and depressive symptoms after engagement with SilverCloud, as determined by changes in PHQ-9 and GAD-7 scores. We hypothesized that patients would demonstrate significant decreases in anxiety and

Figure 1. Fisher Exact *t* Test Demonstrating Mean PHQ-9 and GAD-7 Scores at Initial Appointment as Indicated by a Box and Whisker Plot ($P < .05$)

Abbreviations: GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

depressive symptoms, as evidenced by reductions in GAD-7 and PHQ-9 scores.

METHODS

The Institutional Review Board deemed this quality improvement study exempt. SilverCloud was first introduced within Froedtert Hospital in July 2017. In February 2022, clinicians at the Froedtert and Medical College of Wisconsin Reproductive Medicine Clinic began offering SilverCloud to all patients presenting for new infertility consultations.

A retrospective cohort study was performed. Patients were included if they presented for new infertility consultations between September 1, 2022, and September 1, 2023. Patients were excluded if they did not meet the American Society for Reproductive Medicine (ASRM) diagnostic criteria for infertility or if they were seeking fertility preservation. Baseline PHQ-9 and GAD-7 scores from the initial infertility consultation were recorded in the electronic medical record for all new patients. For patients who accepted a SilverCloud referral, PHQ-9 and GAD-7 scores were recorded at enrollment, every 2 weeks while enrolled in the program, and at completion of a module. Demographic data collected for all new patients included age, race, gravida, parity, infertility diagnosis, number of months of timed intercourse, history of mental health disorders, and previous and current treatment for mental health disorders (Table).

Fisher exact tests were used to compare baseline PHQ-9 and GAD-7 scores between new patients who enrolled in SilverCloud and those who did not. For patients who engaged in the

SilverCloud program, Wilcoxon signed-rank tests were used to compare PHQ-9 and GAD-7 scores immediately before engagement in SilverCloud and at the conclusion of a module. Level of engagement in SilverCloud was defined by the amount of time participants spent in the program (minutes). Mean time spent and standard deviations were calculated.

RESULTS

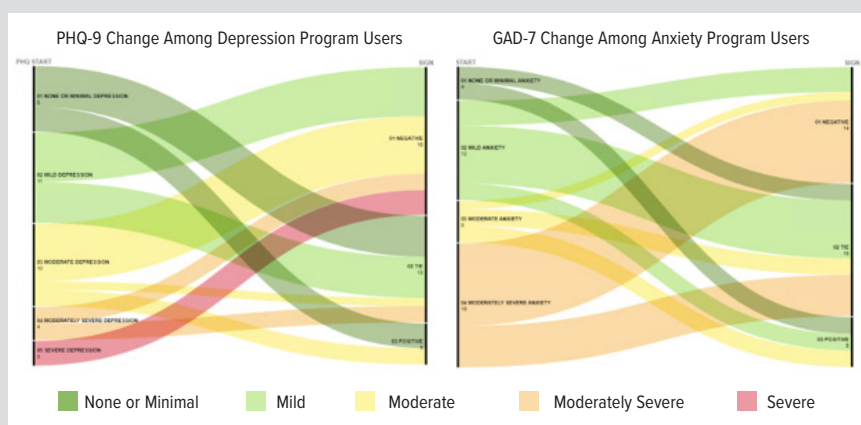
A total of 354 patients were included in this study. Fifty-two patients enrolled in the SilverCloud program, and 32 patients completed individualized modules. Patients were homogenous, with most being White, experiencing a similar duration of infertility, and having a similar history of prior live birth (Table). There was no significant difference in the history of a prior mental health diagnosis (29.4% vs 31.3%; $P=.847$) or utilization of mental health services (9.6% vs 18.8%; $P=.847$) between those who engaged in the program and those who did not (Table). However, patients who engaged in SilverCloud were less likely to have had prior fertility treatment (12.5% vs 33.3% $P=.016$) (Table).

Initial consultation PHQ-9 scores did not differ significantly between patients who elected to engage in SilverCloud and those who did not (0 vs 0; $P=.21$) (Figure 1). However, initial consultation GAD-7 scores were significantly higher among patients who elected to engage in SilverCloud than among those who did not (0.5 vs 0; $P=.006$) (Figure 1).

The mean time between the new patient visit and initiation of a SilverCloud module was 11.8 days. During this time, patients underwent an initial infertility evaluation, began a diagnostic work-up, received prognostic information, and were provided information regarding treatments cost and financing options, consistent with standard clinic practice. Initial PHQ-9 and GAD-7 scores were assessed at enrollment in SilverCloud and again upon module completion.

Following utilization of SilverCloud, patients had significantly lower PHQ-9 scores (median initial score, 8.0, vs median final score, 6.5) ($Z = -2.05$, $P=.04$, $|r|=-0.34$) (Figures 2 and 3). Patients also demonstrated significant reductions in GAD-7 scores following utilization of SilverCloud (median initial score, 12.5, vs

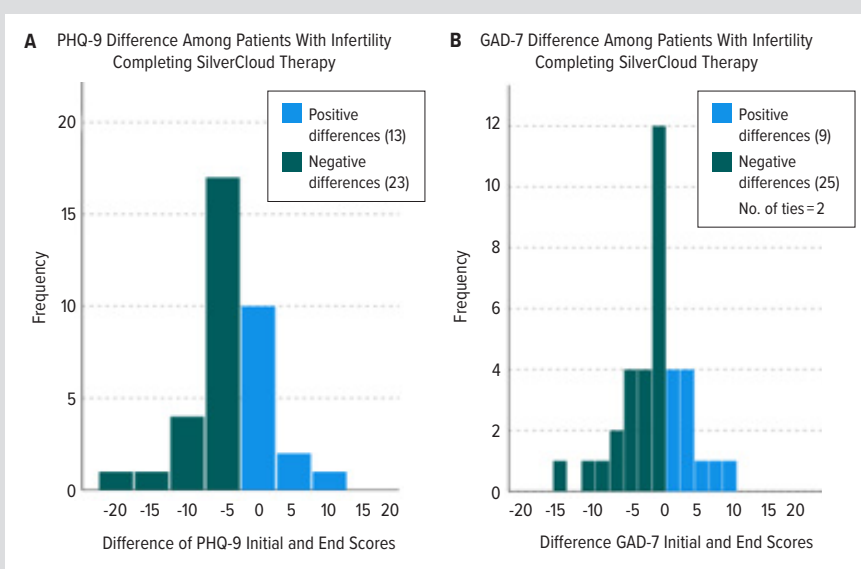
Figure 2. PHQ-9 and GAD-7 Score Changes Among Patients Using SilverCloud Between September 1, 2022, and September 1, 2023



Abbreviations: GAD-7, Generalized Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

Changes in both scores were calculated as the difference between the initial score at signup and the final at program completion. PHQ-9: median initial score, 8.0, vs median final score, 6.5 ($Z = -2.05$, $P=.04$, $|r|=-0.34$); GAD-7: median initial score, 12.5, vs median final score, 9.50 ($Z = -2.43$, $P=.02$, $|r|=-0.41$).

Figure 3. Wilcoxon Signed Rank Test (A) Showing Improvement (lowering) of Patient PHQ-9 Scores and Wilcoxon Signed Rank Test (B) Showing Improvement (lowering) of Patient GAD-7 Scores After SilverCloud Completion



$P=.04$ for PHQ-9 Scores and $P=.02$ for GAD-7 scores.

median final score, 9.5) ($Z = -2.43$, $P=.02$, $|r|=-0.41$) (Figures 2 and 3).

The mean amount of time patients spent in the SilverCloud was 39.4 minutes $\pm$ 93.8 minutes (range <1-576 minutes) (Figure 4). Time spent in SilverCloud was not associated with changes in PHQ-9 or GAD-7 scores.

DISCUSSION

Infertility and its treatments are associated with significant anxiety and depression.^{18,19} Fortunately, SilverCloud offers multiple self-guided modules to assist patients in managing these symptoms.¹³

Our study showed that patients who engaged in SilverCloud demonstrated significant improvement in their GAD-7 and PHQ-9 scores, suggesting reduced depression and anxiety symptoms after program participation. Notably, there was no significant association between the amount of time spent using individual modules and improvement in PHQ-9 or GAD-7 scores. Thus, encouraging patients to engage with the program at any level may be reasonable for improving depression and anxiety symptoms.

Our study also demonstrated that PHQ-9 and GAD-7 scores obtained at the initial infertility consultation were lower than those recorded at enrollment in the SilverCloud program. During the mean 11.8 days between the initial consultation and SilverCloud enrollment, patients were likely presented with new information regarding their diagnosis, prognosis, management options, and the cost of treatment. The significant stressors associated with receiving this information, together with the smaller cohort of individuals who engaged in SilverCloud, likely contributed to the differences observed in PHQ-9 and GAD-7 scores. Patients who perceived infertility evaluation and treatment as more psychologically stressful may have self-selected to into the SilverCloud program compared with those who did not participate.

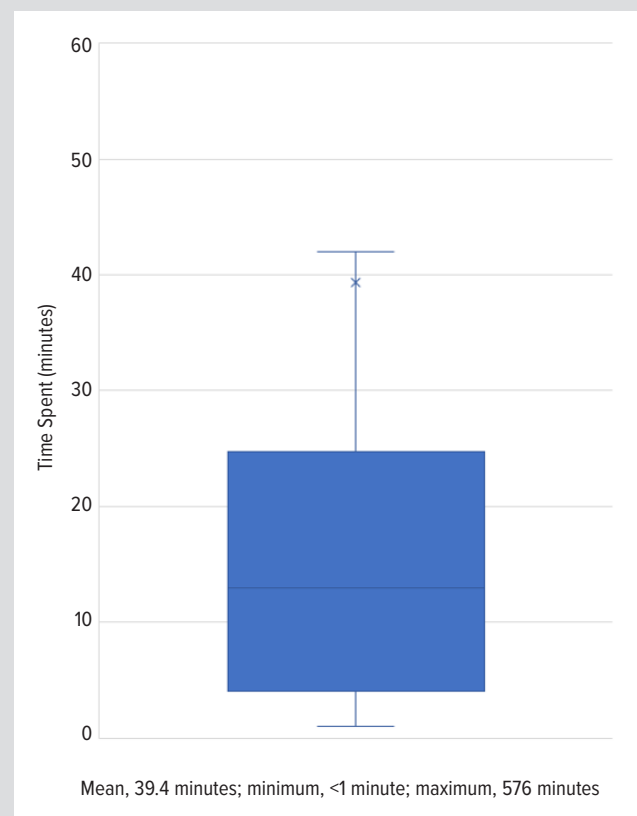
Our study demonstrated decreases in PHQ-9 and GAD-7 scores after completion of at least 1 SilverCloud module, with a median reduction in PHQ-9 scores of 1.5 points ($P=.04$) and a median reduction in GAD-7 scores of 3 points ($P=.02$). We recognize that, although PHQ-9 and GAD-7 scores changed significantly after engagement with SilverCloud, these changes may not necessarily correlate with clinical benefit. Because the PHQ-9 and GAD-7 scores are screening tools and rely on patient self-report, it may be difficult to fully characterize clinical benefit. However, previous studies have demonstrated that PHQ-9 and GAD-7 scores can assist in identifying clinically important changes in depression and anxiety symptoms,¹⁸ and decreases in these scores have been associated with clinical improvement in anxiety and depressive symptoms, even when reductions are relatively small.¹⁹

These results are similar to findings from studies of other mobile app-based programs, which have demonstrated improvements in depressive and anxiety symptoms as reported by patients experiencing infertility.^{14,20-24} Many internet-based programs offer only brief interventions and do not use validated screening tools to assess changes in anxiety and depression symptoms associated with use.^{14,20-24} In addition to currently available free, web-based interventions, SilverCloud offers a more longitudinal and analytical method for tracking changes in anxiety and depressive symptom in patients experiencing infertility. Although SilverCloud may not serve as an effective replacement for psychotherapy or psychopharmacotherapy, it may serve as an adjunct to traditional mental health treatment.

Strengths

Strengths of this study include the use of validated screening tools

Figure 4. Participant Engagement in SilverCloud as Determined by Minutes Spent in the Program



to assess patient response to intervention, an approach not previously reported in similar studies. Additionally, all new patients were asked to complete PHQ-9 and GAD-7 to assess baseline anxiety and depression at the initial infertility consultation. The screening results were reviewed for each patient, and all patients were offered mental health services, highlighting the importance of access to mental health resources for patients experiencing infertility. Our data also demonstrated that individuals without prior infertility treatment were more likely to accept referral to and engage in SilverCloud. This finding may reflect the novelty of the infertility journey, with some individuals more readily acknowledging the mental toll of infertility, and therefore being more willing to utilize accessible resources.

Limitations

Limitations of this study include a racially homogenous patient population composed primarily of married individuals, which limits the generalizability of our findings to patients with more diverse demographic backgrounds. Therefore, we were unable to assess what impact of social and demographic factors on engagement with SilverCloud or responses to anxiety and depression screening measures. Additionally, we recognize that the number of patients who engaged in SilverCloud was limited. Patients were required to have access to a working email address and either a

smartphone or computer to access the modules, creating a potential barrier to participation and offering one explanation for the limited engagement observed in our study. Of the 52 individuals who accepted a SilverCloud referral, only 32 completed at least 1 module. Beyond access barriers, other explanations for limited uptake may include inadequate patient-centered descriptions of SilverCloud by clinicians or the well-documented stigma associated with mental health conditions and treatments.²⁵ Lastly, this study was performed at a single academic clinic; therefore, additional multi-institutional studies are needed to determine whether this program demonstrates efficacy on a larger scale in patients experiencing infertility.

Future studies should explore whether SilverCloud improves anxiety and depressive symptoms over the long term after program completion. Studies should also assess barriers to accessing and engaging with the program despite its self-paced format and lack of cost to users. Finally, additional research could assess whether engagement in mental health services such as SilverCloud affects progression to treatment.

CONCLUSIONS

SilverCloud is an online, self-guided mental health tool that may serve as a useful adjunct to standard mental health care for patients experiencing infertility who report anxiety and depressive symptoms.

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REFERENCES

- Witters D. US depression rates reach new highs. Gallup. May 17, 2023. Accessed September 14, 2025. <https://news.gallup.com/poll/505745/depression-rates-reach-new-highs.aspx>
- Kiani Z, Simbar M, Hajian S, et al. The prevalence of anxiety symptoms in infertile women: a systematic review and meta-analysis. *Fertil Res Pract*. 2020;6:7. doi:10.1186/s40738-020-00076-1
- Swanson A, Braverman AM. Psychological components of infertility. *Fam Court Rev*. 2021;59(1):67-82. doi:10.1111/fcre.12552
- Rooney KL, Domar AD. The relationship between stress and infertility. *Dialogues Clin Neurosci*. 2018;20(1):41-47. doi:10.31887/DCNS.2018.20.1/krooney
- Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-613. doi:10.1046/j.1525-1497.2001.016009606.x
- Gilbody S, Richards D, Brealey S, Hewitt C. Screening for depression in medical settings with the Patient Health Questionnaire (PHQ): a diagnostic meta-analysis. *J Gen Intern Med*. 2007;22(11):1596-1602. doi:10.1007/s11606-007-0333-y
- Plummer F, Manea L, Trepel D, McMillan D. Screening for anxiety disorders with the GAD-7 and GAD-2: a systematic review and diagnostic meta-analysis. *Gen Hosp Psychiatry*. 2016;39:24-31. doi:10.1016/j.genhosppsych.2015.11.005
- Parkerson HA, Thibodeau MA, Brandt CP, Zvolensky MJ, Asmundson GJ. Cultural-based biases of the GAD-7. *J Anxiety Disord*. 2015;31:38-42. doi:10.1016/j.janxdis.2015.01.005
- Omani-Samani R, Maroufizadeh S, Ghaheeri A, Navid B. Generalized Anxiety Disorder-7 (GAD-7) in people with infertility: a reliability and validity study. *Middle East Fertil Soc J*. 2018;23(4):446-449. doi:10.1016/j.mefs.2018.01.013
- Abdollahi HM, Ghojaziadeh M, Abdi S, Farhangi MA, Nikniaz Z, Nikniaz L. Effect of cognitive behavioral therapy on anxiety and depression of infertile women: a meta-analysis. *Asian Pac J Reprod*. 2019;8(6):251-259. doi:10.4103/2305-0500.270102
- Faramarzi M, Alipor A, Esmaelzadeh S, Kheirkhah F, Poladi K, Pash H. Treatment of depression and anxiety in infertile women: cognitive behavioral therapy versus fluoxetine. *J Affect Disord*. 2008;108(1-2):159-164. doi:10.1016/j.jad.2007.09.002
- Cuijpers P, Huibers M, Ebert DD, Koole SL, Andersson G. How much psychotherapy is needed to treat depression? A meta-regression analysis. *J Affect Disord*. 2013;149(1-3):1-13. doi:10.1016/j.jad.2013.02.030
- Quitkin FM, Rabkin JG, Ross D, McGrath PJ. Duration of antidepressant drug treatment. What is an adequate trial? *Arch Gen Psychiatry*. 1984;41(3):238-245. doi:10.1001/archpsyc.1984.01790140028003
- Meyers AJ, Domar AD. Research-supported mobile applications and internet-based technologies to mediate the psychological effects of infertility: a review. *Reprod Biomed Online*. 2021;42(3):679-685. doi:10.1016/j.rbmo.2020.12.004
- SilverCloud. Froedtert & Medical College of Wisconsin. Accessed May 1, 2024. <https://www.froedtert.com/silvercloud>
- Palacios JE, Richards D, Palmer R, et al. Supported internet-delivered cognitive behavioral therapy programs for depression, anxiety, and stress in university students: open, non-randomised trial of acceptability, effectiveness, and satisfaction. *JMIR Ment Health*. 2018;5(4):e11467. doi:10.2196/11467
- Doherty G, Coyle D, Sharry J. Engagement with online mental health interventions: an exploratory clinical study of a treatment for depression. In: CHI '12: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery; 2012:1421-1430.
- Newman MW. Value added? A pragmatic analysis of the routine use of PHQ-9 and GAD-7 scales in primary care. *Gen Hosp Psychiatry*. 2022;79:15-18. doi:10.1016/j.genhosppsych.2022.09.005
- Kroenke K, Wu J, Yu Z, et al. Patient health questionnaire anxiety and depression scale: initial validation in three clinical trials. *Psychosom Med*. 2016;78(6):716-727. doi:10.1097/PSY.0000000000000322
- Clifton J, Parent J, Seehuus M, Worrall G, Forehand R, Domar A. An internet-based mind/body intervention to mitigate distress in women experiencing infertility: a randomized pilot trial. *PLoS One*. 2020;15(3):e0229379. doi:10.1371/journal.pone.0229379
- Cousineau TM, Green TC, Corsini E, et al. Online psychoeducational support for infertile women: a randomized controlled trial. *Hum Reprod*. 2008;23(3):554-566. doi:10.1093/humrep/dem306
- Domar, AD, Jasulaitis, L, Jasulaitis, S, Grill, EA, Uhler, ML. The impact of the FertiStrong app on anxiety and depression in men. *Fertil Steril*. 2019;112(3 Supp):e379. doi:10.1016/j.fertnstert.2019.07.1084
- Grunberg PH, Dennis CL, Da Costa D, Gagné K, Idelson R, Zelkowitz P. Development and evaluation of an online infertility peer supporter training program. *Patient Educ Couns*. 2020;103(5):1005-1012. doi:10.1016/j.pec.2019.11.019
- Boedt T, Dancet E, Lie Fong S, et al. Effectiveness of a mobile preconception lifestyle programme in couples undergoing in vitro fertilisation (IVF): the protocol for the PreLiFe randomised controlled trial (PreLiFe-RCT). *BMJ Open*. 2019;9(7):e029665. doi:10.1136/bmjopen-2019-029665
- Economou M, Bechraki A, Charitsi M. The stigma of mental illness: a historical overview and conceptual approaches. *Psychiatriki*. 2020;31(1):36-46. doi:10.22365/jpsych.2020.31.36

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