



A Chilean survey of perinatal women and health care professionals' views towards perinatal apps

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Background: Women around the globe are increasingly engaging with pregnancy and parenting apps, almost becoming a routine part of the maternity experience. However, little is known about what perinatal women and health care professionals feel about those apps in Latin American countries, where the digital transformation has been slower but where digital technologies could also bridge gaps in access to quality health care.

Methods: This study aimed to assess views towards pregnancy and parenting apps in perinatal women and perinatal health care professionals in Chile through an online survey. In perinatal women, we explored app use, what they value in the apps they use, and what an “ideal app” would be for them. In health professionals, we explored opinions about women using perinatal apps and what they think a perfect app for their clients would be.

Results: The survey was completed by 451 perinatal women and 54 perinatal health care professionals. Results show that perinatal women in Chile frequently use perinatal apps, and they and health care professionals show a positive attitude towards them. The most valued attributes are information and monitoring of body changes during pregnancy, information and monitoring of the baby's development (in the uterus and after birth), information and tips on how to stay healthy, and having the possibility to interact with other women.

Conclusions: Perinatal apps are accepted by perinatal women and health care professionals in Chile. Some needs for an “ideal app” emerged. Participants mentioned the need to address mental health, including the mental health of their partner, and the need for support during the transition to parenthood.

Keywords: Pregnancy; parenting; mobile applications; perinatal health care professionals; mHealth

Received: 05 October 2022; Accepted: 06 January 2023; Published online: 16 January 2023.

doi: 10.21037/mhealth-22-37

View this article at: <https://dx.doi.org/10.21037/mhealth-22-37>

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Introduction

The increasing widespread ownership of mobile phones around the globe has prompted attention to the potential of smartphone apps for delivering health information and self-care (1). The market for health-related apps has proliferated, with pregnancy and parenting apps regularly featuring among the most popular (2). In China, a search in app stores identified 6,153 apps developed for maternal and child health care (3). Perinatal women are increasingly engaging with those apps, almost becoming a routine part of the maternity experience for many expectant and new mothers (4). Apps may be particularly attractive for obtaining information because of their convenience, immediacy, and ease of access (5).

Background on women and health professionals' attitudes towards perinatal apps

Studies show that more than half of perinatal women use perinatal apps and that the vast majority who have ever used one perceive them as useful or helpful (2,6,7). Seeking perinatal information seems to be the primary drive (2,4,6,7). Monitoring changes in pregnant women's bodies and the baby's development (in the uterus and after birth) according

to gestational age are highly valued app features from women's perspectives (2,6,8). On the other hand, perinatal apps also seem to provide reassurance and support when women feel worried about issues to do with their pregnancy or their infants (6,9). The ease of access and use appear as important aspects for user engagement, as well as tailoring and personalizing the platform and content related to women's interests (10).

Less is known regarding perinatal health professionals' views towards the perinatal apps available. Studies have focused chiefly on health professionals' attitudes towards health apps in general and in countries where they can be prescribed by medical professionals (11,12) or on apps from different health fields like nutrition or mental health (13). We found one review on midwives' attitudes towards information and communication technologies for pregnancy self-monitoring (14). However, none of the studies included in that review focused on apps. Nonetheless, the review showed midwives have ambivalent attitudes toward pregnant women using information and communication technologies for perinatal information and self-monitoring (14). Midwife's concerns were about the accuracy of the information that women access and use to inform their decisions and apprehensions around the negative impacts that it may have on the traditional health professional-woman relationship (e.g., disbelieving their advice).

Two studies have explored health professionals' views regarding nutrition and healthy lifestyle apps for antenatal care (10,15). In both, most professionals were optimistic and believed such apps could improve women's health. Some favorable aspects mentioned were the easy access provision to information, with the potential to reach a wider audience compared to traditional methods. However, concerns arose regarding the quality of the information provided, who would be responsible for ensuring that the information is of high quality, and the medico-legal risks of technology.

Another study explored health care professionals' views about the potential development of an app for reducing pregnant women's unnecessary emergency consultations (16). If a woman is feeling unwell or experiencing unspecific symptoms, such an app would execute a series of measurements and provide advice to consult a physician or give an all-clear without needing to see a doctor. The majority of the physicians surveyed were open to the development of such an app. In contrast, more than half of the non-physicians (such as midwives and nurses) categorically rejected such technology because of fear that actual emergencies are detected too late, lack of personal care for worried patients, and fear of replacement of the

Highlight box

Key findings

- Women and health care professionals in Chile perceive apps as useful for delivering information on a wide range of perinatal-related topics. The information must be accurate, evidence-based, and culturally sensitive.
- Some highly valued features are monitoring body changes during pregnancy, monitoring the baby's development (in the uterus and after birth), and interacting with other women through the app.

What is known and what is new?

- The above findings are similar to the ones reported in studies from more developed countries. This study shows that apps can also help improve the health of women and their children in countries with more recent technological developments and fewer health care resources.

What is the implication, and what should change now?

- Even though perinatal women report being satisfied with the existing apps, some requirements emerged. There is a need to consider mothers, babies, and family well-being (and not only medical health), for example, by promoting mother-baby bonding, supporting the couple's transition to parenthood, and addressing women's mental health.

human workforce by machines.

A promising tool for perinatal mental health care

As perinatal apps are highly valued and used by women, they might also be a promising tool for perinatal mental health care. When it comes to mental health, in addition to the lack of time in face-to-face clinical routine, other barriers to addressing it exist, like negative beliefs regarding perinatal mental disorders or limited access to mental health care (17-21). It has been proposed that apps could address perinatal mental health through strategies such as mental health promotion, mood screening, depression prevention, or depressive symptoms reduction (22,23).

Nevertheless, a study about perinatal health professionals' perspectives on mental health apps in maternal depression showed that their attitude towards them differs among health professions (24). All study participants perceived that apps might be helpful for screening, prevention, positive psychological intervention, and follow-up of maternal depression symptoms. However, mental health specialists (psychologists and psychiatrists) perceived them as less useful than midwives and doctors for diagnosis and treatment. Another study on mental health care professionals' attitudes towards using apps for general depression showed that professionals are positive when apps are evidence-based, but primarily for subclinical and mild depression instead of severe depression (13). From the side of perinatal women, a review and meta-analysis of trials that studied internet-delivered psychological interventions for clinical depression and anxiety in perinatal women provided support for both the acceptability and efficacy of those interventions (25). Suppose a massive implementation of a cost-effective app for perinatal depression prevention and early intervention. In that case, the overall impact could be substantial, resulting in improvements in public health outcomes and even contributing to the healthy development of the mothers' infants (26).

Perinatal health care in Chile

In Chile, health care is provided by public and private facilities. In 2007, a system of infancy protection called "Chile Crece Contigo" (Chile Grows with You) was created (27). This system is based on a management model that structures the differentiated deployment of programs, benefits, social services, health care, and education to support children's development from pregnancy to 9 years

old. According to the national health program, pregnant women should attend a minimum of seven prenatal health check-ups (28). In public health facilities, check-ups have a duration of 20 minutes and are conducted by midwives (or a gynecologist in case of high-risk pregnancy). In addition, pregnant women have access to an oral health program. Babies' first-year health check-ups are carried out at 15 days, 1 month, then monthly until 6 months, and every 2 months until 12 months old (28). Midwives conduct the first two check-ups, and nurses conduct the following. There is also one check-up with a nutritionist at 5 months and two check-ups with a dentist, at 6 and 12 months old. Children with delayed psychomotor development are referred to specialized care with a kinesiologist, family occupational therapist, or daycare educator (28). In private health facilities, prenatal and baby health check-ups are carried out on the same frequencies, but there are conducted by gynecologists and pediatricians.

Women attending public health facilities are screened universally for perinatal depression symptoms with the Edinburgh Perinatal Depression Scale (29), at the second pregnancy check-up and at the baby's 2- and 6-month checks (30). If there is a diagnosis suspicion, they are referred to further evaluation by a general practitioner or psychotherapist. In Chile, everyone diagnosed with depression has guaranteed access to treatment at low or no cost. Treatment comprises psychotherapy, alone or combined with pharmacotherapy (31). Despite all these measures, perinatal depression prevalence in Chile is high and is still underdiagnosed and undertreated (32).

Perinatal women's barriers to mental health care include misconceptions about mental disorders and psychotherapy, fear of being judged as an unfit parent, lack of time or energy, and issues with attending health care centers in person (21). Perinatal health practitioners' barriers include a lack of time for further psychological assessment and adequately communicating the diagnostic suspicion during check-ups, in addition to a lack of training in mental health (21). Public mental health providers' barriers include long waiting lists, lack of communication and continuity between perinatal and mental health, frequency and duration of sessions below international recommendations, and high rotation of professionals (21,33).

Digital development in Chile

Chile stands out among other Latin American countries because of its digital development and the growing

pervasiveness of smartphones used to connect to the internet (34). In December 2020, the mobile internet penetration reached 104.7 accesses per 100 inhabitants, and 94% of such access is linked to a smartphone (35). The country has the fastest average speeds in the region (36), and 90.4% of the mobile internet access correspond to 4G networks (35). In 2020, the Global System for Mobile Communications Association (GSMA) mobile connectivity index (37), which measures the performance of 170 countries against key enablers of mobile internet adoption, ranked Chile in the highest category (i.e., “leader”). Chile shares this category with countries like the USA, Canada, Australia, and Western Europe countries. Furthermore, Chile has an ambitious digital agenda in several areas, such as education, economic development, e-government, and digital rights (34,38,39), including the Telecommunication Development Fund to provide mobile connection in remotes areas (40).

The present study

The present study aimed to assess attitudes and preferences towards pregnancy and parenting apps in perinatal women and perinatal health care professionals in Chile. In perinatal women, we explored app use, what content and features they value in the apps they use, and what an “ideal app” would be for them. In health professionals, we explored opinions about women using perinatal apps and what they think a perfect app for their patients/clients would be. We hope our results will provide valuable information for developing apps and other digital tools for the perinatal period. As a secondary aim, we wanted to explore whether perinatal mental health would emerge as a topic of interest for an app.

Methods

Participants and procedure

Two versions of an online survey were built in Spanish: one for perinatal women and one for health care professionals. The survey with perinatal women was carried out between September and October 2020. The survey with perinatal health care professionals was undertaken in November 2020. This research was conducted through a secured online platform, and participants were recruited through posts and advertisements on social networks (Facebook and Instagram). Inclusion criteria to access the perinatal

women’s survey were (I) aged over 18 years old, (II) expecting a baby or having a baby under one year old, and (III) residing in Chile. As compensation, the women could participate in a raffle of three baby-carrying scarves by registering their email at the end of the survey. Inclusion criteria for the perinatal health care professionals’ survey were (I) professional or paraprofessional that works with pregnant or postpartum women (i.e., midwife, gynecologist, psychotherapist or psychiatrist specialized in perinatal mental health specialist, pediatrician, doula, breastfeeding consultant, or another role related to the perinatal period), and (II) residing in Chile. Perinatal health care professionals did not receive any compensation for their participation.

A total of 454 perinatal women agreed to participate in the study (went into the survey link and provided informed consent). Three women left the survey blank; thus, the data of 451 women are included. *Table 1* reports women’s characteristics. Women were between 19 and 47 (mean =31.5, SD =4.8) years old, 64.7% (n=292) were pregnant and 35.3% (n=159) had a baby between 0 to 12 months of age. Although 59.4% (n=268) came from the most habited region of the country (where the capital city is), women from all Chilean regions participated. Pregnant women were on average 22.9 (range, 2–40; SD =9.9) weeks gestation. Babies of postpartum women were, on average, 3.9 (range, 0–11; SD =3.1) months old. About a third of the sample (29.5%; n=133) had more than one child. Most perinatal women were in a couple relationship and had a high level of education.

A total of 57 perinatal health care professionals agreed to participate in the study (went into the survey link and provided informed consent). Three left the survey blank; thus, the data of 54 perinatal health care professionals are included, aged between 26 and 69 (mean =38.3, SD =9.0) years old. As with perinatal women, most participants came from the capital city region (66.7%). *Table 2* shows participants’ professions.

Measures

Survey for perinatal women

This survey explored:

- (I) Participants’ characteristics. Age, relationship status, educational level, region of residence, if pregnant (if first baby, weeks of gestation, pregnancy complications, number of children) or having a baby under one year (if first baby, baby’s age in months, baby’s health problems (*yes/no, which*

Table 1 Women’s sociodemographic information

Sociodemographic characteristic	%	N
Age (in years)		
18–24	9.8	44
25–34	63.0	284
35–44	26.8	121
≥45	0.4	2
Relationship status		
Living with partner	90.7	409
With a partner, not cohabitating	7.8	35
Without partner	1.6	7
Education level		
Uncompleted high school	0.4	2
High school degree	3.8	17
Uncompleted technical studies	2.2	10
Technical studies	6.0	27
Uncompleted college degree	11.1	50
College degree	47.0	212
Uncompleted postgraduate degree	10.9	49
Postgraduate degree	18.6	84
Pregnant	64.7	292
First baby	65.1	190
First trimester	19.0	55
Second trimester	43.3	125
Third trimester	37.7	109
With pregnancy complications	16.2	47
Mother of a baby between 0–12 months of age	35.3	159
First baby	33.3	53
Baby with health problems	12.6	20

one), number of children).

- (II) Perinatal apps use. Whether they have ever used an app available at one of the apps stores for accompaniment/care in the perinatal period (*yes/no; how many; for postpartum women: if they used more pregnancy apps/more parenting apps/or both equally*), if they have used one during the past month (*yes/no*), which ones (open-ended question, up to two apps), how often (*every day/almost every day/once or*

Table 2 Perinatal health care professionals’ professions

Profession/role	%	N
Psychotherapist specialized in perinatal mental health	51.9	28
Gynecologist	9.3	5
Midwife	9.3	5
Psychiatrist specialized in perinatal mental health	9.3	5
Doula	1.9	1
Pediatrician	1.9	1
Perinatal nutritionist	1.9	1
Other: “dentist”, “perinatal nurse”, “professional from daycare”, “kinesiologist”, “family doctor specialized in children”, “pediatric dentist”, “psychologist, breastfeeding and carrying baby consultant”, “psychologist and doula”	14.8	8

twice a week/two or three times a month/once a month), how they value their usefulness (*on a scale from 1 to 5*), and what aspects they find helpful or attractive (open-ended question).

- (III) Topics of an “ideal” app. What topics of the perinatal period would seem attractive to them in an “ideal” app for perinatal accompaniment/care (content), selecting a maximum of 4 from a list of “pregnancy topics” and another list of “postpartum topics” [e.g., “Information about giving birth”, “Mental health during the postpartum period (promotion of well-being, prevention or treatment of depression/anxiety)”] and ranking them. *Table 3* shows all topics.
- (IV) Features of an “ideal” app. What characteristics would they find attractive in an “ideal” app (e.g., “Information through photos, videos, or graphs”/“Allow uploading photos or videos”), selecting a maximum of 4 from a list and ranking them. *Table 4* shows the list of all features.
- (V) The “ideal app”. What would be “an ideal perinatal app” for the participants (open-ended question).

Survey for perinatal professionals

This survey explored:

- (I) Participants’ characteristics. Age, region of residence, profession (*midwife/gynecologist/pediatrician/psychologist specialized in perinatal mental health/psychiatrist specialized in perinatal*

Table 3 List of app topics

Pregnancy

Promotion of healthy habits and pregnancy care (nutrition, exercises, etc.)
 Risks during pregnancy and how to detect them
 Physical changes during pregnancy
 Mental health during pregnancy (promotion of well-being, prevention, or treatment of depression/anxiety)
 Development of the baby in the uterus
 Information about giving birth
 Couple relationship reinforcement
 Sexuality
 Pregnancy and COVID-19
 Other

Postpartum

Promotion of healthy habits and postpartum care (nutrition, exercises, etc.)
 Postpartum health risks and how to detect them
 Mental health during the postpartum period (promotion of well-being, prevention, or treatment of depression/anxiety)
 Development of the baby during the first year
 Taking care of the baby during the first year
 Breastfeeding
 Baby's sleep
 Attachment promotion and baby stimulation
 How to balance mom's needs and baby's needs (taking care of myself and taking care of the baby)
 Couple relationship reinforcement
 Sexuality
 Co-parenting, how to organize parenting with my partner
 Parenting and extended family
 Postpartum period and COVID-19
 Other

COVID-19, coronavirus disease 2019.

mental health/doula/breastfeeding consultant/perinatal nutritionist/other (which one: open-ended question).

- (II) Viewpoints about perinatal apps. What do they think about perinatal apps (open-ended question), what percentage of their patients/clients do they think use that kind of app (*from 0 to 100%*), and if they have ever suggested to a patient/client the use of a perinatal app (*yes/no, which one?*).

The same (III), (IV), and (V) sections from the survey for

perinatal women but asking about their patients/clients' needs (for example: *If you could design the "perfect app" for your patients/clients, how would that app be?*).

Both surveys, including the lists of app topics and features, were developed by the research team consisting of a Ph.D. professor expert in eHealth, a Ph.D. professor expert in perinatal mental health, and two Ph.D. candidates. A social worker who works with perinatal women also collaborated with the app topics list construction.

Table 4 List of app features

Information through text
Information through photos, videos, or graphs
Monitor pregnancy aspects (e.g., woman's body weight during pregnancy)
Monitor aspects of baby's care or development (e.g., body weight, sleep, breastfeeding)
Monitor woman's well-being/mental health (e.g., by asking about mood)
Deliver advice or feedback from information that women enter to the app (e.g., from responses to a questionnaire)
Allow uploading photos and videos
Send reminders (e.g., of clinician check-ups)
Send messages (e.g., giving advice or giving information about baby's development according to his age)
Allow personalization (e.g., of content, of notifications)
Offer entertainment (e.g., games)
Offer the possibility to interact with other parents through the app
Allow establishing personal goals and provide support for meeting them (e.g., allow women to establish the goal of doing exercise periodically and sending reminders or "awards")
Include relaxation or meditation exercises
Offer the possibility to interact with health care professionals to solve doubts
Provide information about places where women can receive health care or other services

Ethical considerations

The Health Sciences Ethical Committee of the Pontificia Universidad Católica de Chile approved the study (IRB: 00002886; protocol ID: 200429004). Participants gave informed consent using the format specified by the Ethical Committee. They demonstrated their agreement to participate using an online checkbox on the first page of the survey before continuing with the survey questions. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Data analysis

Descriptive statistics were used for participants' sociodemographic and quantitative data. Associations between sociodemographic characteristics and responses were analyzed through correlations or squared chi tests. Most selected topics and app features were defined as being selected by at least 30% of the sample. Inductive content analysis was used to identify response patterns in participants' written answers to open ended questions (41). Responses were downloaded from the survey platform into an Excel document. At first, the first author read all

responses to familiarize herself with the data. Then, the entire data set of answers to each open question was coded manually, giving full and equal attention to each data item. The researcher made no interpretation of the participants' responses. The emerging codes were listed in the Excel document in columns next to the responses and then marked the boxes when the code was present. A second revision of the entire database was carried out to refine the codes. A peer debriefing meeting was conducted with a researcher independent of the project to review the coding process. When the final list of codes (and their frequencies) was established, the codes were organized into categories and subcategories. Categories from the "ideal app" answers were divided into app features and app topics. App topics' categories were classified according to whether they were related to pregnancy, postpartum, or transversal to both periods (e.g., "perinatal mental health"). Two meetings were held between the first and the second author to review, refine, and name the categories and subcategories. Then, the third author reviewed the categories and subcategories map and provided feedback.

To highlight the most mentioned aspects, only the subcategories mentioned by at least 20 participants are

described in the “ideal app” results section. We also wanted to explore whether having more experience with apps influences what women want in an “ideal app”, as having seen examples may give a different perspective on what makes a good app. Figures S1,S2 display all “ideal app” categories and subcategories, and report distinctions by recent experience with perinatal apps. Quotations are presented in the text to provide transparency in the analytical process and credibility of the results. The quotations were translated into English with no grammatical corrections.

Results

Women’s perinatal apps use and perceived value

From the total sample, 67.8% (n=306) reported using a pregnancy or parenting app at least once last month. From those, about half reported using 1 app (56.2%, n=172), a third 2 apps (30.0%, n=92) and about a seventh 3 or more apps (13.7%, n=42). The frequency of app use is mostly between “almost every day” and “twice a week” (64.7%, n=198). Women that have used only one app rate it with a 4.2 score on average (range, 1–5, SD =0.7). When they used 2 apps or more, they rate the most used one with 4.3 (range, 1–5, SD =0.7) and the second one with 3.0 (range, 1–5, SD =1.0), on average. Use frequencies and app scores showed a positive correlation (Pearson’s r range: 0.18–0.31, P<0.05).

Regarding the perinatal period, 73.3% (n=214) of pregnant women reported using an app last month versus 57.9% (n=92) of those with a baby; this difference is statistically significant [$\chi^2(2, N=306) = 27.9, P < 0.001$]. When considering first-time mothers (pregnant or with baby), 76.9% (n=179) reported using an app last month; in contrast to 54.6% (n=114) of non-first-time mothers, this difference is also statistically significant [$\chi^2(2, N=293) = 50.5, P < 0.001$]. In pregnant women, use frequency and the number of weeks gestation showed a positive correlation (r=0.23, P=0.002). No association between use frequency and baby’s age (in months) was found in postpartum women.

When asked what they found most attractive or useful about the apps they use as an open-ended question, the most valued attribute is the information they receive through the app. Table 5 shows what women value in the perinatal apps they use. Information in the form of thematic articles (n=24) and advice or recommendations (n=71) was mentioned several times by perinatal women as valued.

“I like the orientation that it gives week by week of the changes

in pregnancy. As I am a first-timer, it gives me a certain idea of what to expect; it provides interesting articles about the period in which I find myself that have helped me to understand the whole process better.” (pregnant woman, 32 years old; pregnancy development week by week, pregnancy symptoms, thematic articles).

The most appreciated topics were the baby’s development in the uterus or after birth (n=209), pregnancy-related body changes week by week (n=151), and how to stay healthy during pregnancy and postpartum (n=51). Several women mentioned valuing having a forum with perinatal women (n=28).

“It helps me follow my pregnancy week by week (baby’s growth, what to expect each week, etc.), advises about nutrition or others, and has a forum where you can solve doubts and share concerns that arise... I love it because you can share info with other pregnant women who are more or less at the same gestational age. It is also a very reliable app since each article they upload is backed up by a health professional.” (pregnant woman, 33 years old; information in the form of advice or recommendations, pregnancy development, how to stay healthy during pregnancy and postpartum, forum with perinatal women, backed-up by health care professionals).

“It helps to know the stage of development that my baby has reached at three months, it has practical advice and a chat forum for concerns and to talk with other moms... during pregnancy, the same app was explaining the development of the baby in the womb and the changes in me as a future mom.” (postpartum woman, 28 years old; information in the form of advice or recommendations, baby’s development in the uterus or after birth, pregnancy development, forum with perinatal women).

Perinatal health care professionals’ viewpoints about perinatal apps

The professionals believe that, on average, a little more than half of their patients/clients use those kinds of apps (57.5%, range, 0–100%, SD =30.0%). However, there was high variability in the responses. When asked if they have ever suggested using those apps to their patients/clients, 26.3% responded: “yes” (n=15).

When asked their viewpoints about pregnancy and parenting apps in an open-ended question, most professionals expressed a positive attitude towards them. Most find that perinatal apps are a helpful tool (90.7%, n=49); however, the majority did not give more information about why they find them helpful. A few mentioned apps

Table 5 Women’s valued aspects of the perinatal apps they use

Valued aspects of perinatal apps	N
Valued general characteristics of the information provided by the apps	
In the form of advice or recommendations	71
Thematic articles	24
Including videos	11
Mainly visual (photos, illustrations, graphs)	13
Brief but also complete and varied	5
Up-to-date, evidence-based, or backed-up by healthcare professionals	4
Including testimonies of mothers	3
Valued topics included in the apps	
Fetus/baby development (intrauterine development and weight week by week; growth curve and development milestones of the born baby)	209
Pregnancy development week by week (body changes)	151
How to stay healthy during pregnancy and postpartum	51
Pregnancy symptoms (what to expect and when to call the doctor/midwife)	22
Breastfeeding	20
Baby stimulation	12
How to take care of a newborn	5
Information or advice for the partner	4
A pregnancy-related exams calendar	4
A list of what to buy for the expecting baby	4
A list of baby names	4
Information about giving birth	3
Other valued features	
A forum with perinatal women	28
Registering data into the app: pregnancy-related (e.g., woman’s weight, symptoms), medical appointments, baby-related (e.g., breastfeeding, sleep)	15
The possibility of uploading pregnancy photos	5

The valued aspects mentioned at least by three women are included.

are useful for delivering perinatal information (n=9) or creating a community between women (n=3).

“They are of great help as support to deliver information and generate a support network.” (psychotherapist specialized in perinatal mental health and doula, 52 years old; helpful tool, delivering information, creating community between women).

They also report recognizing them in line with the current technology development and digital spread (n=4).

“Very good resource considering that access to smartphones

has increased.” (psychiatrist specialized in perinatal mental health, 40 years old; Helpful tool, In line with the current technology development and digital spread).

Nevertheless, they perceive that the information delivered is not always accurate and that it is essential that it is evidence-based and up to date (n=4).

“I think they are a great platform, and women trust them, so designing safe and evidence-based apps seems essential.” (psychotherapist specialized in perinatal mental health and doula, 33 years old; helpful tool, needs to be evidence-based

and up-to-date).

On the other hand, a couple of participants reported that the apps should be culturally-sensitive (n=2).

“I think they are very useful for delivering information and general advice regarding the perinatal period... however, I think it is extremely important that the information is up-to-date, has scientific support, and is relevant to each country’s reality.” (psychotherapist specialized in perinatal mental health, 32 years old; helpful tool, needs to be evidence-based and up-to-date, needs to be culturally-sensitive).

Women’s and perinatal health care professionals’ app topics preferences

Table 6 shows the most selected pregnancy- and postpartum-related topics from the lists provided, with the percentage that chose it as one of the four they had to choose and the portion that rated it as the most essential. From the list of pregnancy-related topics, the most chosen ones by perinatal women were “Baby’s development in the uterus”, “Mental health promotion”, “Promotion of healthy habits and care” and “Information about giving birth”. The most chosen ones by perinatal health care professionals were the same. Regarding postpartum-related topics, the most chosen ones by perinatal women were “Breastfeeding”, “Development of the baby during the first year”, “Mental health promotion”, and “Taking care of the baby during the first year”. By health professionals, the most chosen ones were “Mental health promotion”, “How to balance mother’s and baby’s needs”, “Breastfeeding”, and “Attachment and stimulation”. All pregnancy-related and postpartum-related topics with their selection percentages are showed in Tables S1,S2, respectively.

Women’s and perinatal health care professionals’ app features preferences

Table 6 shows the most selected app features, with the percentage that chose it as one of the four they had to choose and the portion that rated the feature as the most essential. The most chosen ones by perinatal women were “Monitor aspects of baby’s care or development”, “Information through photos, videos, or graphs”, “Offer the possibility to interact with health care professionals to solve doubts”, and “Monitor pregnancy aspects”. Regarding perinatal health care professionals, the most chosen features were “Monitor woman’s well-being/mental health”, “Information through photos, videos, or graphs”, “Offer

the possibility to interact with health care professionals to solve doubts”, and “Offer the possibility to interact with other parents through the app”. All features with their percentages of selection are showed in Table S3.

The “ideal perinatal app”

The interested reader can find all the categories and subcategories that arose (mentioned by at least three participants) from the open-ended question about the “ideal perinatal app” topics and features in Figures S1,S2, respectively. This section presents the most mentioned (cited by at least 20 participants, whether perinatal women or health care professionals).

App interface and friendliness

The app interface should be very visual (with pictures, illustrations, graphs, or videos) (n=37), friendly, and easy to use (n=34), and allow some personalization (n=34).

“Very easy to use, simple, with explanatory videos” (midwife, 56 years old).

“Easy to use, with images and videos...” (pregnant woman, 35 years old).

“I would like it to be easy to use, placing my gestation data, to give me more precise information about my pregnancy” (pregnant woman, 20 years old).

Content characteristics

The content should include information about both pregnancy and postpartum (n=33), evidence-based or backed up by health care professionals (n=21), with relevant and up-to-date tips (n=46).

“An app where you can find important information on both the pregnancy and the first year of my baby’s life...” (pregnant woman, 27 years old).

“To include more postpartum issues because the apps focus more on pregnancy and breastfeeding, so an app that would talk about the postpartum period, which is by far the most difficult” (postpartum woman, 24 years old).

“...information on studies or articles medically backed...” (pregnant woman, 33 years old).

“An app with scientific facts, with up-to-date studies and advice from experts” (Pregnant woman, 28 years old).

Interaction with others

The participants would like the app to have the possibility to interact with both perinatal health care professionals (n=37) and other perinatal women (n=38).

Table 6 Most selected pregnancy-related topics, postpartum-related topics, and app features, with the percentage that chose it between the 4 they had to choose, and the percentage that rated it as the most essential between those 4

Topic/feature	% of perinatal women that choose it between the 4	% of perinatal women that rates it as the most essential	% of PHC professionals that choose it between the 4	% of PHC professionals that rates it as the most essential
Pregnancy-related topic				
Baby's development	69.8	14.2	40.4	7.0
Mental health promotion	41.9	12.9	71.9	43.9
Promotion of healthy habits	52.3	10.6	45.6	21.1
Giving birth	40.4	10.6	38.6	1.8
Postpartum-related topic				
Breastfeeding	50.1	16.6	42.1	12.3
Mental health promotion	43.2	16.6	64.9	40.4
Baby's development	45.0	14.2	–	–
Taking care of the baby	39.5	12.6	–	–
My needs/baby's needs	–	–	43.9	12.3
Attachment and stimulation	–	–	31.6	3.5
App feature				
Monitor aspects of the baby	42.8	15.1	–	–
Information through photos/videos	39.0	14.4	36.8	15.8
Interaction with professionals	41.5	10.9	50.9	12.3
Monitor pregnancy aspects	31.5	9.3	–	–
Monitor woman's well-being	–	–	40.4	21.1
Interaction with perinatal women	–	–	33.3	12.3

%, percentage; PHC, perinatal health care.

“A section where other parents can comment on their experiences... not at the expert level but to provide support” (postpartum woman, 20 years old).

“...a forum where mothers can share their experiences and receive feedback, both from an expert and from other mothers who have had the same experience” (pregnant woman, 32 years old).

“...with the option of interacting with others, professionals, and mothers and fathers going through the same stage, building a support network” (perinatal nurse, 39 years old).

Interaction with the app: the digital agenda

Adding some kind of digital “life diary” or digital agenda (n=31) for registering appointments, milestones, insights, etc., was mentioned several times by perinatal women,

especially postpartum women. Also, the possibility of adding appointment reminders was mentioned (n=22).

“Like a diary/planner that accompanies and supports the mother, (...) even a section of memories: “Today my son got his first tooth”, “Today he started crawling”, or the possibility to register symptoms to tell the doctor in the next check-up” (postpartum woman, 20 years old).

“I would also like it to serve as an agenda of medical appointments, with reminders” (pregnant woman, 28 years old).

Pregnancy-related topics and childbirth

Regarding the subjects what an “ideal perinatal app” should cover, the most mentioned pregnancy-related topics were how to stay healthy during pregnancy (n=64) and pregnancy development week by week, considering both woman’s

changes (n=64) and baby's development (n=57). Information about labor and giving birth was also mentioned (n=23).

"Information about nutrition, exercises, vitamins and how to take care of yourself during pregnancy" (pregnant woman, 41 years old).

"An app that shows week by week the changes my body is experiencing, which for me is especially important because it is my first pregnancy... and also to show the growth of my baby" (pregnant woman, 30 years old).

"Mention the different types of childbirth and how to communicate your desires, what my rights are, to show exercises to prepare the body for it" (pregnant woman, 23 years old).

"... with information on physical and psychological preparation for childbirth" (gynecologist, 34 years old).

Postpartum-related topics

Regarding the postpartum period, information about breastfeeding (n=46) was the most mentioned topic, followed by how to take care of a newborn (n=38), expected baby's development and milestones (n=24), baby stimulation activities (n=23), and how to stay healthy during the postpartum (n=20).

"I would highlight and encourage breastfeeding in the last trimester [of pregnancy] ..." (postpartum woman, 37 years old).

"Information about everything I need to know about how to take care of a newborn" (pregnant woman, 30 years old).

"With up-to-date information on all aspects of my baby's stage of development, what is expected in every health check-up" (postpartum woman, 29 years old).

"Advice on taking care of the baby in the first months (breastfeeding, sleep, baby's development, stimulation at each stage) and health tips for the mom" (postpartum woman, 34 years old).

Addressing mental health

Addressing women's mental health (n=58) was mentioned among perinatal women and health care professionals. Including mental health promotion strategies, psychoeducation, questionnaires for monitoring well-being, advice on dealing with perinatal depressive and anxiety symptoms, and information about when to get professional help were the most mentioned recommendations for mental health care.

"I would add a section on mental health, with activities to be carried that contribute to mental health well-being" (pregnant woman, 21 years old).

"Addressing mental health, which is lacking in existent apps" (pregnant woman, 34 years old).

"... with information about postpartum depression and how to deal with stress" (postpartum woman, 28 years old).

"Emotional well-being and mental health... an emotional support platform" (psychotherapist specialized in mental health, 37 years old).

"(...) with a significant focus in mental health" (psychotherapist specialized in mental health, 32 years old).

Addressing the partner and the couple relationship

Including women's partners and addressing the couple relationship (n=29) was mentioned among perinatal women and health care professionals. Participants would like the app to have sections targeting the partner directly or that any caregiver could use it. Perinatal women also want the app to address prenatal and postnatal couple adjustment.

"... with a section in the same app that includes fathers and allows them to learn about the process and the importance of their role in gestation, also creating a conversation forum for them" (pregnant woman, 32 years old).

"A friendly app that adapts to all types of people, both women, and men, (...) that offers advice to the mom, dad, or the couple itself" (pregnant woman, 23 years old).

Discussion

The study results show that many perinatal women in Chile are using perinatal apps. The frequency of use of the current app or apps is also high, and they report being satisfied with them. Health care professionals show a positive attitude towards perinatal apps, perceiving them as a potentially helpful tool for delivering up-to-date, evidence-based, culturally sensitive information. The most mentioned attributes for a perinatal app from both perinatal women's and health care professionals' perspectives are information and monitoring of body changes during pregnancy, information and monitoring of baby's development (in the uterus and after birth), information and tips on how to stay healthy during pregnancy, and having the chance to interact with other women through the app. Additionally, women who have used an app in the last month, both pregnant and postpartum, expressed the desire to have a single app covering the entire perinatal period.

Our results are similar to those reported in studies with perinatal women in other countries (2,5,9). The interested reader can find in [Table S4](#) the most mentioned attributes in at least two of the three following questions:

what aspects they found helpful or attractive in the apps available, what topics and features are more relevant for a perinatal app, and what would be an “ideal perinatal app”. The positive attitude of health care professionals towards perinatal apps and their concerns about the reliability and accuracy of their content has also been reported in other studies (10,14–16).

The results show that apps can complement the prevention, promotion, and early detection of difficulties present throughout the entire perinatal period. Moreover, the perspective of mothers and professionals is not so different on what an app should look like and what its content and features should be. The last suggests that it is possible to develop an app that would be valued by both groups, increasing the chances of the app being implemented and used. The importance given to the baby and its development, to mother-baby bonding, and parenting gives an opportunity for the prevention and promotion of infant health. The results show a comprehensive view of motherhood from perinatal women, including psychological aspects of both the mother and the baby and not only medical health. Furthermore, women who used a perinatal app last month mentioned more frequently the need to include in an ideal app information about respectful maternity care during labor and childbirth and on promoting a good relationship with their babies.

Moreover, mental health was a highly valued topic to be included in an ideal app, which seems to be under-addressed from the perspective of both perinatal women and health professionals in the apps available. A recent review on apps for the first year of parenthood also identified supporting parents’ mental health as a need not being addressed in parenting apps (42). The fact that both perinatal women and health care professionals are open to this content is an opportunity for mental health promotion, prevention, and early intervention. Apps could help alleviate some pressure put on in-person health care services and overcome barriers to help-seeking, providing an alternative or complementary option for widespread perinatal mental health care provision (23). If massively implemented, the overall impact on public mental health outcomes could be substantial, even contributing to the healthy development of the mothers’ infants (26).

The need to include the partner or the other parent and the couple’s relationship highlights its fundamental role. Including the partner in the apps and not addressing the mothers exclusively regarding infant care probably will contribute to balancing the load placed on mothers

and promote co-parenting. Supporting the couple during the transition to parenthood or the addition of a new infant has also been identified as a need in a review on the use of parenting apps (42), and it seems of great importance for the whole family’s health. On the other hand, considering the association between social support and parenting stress (43), an app should also emphasize the importance of strengthening the social network and guiding on how to do so (e.g., training communication skills). Furthermore, many participants wanted to include peer contact as an app feature, so they seemed open to social support through digital technologies.

Aligned with the need expressed by both women and professionals for the app to be evidence-based and up to date, it is essential to mention that while health apps can benefit consumers by improving access to information, they can also pose safety risks if they are inaccurate and unreliable. Regarding this matter, Boulos *et al.* (44) [2014] and Akbar *et al.* (45) [2020] made several recommendations: (I) ensuring app content is based on the available evidence, adequately referenced, and kept up to date, (II) involving subject matter experts and consumers in app development, (III) conducting usability tests so that users can provide insights about app functionality and medical reliability, (IV) studying the app for its efficacy and safety, (V) having a competent and qualified entity in the country or region that regulates and monitors health apps to address safety concerns, especially if the app works as a medical device (e.g., interpreting data). In Chile, there is no legislation on the development and implementation of health apps, nor a government entity dedicated to regulating this (46). However, the National Center for Health Information Systems (CENS) is a non-profit corporation dedicated to promoting the development of health-related technologies in the country (46). Among other functions, they provide certification to the developments that meet specific quality criteria (47).

Our study has some limitations. First, this study was conducted during the coronavirus disease 2019 (COVID-19) pandemic. Even though the percentages of pregnant and postpartum women that have used a perinatal app last month are very similar to the ones reported by a study conducted in Australia before the pandemic (2), the use of perinatal apps in Chile may have increased because of it. The reduced number of medical consultations because of the restrictions, the feeling of uncertainty, the loss of social support, and increased anxiety (48) may have encouraged women to use them for information and support. However, if, during the pandemic, more women used apps that they

would not have used otherwise (i.e., were less experienced with apps in general) and overall participants are satisfied with them, this may strengthen the conclusion that apps can be valuable. Second, there are some limitations regarding perinatal women demographics, which limit the generalizability of the results. Most perinatal women who participated had high education levels (and probably a high income) and were in a couple's relationship. In particular, lower socio-economic backgrounds have been reported to have lower perinatal app uptake rates (4,49). A challenge for future studies would be how to reach lower-income women. Fourth, there are some limitations regarding the representation of health care professionals, which limit the generalizability of the results. Most health care professionals that participated in the survey were psychotherapists specialized in perinatal mental health. The last probably happened because the recruitment was carried out through social media posts and advertisements that were shared or re-posted by many accounts that had some relation with perinatal mental health. Future studies should include other recruitment strategies to reach a more diverse sample of perinatal health care professionals. The large proportion of mental health professionals most probably increased the frequency of responses about the importance of addressing mental health. However, this topic was also among the top ones for perinatal women.

Conclusions

In conclusion, perinatal women in Chile frequently use perinatal apps, and health care professionals show a positive attitude towards them. Both perceived that apps hold promise for addressing a wide range of topics, ensuring that the content is accurate, evidence-based, and culturally-sensitive. They are also seen as a tool for providing support by interacting with experts and other parents. Even though perinatal women are very satisfied with the available apps, some needs emerged in this study. We wanted to explore if mental health would appear as a topic they would be interested in for a new app; indeed, it was frequently mentioned by both target groups. Additionally, other aspects associated with well-being and self-care emerged, like including the partner or the other parent and supporting the couple's relationship transition to parenthood. We hope our results will be of value to perinatal health care professionals and researchers looking for new ways of supporting women during the perinatal period.

Acknowledgments

Funding: This work was funded by the ANID-Millennium Science Initiative Program/MIDAP ICS13_005. PF received funding from the Chilean National Agency for Research and Development (ANID)/Scholarship Program/Doctorado Nacional/2019–21190745. AM received funding from the Chilean National Agency for Research and Development (ANID)/Scholarship Program/Doctorado Nacional/2020–21200074.

Footnote

Data Sharing Statement: <https://mhealth.amegroups.com/article/view/10.21037/mhealth-22-37/dss>

Conflicts of Interest: The authors have completed the ICMJE uniform disclosure form (available at <https://mhealth.amegroups.com/article/view/10.21037/mhealth-22-37/coif>). PF reports receiving funding from the Chilean National Agency for Research and Development (ANID)/Scholarship Program/Doctorado Nacional/2019–21190745. PF reports that ANID-Millennium Science Initiative Program/MIDAP ICS13_005 funded the article processing charge. AM reports receiving funding from the Chilean National Agency for Research and Development (ANID)/Scholarship Program/Doctorado Nacional/2020–21200074. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The Health Sciences Ethical Committee of the Pontificia Universidad Católica of Chile approved the study (IRB: 00002886; Protocol ID: 200429004). Participants gave informed consent using the format specified by the Ethical Committee. They demonstrated their agreement to participate using an online checkbox on the first page of the survey before continuing with the survey questions. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

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doi: 10.21037/mhealth-22-37

Cite this article as: Franco P, Olhaberry M, Kelders S, Muzard A. A Chilean survey of perinatal women and health care professionals' views towards perinatal apps. *mHealth* 2023;9:7.

Supplementary

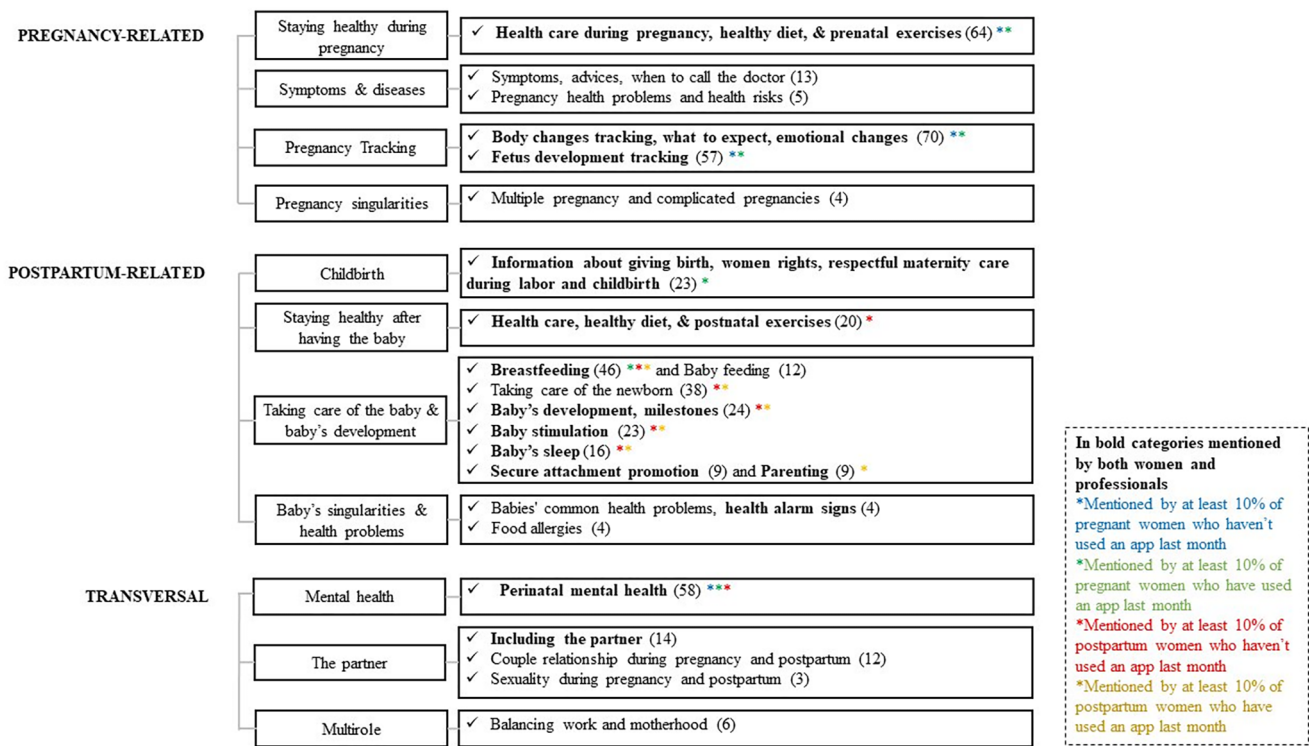


Figure S1 App topics' categories and subcategories that arose (mentioned by at least three participants) from the open-ended question about the "ideal perinatal app". Note: subcategories mentioned by at least three participants are included. There were no subcategories mentioned only by health care professionals.

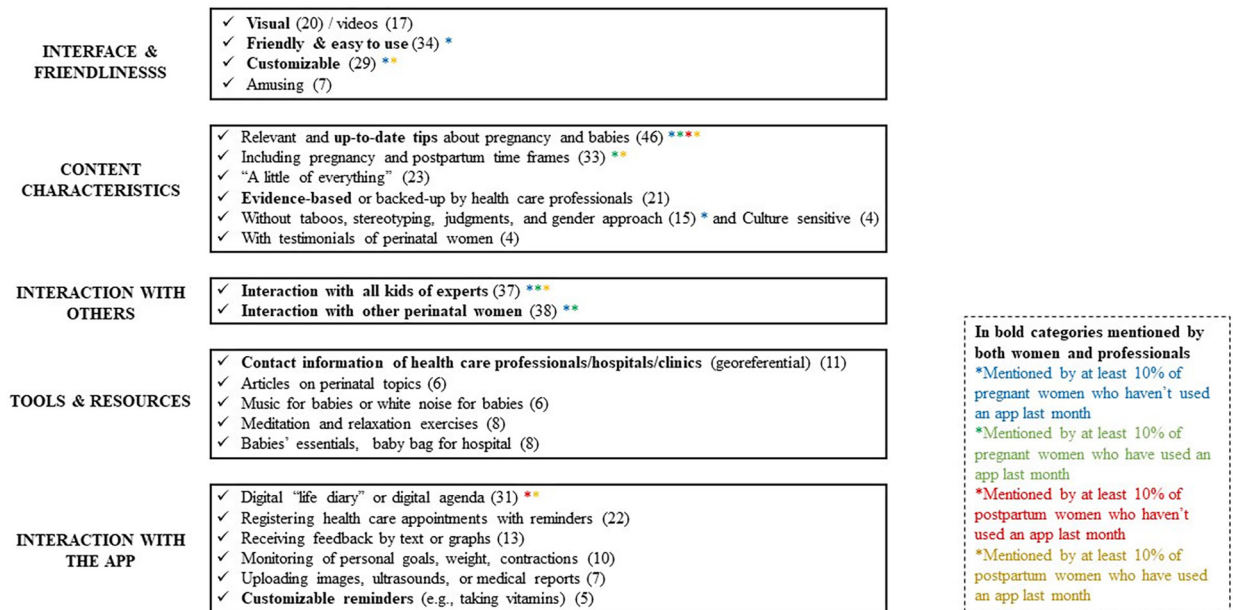


Figure S2 App features' categories and subcategories that arose (mentioned by at least three participants) from the open-ended question about the "ideal perinatal app". Note: subcategories mentioned by at least three participants are included. There were no subcategories mentioned only by health care professionals.

Table S1 Pregnancy-related topics with the percentage that chose each one between the four they had to choose

Topic	% of perinatal women that choose it between the 4	% of perinatal health care professionals that choose it between the 4
Development of the baby in the uterus	69.8	40.4
Mental health during pregnancy	41.9	71.9
Promotion of healthy habits	52.3	45.6
Giving birth	40.4	38.6
Physical changes during pregnancy	39.7	27.8
Risks and how to detect them	34.8	18.5
Sexuality	17.5	11.1
Couple relationship	16.0	29.6
Covid and pregnancy	8.6	13.0
Other	6.2	19.0

Responses to “Other”: (I) *how to manage pregnancy when you have more than one child*; (II) *how to prepare the other children for the arrival of a new sibling*; (III) *advice on brands for baby products*; (IV) *calendar of health check-ups and vaccines*; (V) *health check-ups and what is expected*; (VI) *education and management of pregnancy aimed at men*; (VII) *prenatal exercises*; (VIII) *pregnancy and work*; (IX) *stimulation in pregnancy*; (X) *calendar of pregnancy health exams*; (XI) *lack of support network (due to the quarantine, I am pregnant alone, without friends or family, only my partner)*; (XII) *forum for opinions of doctors, midwives, and doulas...*; (XIII) *twins*; (XIV) *list of hospitals and clinics that have the “respected delivery” modality*; (XV) *it would include physical activities that can be done, accompanied by food advice and a calendar of pregnancy checks*; (XVI) *childbirth preparation information*; (XVII) *breastfeeding*; (XVIII) *I wouldn’t use an app*; (XIX) *humanized childbirth*; (XX) *humanized childbirth and obstetric violence*; (XXI) *breastfeeding preparation*; (XXII) *problems in the last third, such as bradycardia*; (XXIII) *products for mother and baby recommended in Chile*; (XXIV) *let them talk about the not-so-nice changes; most only talk about weight gain and not about stretch marks or hemorrhoids*; (XXV) *sexuality*; (XXVI) *usual symptoms and when to go to the emergency*; (XXVII) *all previous*; (XXVIII) *all the items above are important; you have so many fears that you don’t know where to start*; (XXIX) *I would use an application that gives me all the information mentioned*; (XXX) *pelvic floor care*; (XXXI) *grief, I wouldn’t know how to address it in an app, but I think it’s something to make visible because if it isn’t again as something that “isn’t going to happen to you” when it can... and parenthood!!! Why not prepare for it from pregnancy???*; (XXXII) *pregnancy and mother-baby bond*; (XXXIII) *stress reduction tools!!!*; (XXXIV) *body image and self-esteem*; (XXXV) *breastfeeding, given that the gap between the information they receive versus the results of breastfeeding a posteriori is highly significant*; (XXXVI) *nipple preparation for breastfeeding*; (XXXVII) *post-abortion puerperium*; (XXXVIII) *all dental issues that are important and a part of women’s health that is not considered here. Nor are the recommendations for infants, adults, and children for oral prevention, healthy habits, oral functions, etc.*; (XXXIX) *prenatal bond, as a protective factor of maternal experience and attachment mother and baby.*

Table S2 Postpartum-related topics with the percentage that chose each one between the four they had to choose

Topic	% of perinatal women that choose it between the 4	% of perinatal health care professionals that choose it between the 4
Breastfeeding	50.1	42.1
Mental health promotion	43.2	64.9
Baby's development	45.0	13.0
Taking care of the baby	39.5	24.1
Attachment and stimulation	36.8	31.6
Promotion of health habits and care	29.9	13.0
How to balance my needs/baby's needs	26.6	43.9
Baby sleep	26.6	22.2
Postpartum health risks	11.8	1.9
Co-parenting	9.1	24.1
Sexuality	8.4	7.4
Covid and postpartum	3.1	1.9
Parenting and extended family	1.1	1.9
Other	2.0	0

Responses to "Other": (I) *add activities for early stimulation, and a list of things that the baby should learn according to his age so that parents can check his development*; (II) *calendar or diary on pediatric controls*; (III) *growth spurts*; (IV) *I would choose almost all*; (V) *mark milestones to save them, such as weight, height, first tooth, first crawl, etc.*; (VI) *I would love a real-time notice of promotions of baby products in supermarkets. For example, let me know that there is a diaper sale that day in a particular supermarket. It would be very useful*; (VII) *I wouldn't use an app*; (VIII) *postpartum recovery, whether vaginal delivery or cesarean section*; (IX) *sexuality*; (X) *all the items above are important because sometimes you don't know what you're doing wrong until you read about it*.

Table S3 App features with the percentage that chose each one between the four they had to choose

Feature	% of perinatal women that choose it between the 4	% of perinatal health care professionals that choose it between the 4
Monitor aspects of the baby	42.8	13.0
Information through photos/videos	39.0	15.8
Interaction with professionals	41.5	50.9
Monitor pregnancy aspects	31.5	7.4
Deliver advice or feedback	31.0	38.9
Include relaxation/meditation exercises	19.5	25.9
Information through text	19.1	9.3
Send messages	16.4	0
Monitor woman's wellbeing	15.7	42.6
Allow personalization	15.5	11.1
Send reminders	14.0	7.4
Interaction with other parents	11.8	35.2
Allow establishing personal goals	8.6	1.9
Information about health care services or other	8.0	18.5
Allow uploading photos and videos	2.9	1.9
Offer entertainment	1.8	0
Other	1.4	0

Responses to "Other": (I) *focus more on potential problems than the "pink life" of pregnancy*; (II) *save personal and baby milestones*; (III) *I wouldn't use an app*; (IV) *to provide help or advice (if not, contact advisers) on risks of pregnancy (in case of suffering something) and post-partum problems (such as breastfeeding coupling, how to calm a baby, baby carriers)*; (V) *fill in the personal data of size and weight of the baby and have projections, something more personalized*; (VI) *information about different types of childbirth. Also, an ideal menu for pregnant women would be great*; (VII) *all items are great to be included*.

Table S4 Summary of the most relevant aspects mentioned throughout the survey

Aspect	Valued aspects of current apps	Chosen from pregnancy- and postpartum-related lists	Chosen from the app features list	Ideal app features & topics
Visual interface			W P	W P
Evidence-based information	P			W P
Information in the form of advice or recommendations	W P			W P
How to stay healthy during pregnancy	W	W		W P
Pregnancy development week by week	W		W	W P
Baby in uterus development week by week	W	W	W	W P
How to stay healthy during pregnancy	W	W		W P
Information on labor and giving birth		W		W P
How to stay healthy during postpartum	W			W P
Taking care of a newborn		W		W
Information about breastfeeding		W P		W P
Baby's development and milestones		W	W	W P
Attachment promotion and stimulation exercises		P		W P
Mental health promotion in pregnancy		W		W P
Mental health promotion in postpartum		W P		W P
Enabling interaction with other perinatal women	W		P	W P
Enabling interaction with perinatal professionals			W P	W P

Categories mentioned by at least 20 participants. W = mentioned by mostly perinatal women; P = mentioned by mostly perinatal health care professionals; W P = mentioned by perinatal women and perinatal health care professionals.