Mobile Technology Assisted Interventions Targeting Mental Health Among Pregnant and Postpartum Women: A Protocol for An Equity Focused Systematic Review

Authors
Ammar Saad [1,2], Olivia Magwood [2,3], Qasem Alkhateeb [2,4], Syeda Shanza Hashmi [5], Azaad Kassam [6,7,8], Kevin Pottie [1,2,9]

1. School of Epidemiology and Public Health, University of Ottawa, Ottawa, ON
2. C.T. Lamont Primary Healthcare Centre, Bruyère Research Institute, Ottawa, ON
3. Interdisciplinary School of Health Sciences, University of Ottawa, Ottawa, ON
4. Department of Internal Medicine, Schulich School of Medicine, London, ON
5. School of Medicine, University of Ottawa, Ottawa, ON
6. Department of Psychiatry, University of Ottawa, Ottawa, ON
7. Pinecrest Queensway Community Health Centre, Ottawa, ON
8. Ottawa Newcomer Health Centre, Ottawa, ON
9. Department of Family Medicine, University of Ottawa, Ottawa, ON

Introduction: Pregnant women undergo major physiological and psychological imbalances during pregnancy that increases their likelihood of developing common mental health conditions such as depression, anxiety, and post-traumatic stress disorder. Mobile technology-assisted mental health interventions have been proposed as an alternative approach to a rather fragmented delivery of mental healthcare. Yet little is known about the effectiveness of these interventions and the potential they carry to impact patients' health equity.

Objectives: The aim of this systematic review is to synthesize and appraise available evidence on the effectiveness and health equity impact of mobile technology-assisted mental health interventions on the severity of common mental health disorder symptoms, psychological wellbeing and distress, occurrence of common mental health disorders, and utilization of mental health care among pregnant women.

Methods: A comprehensive search strategy will be used to search seven electronic databases for randomized and non-randomized controlled studies. All included studies will be critically appraised, and findings will be assessed for level of certainty. Equity-focused Meta-analyses and subgroup analyses will be undertaken whenever possible.

Relevance: Our findings will comprise a response to the mental health global crisis of the COVID-19 pandemic as it will inform healthcare providers on whether mobile applications carry the potential to ensure the continuity of mental healthcare, even without traditional face-to-face interaction with a healthcare provider.

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Corresponding author: Ammar Saad ammar.saad@uottawa.ca

Outline

1. Introduction

1.1 The condition, problem, and solution

Pregnancy is a distinct natural phenomenon characterized by physiological, psychological, and emotional changes to the bearing mother and those surrounding her (1–3). The nature and complexity of these changes have been thoroughly examined and documented in the literature, but a certain degree of heterogeneity in the direction of these changes and their lasting effects exists. While some authors have described this phenomenon as a time of emotional equilibrium (4,5), the majority have highlighted the negative psychological sequelae of pregnancy and birth (6–8). Mainly stemming from the transition in their lifestyles and the stressors surrounding the financial and emotional outcomes of pregnancy, pregnant women find themselves employing psychological adaptation techniques to overcome emotional instability and birth anxiety (9). Coupled with adequate and comprehensive prenatal and postpartum care, the majority of mothers are able to overcome any adverse outcomes and consequences brought about by pregnancy (10–12).

Cumulative research shows that being exposed to psychological stressors related to pregnancy increases women's vulnerability to common mental health disorders (13,14). Depression is one of the most common mental health conditions during and after pregnancy; a systematic review among 25,771 pregnant women reported an antepartum depression prevalence of 16.4% (15). Another systematic review found a higher prevalence among women in developing countries, as 19.2% of pregnant women experienced depressive episodes shortly after delivery (16). Rates of anxiety during and after pregnancy showed significant heterogeneity. A systematic review and meta-analysis found that the prevalence rates of multiple anxiety-spectrum disorders differed by study and population; generalized anxiety disorder (GAD) [0.9%-22.7%], obsessive compulsive disorder (OCD) [0.2%-29.1%], panic disorder [0.4%-7.5%], social anxiety [2.0%-27.6%], specific phobia [3.2%-19.9%], and post-traumatic stress disorder (PTSD) [0.6%-16.0%] (17). This heterogeneity, however, did not prevent the authors from concluding that anxiety disorders, especially obsessive compulsive and panic disorders were more common among pregnant women compared to the general population (17).

Even though pregnant women have higher mental health needs compared to the general population, a myriad of quantitative and qualitative evidence shows limited access and utilization of mental health services and care (18–22). The World Health Organization has recognized pregnant women's insufficient access and utilization of essential antenatal care and thus, has prioritized the need to rigorously investigate interventions and programs that employ a "task shifting" approach when delivering antenatal care to this population (23). Task shifting refers to the act of delegating to transferring the delivery of care to less specialized entities, such as peer support workers, for an adequate and timely delivery of services that does not require physical contact with a specialist or professional (24). One proposed method of task-shifting mental health care that is characterized by convenience, anonymity, and reachability is technology (25). Mobile technology-assisted interventions, better known by the acronym "mhealth" represent an evolution of e-health systems and telemedicine platforms (26). It employs wireless and mobile technologies and configurations to deliver health care through the mobile devices of the patient (27). By using user-friendly platforms and culturally adapted psychotherapy techniques, mhealth interventions could be the alternative to traditional mental health care delivery among pregnant women. In nature, even though such interventions have a similar purpose of improving patients' mental health status and decreasing the severity of their symptoms, the features of the application may vary and employ different approaches and methodologies to achieve that purpose (28). Self-management applications supply the patients with feedback and notifications regarding their conditions and how to address their symptoms (29). Illness management with supported care applications provide the patients with the means to connect with others, specifically peer supporters and community advocates, and learn more about their conditions and available lines of treatment (30). Self-improvement applications assist the patients in developing or improving a set of skills, behaviours as well as cognitive and thinking capabilities to overcome negative emotions or compulsive thinking patterns (31). Symptom tracking applications help the patients in documenting their emotions, feelings, or symptoms, allowing them to develop awareness of the landscape of their mentality and nature of their character and psychology (32).

1.2 The importance of considering health equity

Pregnant women are heterogeneous in their background characteristics, history, geopolitical location, and the accessibility of resources available to them (33–35). Certain subgroups of pregnant women find themselves facing unjust and unfair health and social disparities that further magnify their vulnerability to stressors and increase the severity of their mental health symptomatology (36–38). The gradient in accessing, uptaking and benefiting from health care services, more specifically novel mental healthcare interventions such as mhealth, is dependent on certain personal and background characteristics that are hypothesized to impact the magnitude of effect sizes and degree of benefit associated with these interventions (39). O'Neill and colleagues (2013) have proposed using an equity lens when examining the effectiveness of novel interventions among disadvantaged populations (40). The authors have put forward a myriad of personal and background characteristics that were found to influence the health equity of socially disadvantaged populations. Place of residence, race, ethnicity, culture, language, occupation, gender and sex, religion, education, socioeconomic status, social capital, as well as other characteristics associated with discrimination, and time-dependent relationships, all abbreviated into the acronym PROGRESS+, serve as a framework of socially stratifying factors to consider when examining an intervention's impact on health equity (40). Each population, however, is characterized by certain traits and background elements that distinguish their vulnerability from other populations. To provide practitioners and end users with a comprehensive portrayal of what works in the field of mobile technology-assisted mental healthcare, it is important to determine which characteristics carry more potential to impact the health equity of patients using mhealth interventions. Please see figure 1 for a logic model on the causal pathway of mental health conditions, nature and effect of delivering mental healthcare interventions, and the impact health equity might have on that pathway.

1.3 Patient important PROGRESS+ characteristics that impact health equity

To better understand the impact mobile technology assisted mental health interventions have on pregnant women's health equity, we scoped the literature for publications that examined patient characteristics in the context of assessing mental health status, symptoms, and needs, and in the context of delivering perinatal and mental health care among pregnant and delivering women. Our electronic search of Medline, Embase, PsychINFO, CINAHL, and Cochrane CENTRAL yielded a total of n=791 records, of which 34 were deemed relevant to our scoping question (41–74). Evidence on patient characteristics were extracted and aggregated using the PROGRESS+ framework. The findings herein are based on thirty four publications that were reviewed; cross-sectional studies (n=18), prospective and retrospective cohort studies (n=9), Systematic and literature reviews (n=3), nested case control studies (n=2), and qualitative studies (n=2).

Patient characteristics that influence health equity among pregnant women

1.3.1 Age

The rate of perinatal and postpartum mental health conditions from which pregnant women suffered was found to relate to their age at pregnancy. A literature review of studies among Asian pregnant women reported that younger age was significantly associated with depression during pregnancy (68). As well, two cross sectional studies found that younger women had an increased odds of developing poor mental health outcomes compared to their adult counterparts (41,54). Another systematic review found that young age was only a risk factor for depression and anxiety when it is coupled with social disadvantage (72). Conversely, one prospective cohort study among women who have lost their offspring due to sudden infant death syndrome (SIDS) found that older maternal age was related to a more severe prolonged grief disorder (51). Another cross sectional study found that older age was significantly associated with increased odds of having obsessive compulsive disorder (OCD) symptoms (63).

Evidence on accessing and utilizing perinatal and mental health services by age was mixed. One retrospective cohort study found that younger age at birth was associated with inadequate access to perinatal care (52). As well, one cross sectional study found that women who were 20 years of age or younger at birth were at a higher risk of dropping out from mental health medication treatment after delivery compared to their adult counterparts (60). Conversely, one cross sectional study found that older pregnant women were less likely to have a conversation regarding prenatal and postpartum mood disorders (62), whereas one prospective cohort study found that using antidepressant to manage the symptoms of depression was higher among older women compared to younger adults (53). Finally, one cross sectional study found that age was not associated with perinatal

care utilization, but this study focused only on low income and ethnically diverse cohorts of pregnant women (57).

1.3.2 Socioeconomic status

One patient characteristic that influenced pregnant women's perinatal and postpartum mental health status and mental health care utilization is socioeconomic status. A literature review among Asian pregnant women found that financial difficulties were significantly associated with odds of depression during and after delivery (68). One cross sectional study found that lower socioeconomic status was significantly associated with increased odds of depression, anxiety, and stress (66). Furthermore, a prospective cohort study found that adjusting for pregnant women's socioeconomic status attenuates the strength of the association between material and social deprivation and psychological distress, indicating that socioeconomic status confounds this association (74).

Mental health service and perinatal care utilization among pregnant women differed based on their socioeconomic status. A nested case control study found that being low income was a risk factor for using the emergency department regarding mental health compared to outpatient services (42). A retrospective cohort study found that receiving income assistance and living in a low-income neighbourhood was associated with inadequate utilization of prenatal care (52). A cross sectional study found that not being able to afford postpartum depression support due to lower income status was the most prominent barriers of service utilization among Hawaiian pregnant women (59). Another cross sectional study found that those who had enough personal income to pay for their prenatal care or for an extended insurance benefit were more likely to have a conversation with their healthcare provider regarding prenatal and postpartum mood disorders (62). A prospective cohort study among pregnant Dutch women found that lower socioeconomic status was associated with lower odds of continuing depression medications after delivery (64), and a qualitative study among refugee and immigrant pregnant women found that socioeconomic status influenced women's healthcare practices (67).

1.3.3 Race and ethnicity

Pregnant women's race and ethnicity played a significant role in, not only the severity of their mental health symptoms, but also their uptake of mental health services. In one nested case control study, the cumulative effect of lifetime experiences of race-based or ethnic-based racist attacks was associated with poorer maternal mental health outcomes (44). Moreover, the differences in perinatal and mental health care access and utilization based on race and ethnicity was highlighted in the literature. In one mixed-method cohort study, even though black Caribbean women were less likely to experience depression symptoms during pregnancy compared to their white British counterparts, they were less likely to receive a treatment for depression when they needed it (46). One prospective cohort study found that white pregnant women were more likely to use antidepressants to manage the symptoms of depression postpartum compared to other ethnicities (53). A cross sectional study found that, compared to white women, those from Asian or Pacific islander ethnicities were less likely to have a conversation about prenatal and postpartum depression with their healthcare provider (62). A cross sectional study found that being Hispanic was a protective factor for dropping out from psychotherapy treatment, but a risk factor for discontinuing medication treatment (60). As well, descending from African-American backgrounds was associated with increased odds of discontinuing medication treatment (60). Finally, a qualitative study among migrant and refugee pregnant women found that their health care practices were influenced by their cultural background which, in return, intersected with their race (67).

1.3.4 Intimate partner violence

Experiencing verbal, psychological, or physical abuse and violence by pregnant women's intimate partners or spouses has been linked to worsened mental health status. One cross sectional study among African American women found that intimate partner violence in the second trimester and postpartum was significantly associated with increased odds of having depressive symptoms (43). Another cross sectional study among Brazilian pregnant women linked past history of intimate partner violence to depression during pregnancy (45). A third cross sectional study among Zimbabwean pregnant women found that intimate partner violence was a risk factor of antenatal depression (55). As well, a cross sectional study among Latina pregnant women in the United States found a significant association between rates of intimate partner violence and rates of depressive symptoms at each trimester and postpartum (71). Moreover, when examining perinatal service needs and utilization, evidence showed similar trends. A cross sectional study found that domestic abuse was significantly associated with inadequate prenatal health care utilization among low-

income, ethnically diverse pregnant women (57).

1.3.5 Social support

There exists a myriad of evidence to support the notion that the level of support that pregnant women receive from family and social networks influences their mental health status and mental health service utilization. A literature review among Asian pregnant women found an association between marital conflict and lack of social support from family and friends and subsequent depression during and after pregnancy (68). Another systematic review among women in the perinatal period found that one of the most prominent predictors of depression and anxiety is poor partner relationships (72). One cross sectional study among Brazilian pregnant women found that limited family support was linked to depression during pregnancy (45). Another cross sectional study found that pregnant women with high levels of family and non-family social support reported lower rates of depression compared to women with limited social support (48). A prospective cohort study found that low perceived social support during pregnancy was significantly associated with postpartum depression (49). A mixed-method cross sectional study among Nepalese pregnant women used a qualitative lens to examine how limited family support increased women's stress levels during pregnancy (54). A cross sectional study among Zimbabwean pregnant women found that being married or cohabiting with an intimate partner were protective factors against antenatal depression (55). Similarly, a cross sectional study among pregnant veterans found that intimate partner support during pregnancy decreased the odds of experiencing postpartum depression (61). Moreover, access and utilization of perinatal care varied between pregnant women groups based on their social support status as one retrospective cohort study found that being a lone parent or suffering from social isolation were related to inadequate prenatal care (52).

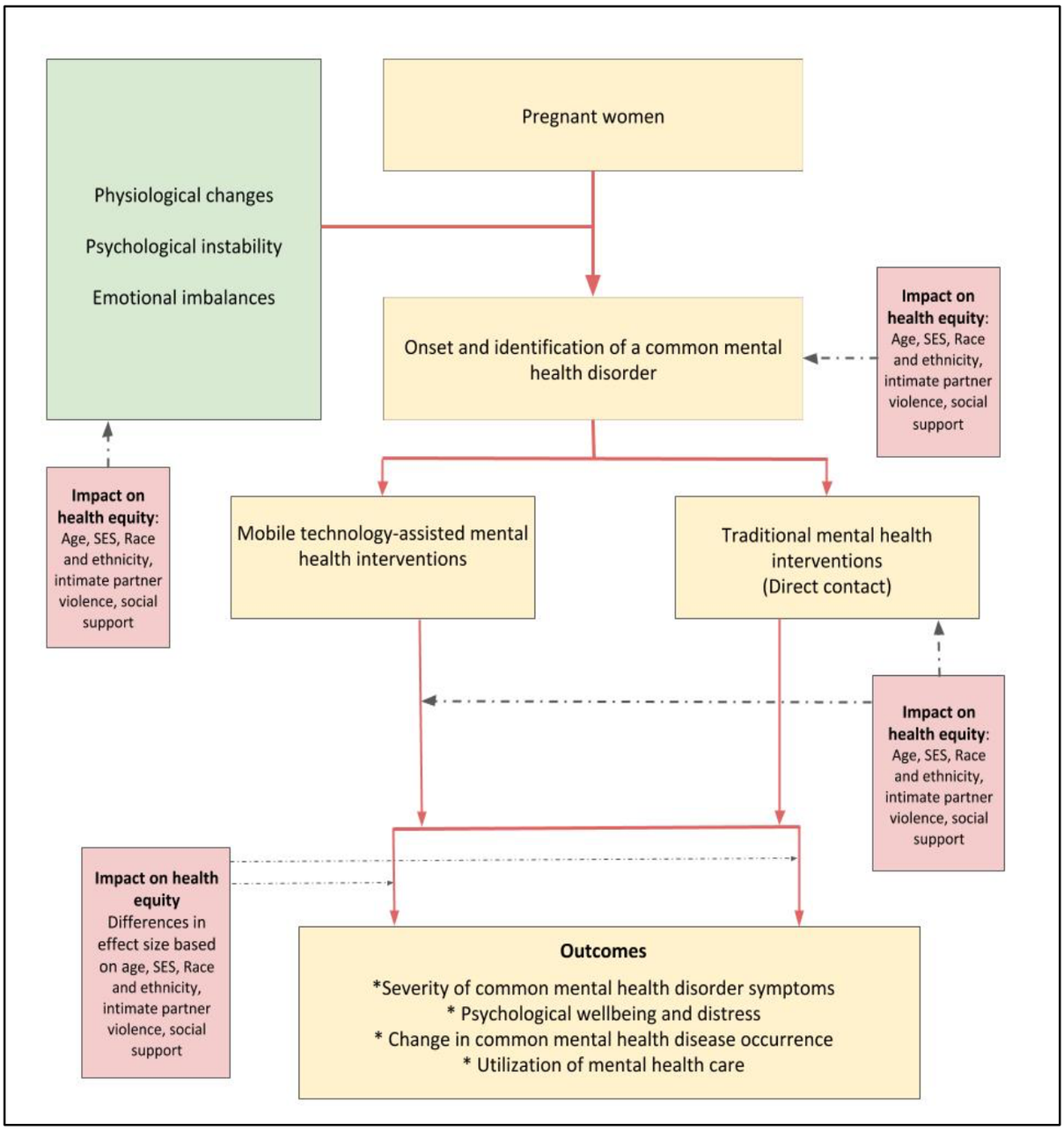


Figure 1. Logic model of causal pathway, intervention delivery and effect, and impact on health equity

1.4 Previous literature on technology-assisted interventions among pregnant women

Multiple systematic reviews have examined mobile and non-mobile technology-assisted mental health interventions when delivering mental health care to pregnant women, but none examined the impact such interventions might carry on patients' health equity. One systematic review by Zhou and colleagues focused on postpartum depression and examined the effectiveness of mhealth interventions by exploring evidence from randomized controlled trials (75). The authors reported findings from n=11 trials involving n=2424 pregnant women and found that mhealth significantly decreased the severity of postpartum depressive symptoms (75). Another systematic review by Dol and colleagues focused on the effectiveness of mhealth educational interventions on maternal psychological outcomes in high income settings (76). The authors of this review built their findings on n=21 randomized and non-randomized studies and reported that mhealth interventions were beneficial in decreasing women's postpartum depression, but showed mixed results when examining self-efficacy, social support, and anxiety (76). Finally, a systematic review by Nair and colleagues examined the effectiveness of telemedicine in reducing pregnant women's maternal depression (77). The authors explored evidence from randomized controlled trials conducted between 2000 and 2018, and highlighted the limited but promising evidence supporting the use of telemedicine among this population (77).

To the best of our knowledge, our systematic review will provide the most robust knowledge synthesis on the effectiveness of mobile technology-assisted mental health interventions among pregnant women, and will be the first analysis to comprehensively examine health equity as it relates to patient-important characteristics. Even though there exists some overlap between the scope of

our systematic review and the previously mentioned knowledge synthesis studies, our equity-focused analysis will allow us to widen the horizon on the benefits of these interventions. As well, the replication of systematic review findings will allow health decision makers to build their policies and guidelines using an approach characterized by its robustness and certainty (78). The findings of this systematic review will inform practitioners (i.e primary health care providers and psychotherapists) as well as end users on what works when delivering mental health care using mhealth.

2. Objectives and research questions

The aim of this systematic review is to synthesize and appraise the best available evidence on the effectiveness and health equity impact of mobile technology-assisted mental health interventions (mhealth interventions) in improving the severity of common mental health disorder symptoms, psychological wellbeing and distress, occurrence of common mental health disorders, and utilization of mental health care among pregnant women. To achieve this objective, we plan to answer the following research questions:

Q1) What is the effectiveness of mobile technology-assisted mental health interventions on pregnant women' severity of common mental health disorder symptoms, psychological wellbeing and distress, occurrence of common mental health disorders, and utilization of mental health care?

Q2) What are the differences in effect sizes that mobile technology-assisted mental health interventions have across pregnant women PROGRESS+ characteristics?

3. Methods

The methodology described herein was developed according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) (79), as well as the Preferred Reporting Items for Systematic Review and Meta-Analysis Equity-focused Reviews (PRISMA-E) (80).

3.1 Ethical approval

This project consists of knowledge synthesis activities that employ secondary analysis methodologies to data from primary studies. No research that involves direct contact with humans or animals is required, and thus, our activities are exempted from the obligation to obtain ethical approval.

3.2 Eligibility criteria

3.2.1 Study design

To ensure that our findings are based on a comprehensive base of evidence, and to ensure that knowledge on health equity impact is properly synthesized, we will conform to the Cochrane Collaboration's Effective Practice and Organisation of Care (EPOC) criteria for the selection of study designs (81). We will include individual and clustered randomized controlled trials (RCTs), Quasi randomized controlled trial (q-RCTs), Non-randomized controlled studies (e.g. non-randomized trials; historically controlled cohort studies; etc.), Controlled before and after studies (CBA), and Controlled interrupted time series and repeated measures studies (CITs). Studies that did not employ a control or comparison group when comparing the effectiveness of the intervention will not be included. As well, because we are interested in capturing the effectiveness of mhealth interventions over a period of time, we will exclude studies that did not follow up with participants, or studies that did not measure the effect of the intervention in the same population over a period of time such as cross-sectional studies.

3.2.2 Population description

We will include studies with samples consisting of women who were pregnant, regardless of the trimester, or who have given birth within the last 12 months, regardless of the birth outcome, at the point of delivering the intervention at hand. Studies that are conducted among women who were trying to conceive or women who have infertility issues will be excluded. Studies that examine more than one subsample of women, including those who were pregnant, will be included only if the pregnant subsample consisted 50% of the full sample, and if the investigators reported the findings of this subsample independently on other subsamples, or in manner that allows us to isolate the effect of the interventions among this subsample independently.

3.2.3 Intervention description

This systematic review will focus on mobile technology-assisted interventions that deliver mental health care or pregnancy support with the intention of improving mental health outcomes, or preventing common mental health conditions during pregnancy (i.e. prenatal or antenatal care), around the time of delivery (i.e. perinatal care), or within 12 months of delivery (i.e. postnatal care), independent of the need for direct, face-to-face contact with a psychiatrist, psychotherapist, or primary healthcare provider. Regardless of the intended features of using the application (self-management of symptoms, self-

management with supported care, improving cognition and thinking, improving skills and behaviours, or tracking of symptoms), the purpose of using the intervention should be to improve the mental health status of participants. The application could provide overall support, health promotion, or use one or all of the principles of a validated psychotherapy technique, including but not limited to cognitive behavioural therapy (CBT) (82), narrative exposure therapy (NET) (83), stress inoculation or stress management (SM) (84), cognitive analytic therapy (CAT) (85), dialectical behavior therapy (86), or acceptance and commitment therapy (ACT) (87).

The psychotherapy intervention should be delivered using an application-based platform that is downloaded on the patient's mobile device (smartphone, tablet, phablet) and/or by pushing notifications into the patient's mobile phone, such as external automated text messages or internal notifications. The service could be accessed with or without an internet connection.

3.2.4 Comparison description

We will include studies that compare participants who have received technology assisted mental health interventions to a control group of participants who received no intervention, a placebo or quality controlled intervention, usual care in any form as long as it does not include the same components or characteristics of the intervention of interest, or those who have been waitlisted to receive the same intervention.

For studies with multiple arms, we will select the intervention arm that is considered to have the highest dose of psychotherapy and compare that to the control group. Moreover, if the study delivers the intervention as part of a complex program with other forms of support, we will include it only if the comparison between study arms would allow us to isolate the effect size of the intervention of interest alone (For example, comparing intervention A and intervention B to intervention B alone would allow us to isolate the effect of intervention A alone). However, we will exclude studies that compare two interventions relative to each other without a standardized control group as explained above.

3.2.5 Outcomes of interest

To ensure that our findings reflect the benefits and harms that are most important to pregnant women, we selected relevant outcomes of interest by comprehensively scoping the literature for systematic reviews that examined the effectiveness of mental health interventions for the management of common mental health disorders among pregnant women. We searched MEDLINE, EMBASE, PsychINFO, Cochrane CENTRAL, and CINAHL for knowledge synthesis studies (i.e. reviews, scoping reviews, systematic reviews, and meta-analyses) that examined mental health outcomes during and after pregnancy. Our search yielded a total of 1,016 records, of which 39 systematic reviews were included. Fifteen systematic reviews focused on depression-specific interventions (77,88–101), four systematic reviews examined anxiety-specific interventions (102–105), two systematic reviews examined trauma-specific interventions (106,107), whereas the remaining eighteen systematic reviews examined common mental health disorders in general (i.e. depression, anxiety, and stress) (108–125).

The timing of intervention delivery also differed between systematic reviews; Twenty-five reviews focused on perinatal conditions that occurred immediately before or after birth (77, 88, 91, 92, 94, 98, 101, 102, 104, 105, 108–111, 113–116, 118–121, 123–125), whereas nine systematic reviews focused on postpartum conditions taking place after delivery only (89,93,95–97,99,106, 107, 122), and five systematic reviews examined antenatal conditions happening during pregnancy (90,100,103,112,117). The outcomes reported herein represent the most prominent mental health outcomes that were examined in these systematic reviews (Please see Table 1 for a summary of our outcomes of interest).

3.2.5.1 Severity of common mental health disorder symptoms

Exploring the effectiveness of mental health interventions requires examining the extent to which these interventions decrease or increase the severity of psychological symptoms relating to depression, anxiety, and stress. Thirty-six systematic reviews examined the severity of depression symptoms (77,88–102,105,107–125), by using validated tools with continuous scales such as the Edinburgh Postnatal Depression Scale (EPDS) (126), the Beck Depression Inventory (BDI) (127), or the Hamilton Rating Scale (128), or by using dichotomous measures to examine the percentage of patients with severe depressive symptoms or the percentage of episodes of severe depressive symptoms that patients experienced over a period of time.

Twenty-one systematic reviews examined the severity of symptoms relating to anxiety-spectrum disorders (77,90,102–105,107–113,115–120,122,123), by using validated

tools with continuous scales such as the State-Trait Anxiety Inventory (STAI) (129) and the Beck Anxiety Inventory (BAI) (130), or by using dichotomous measures to examine the percentage of patients with severe anxiety symptoms or the percentage of episodes of severe anxiety symptoms that patients experienced over a period of time.

Five systematic reviews examined the severity of post-traumatic stress disorder (PTSD) symptoms (106–108,118,120), by using validated tools with continuous scales such as the Post-traumatic Symptom Scale (PSS) (131) and the Revised Symptom Checklist-90 (SCL-90-R) (132), or by using dichotomous measures to examine the percentage of patients with severe PTSD symptoms or the percentage of episodes of severe PTSD symptoms that patients experienced over a period of time.

3.2.5.2 Psychological wellbeing and distress

Certain interventions do not target common mental health disorders, but rather improve pregnant women's level of psychological distress and increase their overall wellbeing. Fifteen systematic reviews examined these outcomes (89, 90, 105, 107–111, 113–115, 117, 120, 123, 125), by using validated tools with continuous scales such as the Kessler Psychological Distress Scale (K10) (133), or by using adaptive questionnaires that allow women to rate their level of psychological wellbeing or distress on a continuous scale or by answering dichotomous questions.

3.2.5.3 Change in common mental health disease occurrence

Examining whether a certain intervention is effective in managing a mental health disease requires exploring the changes in the occurrence measurements of this disease over time, such as the change in the percentage of patients who no longer meet the diagnosis criteria for depression, anxiety or PTSD, or the percentage of patients who no longer experience symptoms of a certain disease. Twenty-one systematic reviews measured the occurrence of common mental health conditions such as depression, anxiety, and post-traumatic stress disorders (89–94, 96, 97, 101, 103, 104, 106, 109, 111–113, 117, 121, 122, 124, 125), by measuring the incidence, rate, or risk of having mental health symptoms or meeting a standardized diagnosis criteria for a certain disease.

3.2.5.4 Utilization of pregnancy related services and mental health care

Effective mental health interventions delivered during pregnancy promote better utilization of pregnancy-related care, as well as improve access to mental health services when needed. Three systematic reviews examined patients' access and maintenance of pregnancy-related care services, or measured utilization of pharmacological and non-pharmacological mental health treatment regimens (98,105,121), by studying the percentage of patients who have used or maintained a treatment or service and the mean number of contacts with psychologists or healthcare providers that patients have had over time.

Table 1. Outcomes of interest

Outcome category	Outcome measurement	Categorization
Severity of common mental health disorder symptoms	Severity of depression symptoms	Continuous
	Severity of anxiety-spectrum disorder symptoms	Continuous
	Severity of post-traumatic stress disorder (PTSD) symptoms	Continuous
	Percentage of patients with severe depression symptoms	Categorical (dichotomous)
	Percentage of patients with severe anxiety symptoms	Categorical (dichotomous)
	Percentage of patients with severe post-traumatic stress disorder (PTSD) symptoms	Categorical (dichotomous)

	Percentage of episodes of severe depression symptoms	Categorical (dichotomous)
	Percentage of episodes of severe anxiety symptoms	Categorical (dichotomous)
	Percentage of episodes of severe post-traumatic stress disorder (PTSD) symptoms	Categorical (dichotomous)
Psychological wellbeing and distress	Changes in levels of psychological wellbeing	Continuous
	Changes in levels of psychological distress	Continuous
	Percentage of patients who reported changes in their psychological wellbeing levels	Categorical (dichotomous)
	Percentage of patients who reported changes in their psychological distress levels	Categorical (dichotomous)
Change in common mental health disorder occurrence	Percentage of patients who meet/ no longer meet a standardized diagnosis criterion for depression	Categorical (dichotomous)
	Percentage of patients who meet/ no longer meet a standardized diagnosis criterion for anxiety	Categorical (dichotomous)
	Percentage of patients who meet/ no longer meet a standardized diagnosis criterion for post-traumatic stress disorder (PTSD)	Categorical (dichotomous)
	Percentage of patients who experience/ no longer experience mental health symptoms relating to depression	Categorical (dichotomous)
	Percentage of patients who experience/ no longer experience mental health symptoms relating to anxiety	Categorical (dichotomous)
	Percentage of patients who experience/ no longer experience mental health symptoms relating to post-traumatic stress disorder (PTSD)	Categorical (dichotomous)
Utilization of pregnancy related services and mental health care	Percentage of patients compliant with their pharmacological treatment regimen	Categorical (dichotomous)
	Percentage of patients compliant with their non-pharmacological treatment regimen	Categorical (dichotomous)
	Percentage of patients who accessed pregnancy-related perinatal or postnatal care services	Categorical (dichotomous)
	Mean number of contacts that patients made with mental, primary, or pregnancy-related healthcare providers	Continuous

3.2.6 Time points of interest

In this systematic review, we will examine the short, medium, and long-term effectiveness of mobile technology-assisted mental health interventions. Short-term effectiveness refers to the immediate post-test effectiveness as well as all outcomes that were measured during the first three months after the end of intervention delivery. Medium-term effectiveness encompasses all outcomes that were measured after the short-term interval and until the six months point-in-time. Long term effectiveness encompasses outcomes that were measured after the six months point-in-time. We have selected these time intervals to be narrow in width because the nature of the interventions of interest are short-term. This approach was reflected in previous systematic reviews examining similar interventions (75,76).

3.3 Searching the literature

3.3.1 Literature resources

We aim to search seven electronic databases for relevant records. Please see table 2 for information regarding which databases to search, what engine hosts to use, and dates of database inception and our search process.

To ensure literature search saturation, we will hand search all included studies and systematic reviews captured by our search for any relevant primary studies. We will also search PROSPERO for any relevant systematic reviews and hand search their

reference lists for primary studies, and scope electronic registries of clinical trials such as clinicaltrials.gov and the International Clinical Trials Registry for any recently published trials not captured by our search. Finally, we will consult experts in the fields of psychiatry and cultural psychotherapy, obstetrics and gynecology, and mhealth for any relevant records.

3.3.2 Search strategy

We plan to develop a comprehensive search strategy in consultation with a health science librarian (Amanda Hodgson) with expertise in the fields of systematic reviews and literature searches. The search strategy will be developed using the eligibility criteria and will be adapted to the syntax and subject headings of each electronic database and engine host. A combination of indexed terms, database-specific and MeSH headings, and free text keywords will be used. No date, language, or setting filters will be used. Please see Appendix I. for details on our search strategy.

3.3.3 Grey literature search

In addition to searching the bibliographic databases, we will conduct a focused grey literature search for electronic manuscripts reporting on mobile technology-assisted interventions targeting mental health among pregnant women and following our inclusion criteria. We will search OpenGrey for grey literature originating from Europe. We will also use a Google Custom Search Engine to search the websites of pregnancy and maternal organizations for relevant reports or studies. A combination of simple keywords will be used to conduct this search including, but not limited to, “pregnant”, “postpartum”, “mobile”, “technology”, and “mental health”.

Table 2. Literature sources

Database	Engine host	Year of database inception	Date of search
Medline	Ovid	1946	June, 2020
Embase	Ovid	1947	June, 2020
PsychINFO	Ovid	1806	June, 2020
CINAHL	EBSCO	1981	June, 2020
Cochrane CENTRAL	Ovid	1996	June, 2020
PTSDpubs (PILOTS)	ProQuest	1871	June, 2020
Web of science	Clarivate web	1900	June, 2020

3.4 Study selection and data management

3.4.1 Study screening

All records yielded by our search will be screened against our eligibility criteria. A two-phased study screening process will be adapted. The first phase includes screening all records by their titles and abstracts, whereas the second phase includes screening potentially relevant records that were identified from the first phase using the full-text publication. Two independent reviewers will screen records in duplicate and make a decision on whether to include or exclude a certain record while blinded from the decision of the other reviewers. All discrepancies will be resolved by consensus between reviewers, and if no consensus was reached, a third reviewer with expertise in the area of disagreement will make the final decision. Before initiating the screening process, and to ensure the reliability of our screening process, we will perform a reliability exercise with a random sample of n=100 records to test for inter-rater agreement by calculating the kappa coefficient (134). A kappa statistic of 0.81 or higher (135) will be deemed an indication of adequate inter-reviewer screening reliability, and the screening process will start, whereas any values below 0.81 will entail the need to calibrate the screening process and re-train reviewers. All screening procedures will be undertaken using a systematic review management software called “Covidence” (136).

3.4.2 Data extraction

Following the identification of all studies that meet our eligibility criteria, we will extract relevant data from included studies using standardized data extraction forms. Two independent reviewers will extract data in duplicate and while blinded from forms of the other reviewer. Any discrepancies in data extraction will be resolved by consensus or the consultation of a third reviewer. The following variables and information will be extracted from the primary studies: (1) Study

identifiers: such as name of authors, date of publication, journal, volume, and page number if needed (2) Study methodology: objectives, study design, methodological details such as processes for randomization, allocation and blinding, target population, recruitment and sampling procedures, setting, participant eligibility criteria, participant baseline characteristics, sample size per arm at baseline (3) Intervention description: name, nature, components (e.g. timing, frequency, route of delivery, and adaptation to cultural context), and details of the comparison intervention; (4) Outcomes: Definitions, instrument and scale interpretation, any cultural adaptation to psychiatric terminology, timing of outcome measures, and adverse events; (5) Results: Participant attrition rate, categorical data, continuous data, between-group estimates; and (6) Author conclusions, funding and conflict of interest. An emphasis will be put on extracting information regarding health equity, meaning any descriptions of populations characteristics that fall under the PROGRESS+ framework (Please see section IV below), as well as any stratification, adjustment, or controlling for any of these characteristics when reporting effect estimates (O'Neill 2013). All extraction activities will be conducted using Google sheets (137).

3.5 Critical appraisal

We will critically appraise the quality of included studies on the individual result level in each primary study. The Cochrane Risk of Bias R.O.B 2.0 tool (138) will be used to examine sources of bias in randomized and quasi-randomized controlled trials. This tool allows reviewers to make an assessment about the presence of concerns for risk of bias in the following domains: a) the randomization process, including random sequence generation and allocation concealment, b) deviations from the intended interventions while examining the effect of assignment to the intervention, c) missing outcome data, d) measurement of outcomes, and e) selection of the reported results. Two independent reviewers will make assessments by providing a judgment for risk of bias (high, low, some concerns) on each individual domain and an overall risk of bias judgement across domains and at the result level for the examined outcome of interest. Any discrepancies in judgements between the two reviewers will be resolved by consensus or the use of a third reviewer with professional knowledge in critical appraisal.

The Cochrane Risk of Bias In Non-Randomized Studies of Interventions (ROBINS-I) (139) will be used to critically appraise the quality of included non-randomized studies. This tool allows reviewers to make an assessment about the presence of concerns for risk of bias in the following seven domains: a) selection of participants, b) confounding, c) classification of the intervention, d) deviation from the intended intervention, e) missing data, f) measurement of outcomes, and g) selection of reported results. Two independent reviewers will make assessments by providing a judgement for risk of bias (low, moderate, serious, or critical) for each of the seven domains and overall risk of bias assessment across domains for the intended outcome of interest. Any discrepancies in judgements between the two reviewers will be resolved by consensus or the use of a third reviewer with professional knowledge in critical appraisal.

Finally, visual representations of the risk of bias assessments for both the ROB 2.0 and the ROBINS-I tools across each of the outcome domains will be created using the Robvis tool (140).

3.6 Data synthesis and analysis

3.6.1 Statistical analysis of primary results

Outcome data from continuous measures such as the severity of symptoms or mental health-related quality of life will be synthesized and reported as between-group mean differences in change from baseline. If baseline mean estimates are not available, we will report between-group mean differences at the follow-up point. If between-group differences are not reported, we will use RevMan 5.3 to calculate these values (141). Outcome data from categorical or dichotomous measures such as the percentage of patients with somatic symptoms or the percentage of patients who made contact with a health care provider will be synthesized and reported as relative risk estimates such as risk ratios (RR) or odd ratios (OR), or as absolute risk estimates such as risk difference (RD). Whenever possible, we will prefer the use of the risk ratio over the odds ratio because the latter tends to overestimate the magnitude of effect estimates compared with the former (142). All continuous and categorical effect size estimates will be accompanied by estimates of statistical significance such as 95% confidence intervals and p values at the 0.05 level of significance. If investigators report a certain p value under the 0.05 level, we will report the value as has been provided.

If study investigators adjusted or controlled for a certain covariate by using linear or

logistic regression methodology, we will report the adjusted or "corrected" effect estimates and point out the methods used for such adjustment. As well, if investigators reported regression analysis coefficients only without other effect estimates (i.e. RR or MD), we will report their effect estimates as have been provided.

The unit of analysis will be per individual randomized in the study. For cluster randomized trials, we will assess unit of analysis errors (e.g. no adjustment for clusters made). If errors are detected, we will inflate the standard deviation using an intra-cluster correlation coefficient (ICC). In the presence of dichotomous outcomes, we will adjust the numerator and denominator for unit of analysis errors.

3.6.2 Assessment of clinical heterogeneity

Clinical heterogeneity for each outcome will be assessed by two reviewers through searching for any clinically important differences in study populations, characteristic of interventions, nature of comparator groups, outcome measurements, and time points of measurement. The two reviewers will have access to the primary studies and data extraction forms and will need to reach a consensus on whether clinical heterogeneity may impede the process of pooling results from difference studies.

3.6.3 Meta-analyzing results and pooling of effect estimates

Whenever clinical homogeneity permits a sensible pooling of data from different studies, we will meta-analyze effect estimates from studies with similar designs and at similar time points. Because we anticipate a certain degree of unreported heterogeneity in the delivery of the intervention and history of the population of interest, we will use random effects models in our analyses (143). Pooled effect estimates will be synthesized and reported as relative risks or standardized mean differences from baseline, as appropriate. All pooled results will be accompanied by forest plots that will be developed using RevMan 5.3 software to allow for a better data visualization (141).

3.6.4 Assessment of statistical heterogeneity

Whenever meta-analyses are undertaken, statistical heterogeneity will be assessed using the I^2 and Chi Square statistics (144). We will use the RevMan 5.3 software to calculate these statistical estimates (141). An I^2 estimate of 75% or higher or a Chi Square estimate with a p value of 0.1 or lower would indicate statistical heterogeneity (144), which will require conducting sensitivity analyses to examine the impact of this statistical heterogeneity on the pooled effect estimate.

3.6.5 Assessment of reporting bias

Whenever a pooling of effect estimates with 10 or more studies is undertaken (144), we will assess for reporting bias by visually creating funnel plots using the RevMan 5.3 software (141). If any indication of reporting bias is apparent, we will report this concern descriptively alongside the pooled effect estimate.

3.6.6 Assessment of certainty of evidence

We will use the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework to make assessment about the "quality" or "certainty" of our findings (145). We will rate certainty down based on the level of concerns (not serious, serious, very serious) in regard to risk of bias, inconsistency, indirectness, impression, and publication bias. Conversely, we will rate it up with the presence of a large magnitude for the effect estimate, a dose-response gradient, or if all residual confounding that would decrease this magnitude of effect is addressed (145). Evidence from included studies and pooled effect estimates will be presented in GRADE Evidence profiles (146), and a final assessment of evidence certainty will be reported using one of the following domains; Very low, low, moderate, and high (147). Please see table 3. for a description of each level of evidence certainty rating.

Table 3: Description of the GRADE certainty rating (145)

Certainty rating	Description
High	Further research is very unlikely to change our confidence in the effect estimate
Moderate	Further research is likely to have an important impact on our confidence in the effect estimate and may also change the estimate
Low	Further research is very likely to have an important impact on our confidence in the effect estimate and is also likely to change the estimate

Very low	Any estimate of the effect is very uncertain

3.6.7 Handling missing data

We will attempt to calculate effect estimates accompanied by standard deviations or other estimates of statistical significance for values with missing data. These calculations will run according to the formulae provided in the Cochrane handbook for systematic reviews of Interventions (144) and using RevMan 5.3 software (141). Whenever data from included primary studies are not reported or reported in a way that prevents pooling of effect estimates or appropriate data analysis, we will contact authors to obtain further information. Two attempts will be made to contact the corresponding author of each publication with missing data with a one-week time interval between the two attempts. Both attempts will be made by the first author (AS) using the corresponding author's email address. If the corresponding author does not respond or is unable to provide further information regarding the missing data, we will report the estimates as have been provided. Studies with no quantitative results will not be included in our analysis.

Because we are interested in examining the effectiveness of mobile technology-assisted mental health interventions delivered at the clinical practice or community level, we will use intention to treat (ITT) analysis methods to examine the effect of assignment to the intervention, using the number of individuals randomized into the study, including missing individuals as the denominator, assuming that the event did not occur in the missing individuals. If a study further reports effect estimates using per-protocol analyses, we will conduct a sensitivity analysis to test the effect of the analysis method.

3.6.8 Handling overlapping effect estimates

Whenever a study reports a certain outcome using more than one measurement or tool, we will avoid the double counting of that sample by selecting one measurement that is most common among other studies to increase the likelihood of pooling of effect estimates. The remaining measurements will be dropped from all analyses. As well, whenever an outcome is evaluated in multiple publications using sub-samples of the same target population sample, we will consider the evaluation with the largest sample size to capture the effect estimate with the largest power and higher external validity to our population of interest. If an outcome was measured at different time points, we will analyze and report effect estimates at the earliest time point post-intervention for the short-term effectiveness, the effect estimate closer to the six months post-intervention time-point for the medium term effectiveness, and the effect estimate with the longest follow-up period for the long-term effectiveness.

3.6.9 Equity focused subgroup analysis

Data regarding patient important PROGRESS+ characteristics will be reported using descriptive statistics as have been provided in the primary study (Please see section 3.5). Any between-group or inter-group differences or gradients in effect estimates while stratifying for participants' age, socioeconomic status, race and ethnicity, intimate partner violence, and social support will be reported. As well, any stratification or adjustment of participants' characteristics undertaken by the study investigators at the patient selection or analysis levels will be reported. Whenever possible, we will attempt to conduct all subgroup analyses or meta-analyses while stratifying for participants' age, socioeconomic status, race and ethnicity, intimate partner violence, and social support.

4. Reporting of findings

Information regarding the characteristics of included studies and context in which the intervention is delivered will be tabulated and reported. As well, information regarding the nature and purpose of the intervention, psychotherapy technique delivered, route of delivery, functionality and features, dosage, and adaptation to the local context will be tabulated and reported. All critical appraisal assessments across studies will be reported visually (Please see section 3.6). All meta-analyses will be reported using forest plots and pooled effect estimates in text (Please see section 3.7.3). All outcomes will be tabulated in GRADE Evidence Profiles (Please see section 3.7.6). All findings that were not meta-analyzed due to clinical heterogeneity will be reported narratively using the Synthesis Without Meta-Analysis (SWiM) approach (148,149).

5. Stakeholder engagement

Evidence shows that stakeholders may benefit from being involved in the development, implementation, and evaluation of interventions that carry the potential to impact their health and wellbeing (150–152). Community scholars are representatives of a certain vulnerable population who are attuned to the needs of this population and carry the potential to

facilitate the integration and proper dissemination of knowledge mobilization tools into their communities (153). To ensure the relevance and proper public reachability of our findings, we will actively engage two representatives from vulnerable pregnant women communities in providing feedback regarding the findings of this project, and participating in the development of a culturally-adapted knowledge mobilization product (Please see section 6). We will develop a summary of the project's scope and final results of the review using layman terms and language and share this summary with the community scholars. Consequently, we will ask them to provide us with written or verbal feedback on the findings and their relevance to these vulnerable populations. The feedback will be discussed among members of the research team as well as experts in the fields of cultural psychology, and relevant elements will be integrated into the dissemination of knowledge. We will aim to recruit a community scholar who has experienced stress and/or common mental disorders during or within 12 months postpartum. The recruitment process will take place using our established networks of clinicians and psychotherapists. All community scholars will be compensated for their time, and their names, should they consent, will be acknowledged in the final review. Because the stakeholder feedback will not be used verbatim for research purposes, but rather to improve the relevance of our findings and prompt knowledge mobilization activities, we will not need to obtain ethics approval for this engagement.

6. Knowledge translation and mobilization

We aim to properly disseminate the findings of this project to scientific and medical communities, as well as the general public. To achieve this objective, we plan to publish the findings of this review in an open-source peer reviewed journal. Moreover, we will seek consultations from local and national stakeholders focusing on perinatal and postpartum care such as the Perinatal Mental Health Program of the Ottawa Hospital, the Perinatal Services of British Columbia (PSBC), and the Mental Health Commission of Canada to develop a community-based knowledge mobilization product that is tailored to the needs pregnant women in Canada. Our community scholars, representing pregnant communities in Canada, will be engaged in the development and dissemination of this product. Furthermore, we will develop two conference posters, one for the protocol at hand, and the other for the final review, and aim to present our findings in national and international conferences and events. We have submitted an abstract of this protocol to the 2020 Cochrane Colloquium, Toronto, ON, Canada, and the North American Primary Care Research Group (NAPCRG) conference, Los Angeles, California, United States, and will present our findings in these events should the opportunity permit. A policy brief and a public health brochure using layman terms and language will be created and properly disseminated through our networks of clinicians, mental healthcare providers, and maternity clinics.

7. Amendment to the protocol

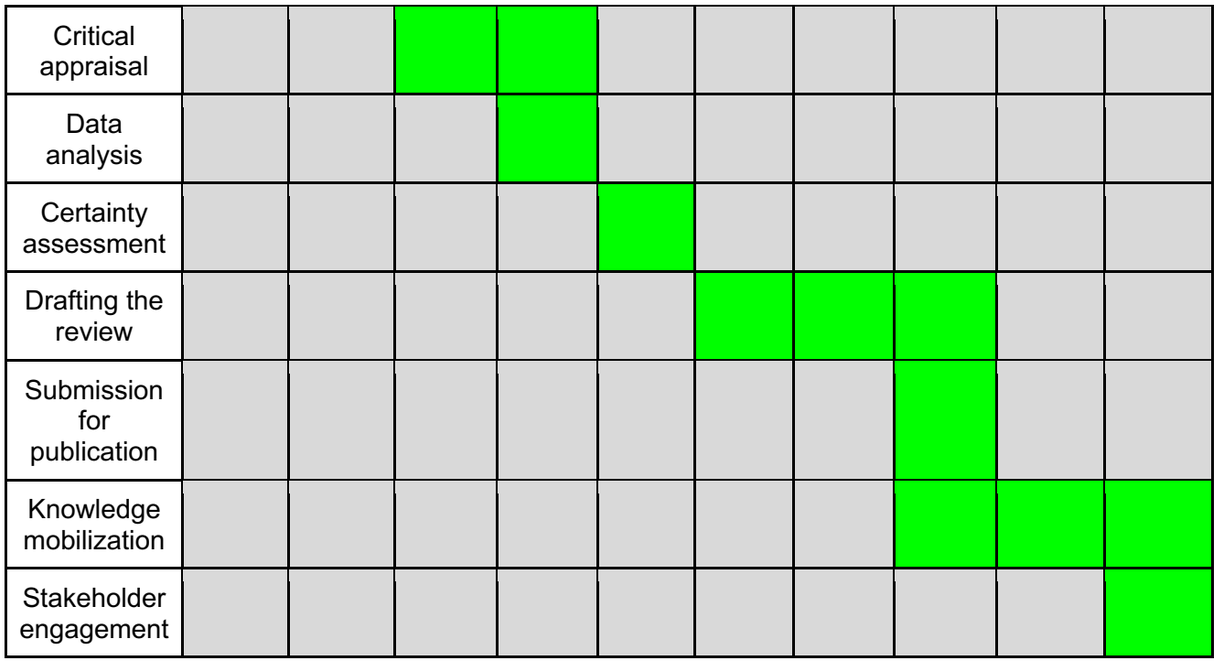
Should the data screening, extraction, or analysis processes reveal new information that require further analysis of interventions, outcome measurements, or patient characteristics, we will provide a written amendment to the methodology provided in the protocol and ensure that all changes and alterations are adequately discussed in the review manuscript.

8. Timeline

We anticipate that the review will approximately take 8 months to finalize and submit for publication (June 2020, January 2021). Knowledge mobilization and stakeholder engagement activities will continue after the 8-month checkpoint. Table 5 below presents a timeline that we propose to complete this project.

Table 5. Timeline for proposed activities

	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021
Search & Registration										
2-phase Screening										
Data extraction										



9. Role of individuals involved in this project

The primary author (AS) was responsible for the conceptualization of the project scope and selection of appropriate methodology. AS and OM will design the search strategy in consultation with a health science librarian and will use it to search all electronic databases. AS, QA, OM, and SH will undertake data screening, selection, extraction, quality assessment, and analysis. AS will draft the first version of the manuscript. All authors will approve the first and subsequent versions of the manuscript. AK will provide contextual feedback relating to mental health and knowledge dissemination. OM will provide feedback relating to health equity and methods. KP will supervise the entire project. AS is the guarantor of this project and the proposed plans.

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Appendices

Appendix I. Search strategies

MEDLINE via OVID
exp pregnancy/ or pregnant women/
exp prenatal care/ or exp perinatal care/ or exp postnatal care/ or exp postpartum period/
(pregnan* or prenatal or pre-natal or perinatal or peri-natal or postnatal or post-natal or postpartum or post-partum or ((perinatal or prenatal or postpartum or postnatal) adj2 care*) or ((peri-natal or pre-natal or post-partum or post-natal) adj2 care*)).ti,ab,kf.
1 or 2 or 3
mental health/ or exp mental disorders/ or depression/ or anxiety/ or stress disorder, post-traumatic/ or stress, psychological/ or psychological distress/
(mental health* or wellbeing or well-being or (mental adj2 health*) or psychology or psychiatry or psych* or stress* or depress* or anxiet* or anxi* or anxious* or posttrauma* or post-trauma* or trauma or PTSD).ti,ab,kf.
5 or 6
smartphone/ or exp cell phones/ or exp computers, handheld/ or mobile application/ or wireless technology/ or text messaging/
(mhealth* or m-health*).ti,ab,kf.
(((mobile or cell* or portable) adj2 phone*) or cellphone* or cell-phone* or smartphone* or smart-phone*).ti,ab,kf.
((mobile adj2 application*) or (phone adj2 application*) or app or apps).ti,ab,kf.
((mobile adj2 health) or (mobile adj2 tech*)).ti,ab,kf.
(text* or sms or (text* adj2 messag*) or (sms adj2 messag*)).ti,ab,kf.
8 or 9 or 10 or 11 or 12 or 13
4 and 7 and 14

EMBASE via OVID
exp pregnancy/ or exp pregnancy outcome/ or exp high risk pregnancy/
exp prenatal care/ or exp perinatal care/ or exp postnatal care/
(pregnan* or prenatal or pre-natal or perinatal or peri-natal or postnatal or post-natal or postpartum or post-partum or ((perinatal or prenatal or postpartum or postnatal) adj2 care*) or ((peri-natal or pre-natal or post-partum or post-natal) adj2 care*)).ti,ab,kw.
1 or 2 or 3
Mental health/ or exp mental disease/ or depression/ or anxiety/ or anxiety disorder/ or posttraumatic stress disorder/ or exp stress/ or distress syndrome/
(mental health* or wellbeing or well-being or (mental adj2 health*) or psychology or psychiatry or psych* or depress* or anxiet* or anxi* or anxious* or stress* or posttrauma* or post-trauma* or trauma or PTSD).ti,ab,kw.
5 or 6
Smartphone/ or exp mobile phone/ or tablet computer/ or mobile application/ or wireless communication/ or text messaging/
(mhealth* or m-health*).ti,ab,kw.
(((mobile or cell* or portable) adj2 phone*) or cellphone* or cell-phone* or smartphone* or smart-phone*).ti,ab,kw.
((mobile adj2 application*) or (phone adj2 application*) or app or apps).ti,ab,kw.
((mobile adj2 health) or (mobile adj2 tech*)).ti,ab,kw.
(text* or sms or (text* adj2 messag*) or (sms adj2 messag*)).ti,ab,kw.
8 or 9 or 10 or 11 or 12 or 13
4 and 7 and 14

Cochrane CENTRAL via OVID
exp pregnancy/ OR pregnant women/ OR exp pregnancy complications/
exp prenatal care/ or exp perinatal care/ or exp postnatal care/ or exp postpartum period/
(pregnan* or prenatal or pre-natal or perinatal or peri-natal or postnatal or post-natal or postpartum or post-partum or ((perinatal or prenatal or postpartum or postnatal) adj2 care*) or ((peri-natal or pre-natal or post-partum or post-natal) adj2 care*)).ti,ab.
1 or 2 or 3
Mental health/ OR exp mental disorders/ or depression/ OR depression, postpartum/ OR anxiety/ OR exp anxiety disorders/ OR stress disorder, post-traumatic/ OR stress/ OR stress, psychological/
(mental health* or wellbeing or well-being or (mental adj2 health*) or psychology or psychiatry or psych* or depress* or anxiet* or anxi* or anxious* or stress* or posttrauma* or post-trauma* or trauma or PTSD).ti,ab.
5 or 6
smartphone/ OR cellular phone/ OR mobile applications/ OR wireless technology/ OR exp computers, handheld/ OR text messaging/
(mhealth* or m-health*).ti,ab.
(((mobile or cell* or portable) adj2 phone*) or cellphone* or cell-phone* or smartphone* or smart-phone*).ti,ab.
((mobile adj2 application*) or (phone adj2 application*) or app or apps).ti,ab.
((mobile adj2 health) or (mobile adj2 tech*)).ti,ab.
(text* or sms or (text* adj2 messag*) or (sms adj2 messag*)).ti,ab.
8 or 9 or 10 or 11 or 12 or 13
4 and 7 and 14

PsychINFO via OVID
exp pregnancy/
exp prenatal care/ or exp perinatal period/ or exp postnatal period/
(pregnan* or prenatal or pre-natal or perinatal or peri-natal or postnatal or post-natal or postpartum or post-partum or ((perinatal or prenatal or postpartum or postnatal) adj2 care*) or ((peri-natal or pre-natal or post-partum or post-natal) adj2 care*)).ti,ab.
1 or 2 or 3
mental health/ or exp mental disorders/ or depression/ or postpartum depression/ or exp anxiety/ or exp anxiety disorders/ or posttraumatic stress disorder/ or post-traumatic stress/ or stress/ or acute stress disorder/
(mental health* or wellbeing or well-being or (mental adj2 health*) or psychology or psychiatry or psych* or depress* or anxiet* or anxi* or anxious* or stress* or posttrauma* or post-trauma* or trauma or PTSD).ti,ab.
5 or 6
smartphones/ or exp mobile phones/ or mobile applications/ or wireless technologies/ or tablet computers/ or text messaging/
(mhealth* or m-health*).ti,ab.
(((mobile or cell* or portable) adj2 phone*) or cellphone* or cell-phone* or smartphone* or smart-phone*).ti,ab.
((mobile adj2 application*) or (phone adj2 application*) or app or apps).ti,ab.
((mobile adj2 health) or (mobile adj2 tech*)).ti,ab.
(text* or sms or (text* adj2 messag*) or (sms adj2 messag*)).ti,ab.
8 or 9 or 10 or 11 or 12 or 13
4 and 7 and 14

Web of Science via Clarivate Analytics website

TS=pregnan* OR TI=pregnan* OR AB=pregnan* OR AK=pregnan* OR KP=pregnan* Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
TS=(perinatal OR peri-natal OR prenatal OR pre-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postnatal OR postpartum) Near2 care) OR ((peri-natal OR pre-natal OR post-natal OR post-partum) Near2 care)) OR TI=(perinatal OR peri-natal OR prenatal OR pre-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postnatal OR postpartum) Near2 care) OR ((peri-natal OR pre-natal OR post-natal OR post-partum) Near2 care)) OR AB=(perinatal OR peri-natal OR prenatal OR pre-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postnatal OR postpartum) Near2 care) OR ((peri-natal OR pre-natal OR post-natal OR post-partum) Near2 care)) OR AK=(perinatal OR peri-natal OR prenatal OR pre-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postnatal OR postpartum) Near2 care) OR ((peri-natal OR pre-natal OR post-natal OR post-partum) Near2 care)) OR KP=(perinatal OR peri-natal OR prenatal OR pre-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postnatal OR postpartum) Near2 care) OR ((peri-natal OR pre-natal OR post-natal OR post-partum) Near2 care)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
#2 OR #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
TS=((mental NEAR2 health*) OR (mental NEAR2 disorder*) OR depression OR anxiety OR stress OR well-being OR well-being OR psychology OR psychiatry OR psych* OR depress* OR anxiet* OR anxi* OR anxious* OR stress* OR posttrauma* OR posttrauma* OR trauma OR PTSD) OR TI=((mental NEAR2 health*) OR (mental NEAR2 disorder*) OR depression OR anxiety OR stress OR wellbeing OR well-being OR psychology OR psychiatry OR psych* OR depress* OR anxiet* OR anxi* OR anxious* OR stress* OR posttrauma* OR posttrauma* OR trauma OR PTSD) OR AB=((mental NEAR2 health*) OR (mental NEAR2 disorder*) OR depression OR anxiety OR stress OR wellbeing OR well-being OR psychology OR psychiatry OR psych* OR depress* OR anxiet* OR anxi* OR anxious* OR stress* OR posttrauma* OR posttrauma* OR trauma OR PTSD) OR AK=((mental NEAR2 health*) OR (mental NEAR2 disorder*) OR depression OR anxiety OR stress OR wellbeing OR well-being OR psychology OR psychiatry OR psych* OR depress* OR anxiet* OR anxi* OR anxious* OR stress* OR posttrauma* OR posttrauma* OR trauma OR PTSD) OR KP=((mental NEAR2 health*) OR (mental NEAR2 disorder*) OR depression OR anxiety OR stress OR wellbeing OR well-being OR psychology OR psychiatry OR psych* OR depress* OR anxiet* OR anxi* OR anxious* OR stress* OR posttrauma* OR posttrauma* OR trauma OR PTSD) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
TS=(mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (mobile NEAR2 application*) OR (phone NEAR2 application*) OR app OR apps OR (mobile NEAR2 health) OR (mobile NEAR2 tech*) OR text* OR sms OR (text* NEAR2 messag*) OR (sms NEAR2 messag*) OR (wireless NEAR2 technologies) OR (tablet NEAR2 computers)) OR TI=(mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (mobile NEAR2 application*) OR (phone NEAR2 application*) OR app OR apps OR (mobile NEAR2 health) OR (mobile NEAR2 tech*) OR text* OR sms OR (text* NEAR2 messag*) OR (sms NEAR2 messag*) OR (wireless NEAR2 technologies) OR (tablet NEAR2 computers)) OR AB=(mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (mobile NEAR2 application*) OR (phone NEAR2 application*) OR app OR apps OR (mobile NEAR2 health) OR (mobile NEAR2 tech*) OR text* OR sms OR (text* NEAR2 messag*) OR (sms NEAR2 messag*) OR (wireless NEAR2 technologies) OR (tablet NEAR2 computers)) OR AK=(mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (mobile NEAR2 application*) OR (phone NEAR2 application*) OR app OR apps OR (mobile NEAR2 health) OR (mobile NEAR2 tech*) OR text* OR sms OR (text* NEAR2 messag*) OR (sms NEAR2 messag*) OR (wireless NEAR2 technologies) OR (tablet NEAR2 computers)) OR KP=(mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (mobile NEAR2 application*) OR (phone NEAR2 application*) OR app OR apps OR (mobile NEAR2 health) OR (mobile NEAR2 tech*) OR text* OR sms OR (text* NEAR2 messag*) OR (sms NEAR2 messag*) OR (wireless NEAR2 technologies) OR (tablet NEAR2 computers)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
#5 AND #4 AND #3 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years

CINAHL via EBSCO
TX (MH "Pregnancy+") OR (MH "Pregnancy, Unplanned") OR (MH "Pregnancy Outcomes") OR (MH "Pregnancy Complications, Psychiatric")
TX (MH "Prenatal Care") OR (MH "Perinatal Care") OR (MH "Perinatal Care (Saba CCC)+") OR (MH "Postnatal Period+") OR (MH "Postnatal Care+")
TX pregnan* or prenatal or pre-natal or perinatal or peri-natal or postnatal or post-natal or postpartum or post-partum or ((perinatal or prenatal or postpartum or postnatal) N2 care*) or ((peri-natal or pre-natal or post-partum or post-natal) N2 care*)
S1 OR S2 OR S3

TX (MH "Mental Health") OR (MH "Mental Disorders+") OR (MH "Mental Disorders, Chronic") OR (MH "Depression+") OR (MH "Depression, Postpartum") OR (MH "Anxiety+") OR (MH "Anxiety Disorders+") OR (MH "Stress Disorders, Post-Traumatic+") OR (MH "Stress") OR (MH "Stress, Psychological")
TX mental health* or wellbeing or well-being or (mental N2 health*) or psychology or psychiatry or psych* or depress* or anxiet* or anxi* or anxious* or stress* or posttrauma* or post-trauma* or trauma or PTSD
S5 OR S6
TX (MH "Smartphone") OR (MH "Text Messaging") OR (MH "Mobile Applications") OR (MH "Computers, Hand-Held+") OR (MH "Cellular Phone+") OR (MH "Computers, Portable+") OR (MH "Assistive Technology") OR (MH "Wireless Communications")
TX mhealth* or m-health*
TX (mobile or cell* or portable) N2 phone*) or cellphone* or cell-phone* or smartphone* or smart-phone*
TX (mobile N2 application*) or (phone N2 application*) or app or apps
TX (mobile N2 health) or (mobile N2 tech*)
TX text* or sms or (text* N2 messag*) or (sms N2 messag*)
S8 OR S9 OR S10 OR S11 OR S12 OR S13
S3 AND S7 AND S14

PTSDPUBS via ProQuest
MAINSUBJECT.EXACT.EXPLODE("Pregnancy") OR MAINSUBJECT.EXACT("Adverse Pregnancy Outcomes")
pregnan* OR prenatal OR pre-natal OR perinatal OR peri-natal OR postnatal OR post-natal OR postpartum OR post-partum OR ((perinatal OR prenatal OR postpartum OR postnatal) NEAR/2 care*) OR ((peri-natal OR pre-natal OR post-partum OR post-natal) NEAR/2 care*)
S1 OR S2
MAINSUBJECT.EXACT.EXPLODE("Mental Illness") OR MAINSUBJECT.EXACT("Mood Disorders") OR MAINSUBJECT.EXACT.EXPLODE("Psychiatric Disorders") OR MAINSUBJECT.EXACT.EXPLODE("Mood Disorders") OR MAINSUBJECT.EXACT.EXPLODE("Depressive Disorders") OR MAINSUBJECT.EXACT.EXPLODE("Anxiety Disorders") OR MAINSUBJECT.EXACT.EXPLODE("PTSD") OR MAINSUBJECT.EXACT.EXPLODE("Acute Stress Disorder") OR MAINSUBJECT.EXACT("(Stress Disorders)") OR MAINSUBJECT.EXACT("Prenatal Stress")
mental health* or wellbeing or well-being or (mental NEAR/2 health*) or psychology or psychiatry or psych* or depress* or anxiet* or anxi* or anxious* or stress* or posttrauma* or post-trauma* or trauma or PTSD
S4 OR S5
MAINSUBJECT.EXACT.EXPLODE("Computer Assisted Psychotherapy")
mhealth* OR m-health* OR ((mobile OR cell* OR portable) NEAR/2 phone*) OR cellphone* OR cell-phone* OR smartphone* OR smart-phone* OR (tablet NEAR/2 computer*) OR wireless OR (mobile NEAR/2 application*) OR (phone NEAR/2 application*) OR app OR apps OR (mobile NEAR/2 health) OR (mobile NEAR/2 tech*) OR text* OR sms OR (text* NEAR/2 messag*) OR (sms NEAR/2 messag*)
S7 OR S8
S3 AND S6 AND S9