

The role of menstrual apps in healthcare: provider and patient perspectives

Bryndl E Hohmann-Marriott, Tiffany Williams, Jane E Girling

ABSTRACT

AIM: This study aimed to understand the role that menstrual apps (“period tracking apps” or “fertility apps”) could perform in healthcare.

METHODS: Expert stakeholders including healthcare providers, app users, and patients offered perspectives on potential benefits, concerns, and role of apps in healthcare. Responses from an online qualitative survey ($N=144$) and three online focus groups ($N=10$) were analysed using reflexive thematic analysis.

RESULTS: The role of menstrual apps in healthcare could include keeping a record of cycle dates and symptoms and assisting in the management of menstrual disorders, diseases and conditions linked to the menstrual cycle such as endometriosis, PCOS, infertility, and perimenopause. Respondents are using app calendars and symptom tracking to improve communication between healthcare providers and patients, while also expressing concerns about inaccuracies and other uses of data. Respondents wished for assistance in managing their health, while noting that apps currently are limited and suggesting that apps need to be better suited to Aotearoa New Zealand specific menstrual disorders, diseases and life stages.

CONCLUSIONS: Menstrual apps may have a role in healthcare, but further research needs to develop and evaluate app functions and accuracy as well as providing education and guidelines for whether and when apps are appropriate for healthcare.

Digital mobile applications (apps) for tracking menstrual cycles, also known as “period tracking apps” and “fertility apps”, are a widely used and rapidly growing area of mobile health and digital health, with over 500 million downloads worldwide.¹ These menstrual apps position themselves as contributing to health and wellbeing. Some types of information collected by menstrual apps, including last menstrual cycle (LMC) and menstrual symptoms, are used in healthcare for diagnosis of menstrual disorders and diseases linked to the menstrual cycle, such as abnormal uterine bleeding.^{2,3} Most menstrual apps offer features that purport to assist fertility and conception such as predictions of ovulation timing and the “fertile window”.^{4,5} Some offer their users screening and clinical advice for endometriosis, polycystic ovary syndrome (PCOS), and menopause.^{6,7} While we do know that menstruators are using these functions in their apps,^{8,9} including menstruators in Aotearoa New Zealand and those with menstrual disorders,^{10,11} it is unknown whether healthcare providers or patients rely on apps as a record of menstrual cycles or other information.

Menstrual tracking apps offer benefits but also risks

To perform their functions, most menstrual tracking apps require users to input informa-

tion at signup (e.g., typical cycle length) and users are requested to input ongoing information about dates of menstruation.¹² Apps may also allow users to track a variety of symptoms (e.g., amount of bleeding, pain, mood). Apps will usually have an interface showing users the past dates and symptoms they have logged, arranged by calendar and/or cycle.¹² Most apps have algorithms that produce predictions and suggestions for users. This process is not transparent, as algorithms are treated as commercially sensitive and not revealed.⁴ There appear to be two types of predictive algorithm used by apps:⁵ (1) period tracking algorithms, which take user-input dates of menstruation along with standardised information about menstrual cycles and ovulation timing, and (2) fertility algorithms, which incorporate user-input menstruation dates along with one or more user-input physiological indicators of ovulation (e.g., temperature, urine test, cervical fluid). Both types of predictive algorithms offer estimates of date of next menstruation and date of ovulation,^{4,5,13} although these estimates have questionable accuracy.^{4,13,14} Another issue is that the information collected and created by apps may be leaked, sold and shared, revealing sensitive personal information to marketers, law enforcement, and others.¹⁵

Symptoms related to menstrual cycles have substantial effects

Menstrual disorders and diseases are of substantial concern in Aotearoa New Zealand and worldwide. Endometriosis, an inflammatory disease where tissue resembling the endometrium is present outside the uterus,¹⁶ affects approximately 11% of reproductive-age women and can cause severe and chronic pain, organ damage and infertility.^{17,18} PCOS, a chronic condition defined by androgen excess and ovarian dysfunction, is one of the most common endocrine and metabolic disorders among women and is also linked with infertility.¹⁹ Infertility, when pregnancy is not established after 12 months of regular unprotected sexual intercourse or where a person's capacity to reproduce is impaired,²⁰ can have multiple causes and is experienced by up to 26% of women in Aotearoa New Zealand who attempt to become pregnant.²¹ Everyone with cycles will eventually experience the cessation of their cycles at menopause, with the years leading up to menopause frequently associated with debilitating symptoms.²² For all of these menstrual disorders, symptoms are frequently unrecognised or misdiagnosed, with research consistently finding that the concerns and experiences of women and reproductive health patients are dismissed.^{23,24} Diagnoses often take considerable time; for instance, recent data from Aotearoa New Zealand suggests a diagnostic delay of 8.7 years for endometriosis.²³ Delays in diagnosis lead to increased severity, prolonged pain, decreased quality of life and psychosocial distress.²⁵ Further, the economic burden from healthcare costs and loss of productivity is substantive at both individual and population levels.^{26,27} To more effectively diagnose, treat and manage menstrual disorders and diseases, patients are pleading for better options.²⁶

Aim and research question

Menstrual disorders and diseases linked to the menstrual cycle could potentially be addressed by digital health applications; however, an understanding of potential possibilities and limitations is lacking. Our study aims to understand menstrual tracking apps and menstrual disorders and diseases in Aotearoa New Zealand, and begins by asking the question: how do expert stakeholders, including healthcare providers, app users and patients, view the role of menstrual apps in healthcare?

Methods

Study design

Our study involved an online qualitative survey followed by online focus groups. Ethical approval for the study was granted by the University Human Ethics Committee (reference: #D21/418).

Recruitment

The study aimed to engage experts and stakeholders with an interest in menstrual tracking applications and menstrual disorders and diseases including endometriosis, PCOS, infertility, and menopause, namely healthcare providers, patients, app users, app developers or regulators, and researchers. A purposive sampling technique was used to recruit participants. First, a list of individuals and organisations who fit the study aim was generated by the research team. The researchers then sent email invitations, which organisations shared with their members via newsletters or social media. All invitations included links to study information and the online survey. At the end of the online survey there was a link to a separate form (to ensure anonymity of survey responses) where respondents could register interest in participating in a focus group. Respondents were considered eligible to participate in this study if they were aged 18 years or older and gave consent based on the participant information provided.

Qualitative survey

The purpose of the survey was to gather initial perspectives from those who may be interested in participating in a focus group, and to give those who could not participate in a focus group the chance to share perspectives. Our online qualitative survey was hosted on Qualtrics and open for four weeks in February 2022. Following participants' consent to participate in the study, the survey asked demographic information and open-ended questions related to menstrual tracking apps. Respondents were able to opt-out of any question. The three key questions focused on 1) perceived benefits; 2) perceived concerns; and 3) the potential role of menstrual apps in healthcare.

Focus groups

Focus groups were held to expand on and enhance understanding of the online survey responses. All interested respondents were invited via email to a focus group held over a two-week period in March/April 2022. Three focus groups

were hosted on Zoom and followed a semi-structured format. Verbal confirmation of consent to participate in the study and permission to audio-record was sought prior to commencement. Preliminary results from the online survey were shared with focus group participants to prompt relevant discussion. Participants received an electronic gift card to acknowledge their contribution.

Analysis

Qualitative survey responses and focus group discussions were analysed using Braun and Clarke's Reflexive Thematic Analysis.²⁸ Our analysis took a critical realist and semantic approach that focused on the explicit and overt content of the responses. We answered our research question by following the six steps of analysis:²⁸ To 1) *familiarise ourselves with the dataset* we read all survey responses and focus group transcripts, then 2) *coded* data using NVivo12.²⁹ The codes were used to 3) *generate initial themes*, which we 4) *developed and reviewed* by discussing with team members, checking against the data, and revising. Finally, we 5) *defined and named themes*, and 6) *wrote up the themes*.

Results

Respondents

We received 144 responses to the online qualitative survey. Just under half (45%) were participating as app users, one-quarter (26%) were healthcare providers, 17% were patients/health advocates, 3% were researchers, and 3% were app developers or regulators. Respondent ages ranged from 19–55 years and 92% identified their gender as female. Ethnicity was identified by 80% as NZ European, 6% as Māori and 1% as Pacific peoples. About half (49%) had ever used a menstrual app, with the most common being Flo and Clue, and 94% reported that they had knowledge and/or experience with one or more of menstruation, endometriosis, PCOS, infertility, and peri/menopause. A table of participant characteristics is included in Table 1.

Of the survey respondents, 37 individuals expressed interest and were invited to participate in a virtual focus group, held on Zoom. A total of 10 participants attended three focus group sessions (Healthcare Providers Group, $n=4$; App Users Group A, $n=3$; App Users Group B, $n=3$).

Role of menstrual apps in healthcare

The analysis began by considering all responses to the survey and focus groups to understand respondents' overall views on the role of men-

strual apps and their medical information in healthcare. We found four main roles described by participants: record-keeping, management, self-knowledge and self-diagnosis. The first two roles were described consistently and had wide agreement, and these will be the focus of the current paper. The more complex and ambiguous roles of self-knowledge and self-diagnosis will be explored in a further article.

Menstrual apps as record-keeping

Analysis of survey responses and focus group discussions relating to the role of apps in record keeping developed three main themes: 1) *Keeping a record of past cycle dates and symptoms*; 2) *Showing cycle dates and symptoms to healthcare providers*; and 3) *Problems with record keeping using apps*. These themes are described in the following text and illustrative quotes are given in Table 2.

Keeping a record of past cycle dates and symptoms was recognised most consistently by respondents as a positive function of menstrual apps. The calendar aspect was mentioned as helpful by all types of participants, including app users and healthcare providers. Participants noted that apps may offer improvements over other methods of cycle histories. Apps are convenient and “easy to track as it's on my phone, I never did it reliably on the calendar.” A participant in the healthcare provider focus group made the comparison that “in the old days, you'd be told to write down things and keep a diary, and I thought it was always very difficult to do. And so now it seems like actually, you could just log that ‘I had tummy pain on these days’.” Participants also described apps as more accurate than memory when taking cycle histories: “It remembers; I am amazed at how quickly time moves on and how easy it is to forget when your periods were last”; and particularly for those with irregular cycles: “I have PCOS so I find it handy to be able to track my periods as sometimes I can go months without having one.” Further, participants noted that apps offer the option of recording symptoms. Respondents described menstrual apps allowing for “better habits of tracking to start monitoring holistic symptoms,” such as supporting users “to record issues with pain or other symptoms.” The symptom options in apps may be unsuitable, however. For some users, there were too many options: “I thought the apps had an overwhelming number of fields, making it more difficult to find the info I was interested in.” Conversely, other users expressed that they “need more options i.e., where pain is located.”

Table 1: Descriptive characteristics of online qualitative survey respondents

		N	%
Expertise			
App user		65	45
Health professional		37	26
Patient or health advocate		24	17
Researcher		5	3
App developer, evaluator and/or regulator		4	3
No response		9	6
Total		144	100
Age			
Range		19–55	
Gender			
Female		132	92
Male		1	1
Another gender		3	2
No response		8	6
Total		144	100
Ethnicity			
NZ European		115	80
Māori		8	6
Pacific peoples		2	1
Asian		2	1
Other/no response		17	12
Total		144	100
Menstrual apps			
Flo		36	51
Clue		21	30
Period Tracker		4	6
Other ¹		10	14
Total		71	49
Knowledge/ Experience	One or more of: menstruation, endometriosis, PCOS, infertility, peri/menopause	136	94

¹Other apps: My Calendar, Period Diary, Balance, Apple Health, Fitbit, Lily, Ava, Daysy, Kindara.

Table 2: Menstrual apps as record-keeping – illustrative quotes from survey respondents.

Theme 1: Recording past cycle dates and symptoms
Convenient to enter and view data
<i>Easy to track as it's on my phone, I never did it reliably on the calendar</i>
<i>Easy to add data to, with you whenever you need it, has information on the app</i>
Accurate record of past cycle dates
<i>Months fly by quickly and keeping a reminder of my cycle is why I use an app</i>
<i>It remembers; I am amazed at how quickly time moves on and how easy it is to forget when your periods were last</i>
<i>Helps keep track of more accurate data re: cycle length etc</i>
<i>They provided a useful record to look back on and compare my (irregular) cycles from month to month</i>
<i>I have PCOS so I find it handy to be able to track my periods as sometimes I can go months without having one</i>
Recording symptoms
<i>Allows for better habits of tracking to start monitoring holistic symptoms</i>
<i>Simple way of monitoring menstruation cycle and the symptoms accompanying it</i>
<i>To record issues with pain or other symptoms</i>
<i>Easy to add symptoms and self-assess severity</i>
<i>Track a large range of symptoms associated with the cycle</i>
<i>I can track anything menstrual cycle, IBS [irritable bowel syndrome] and migraine stuff</i>
<i>Can track symptoms over all cycles (from start of documentation)</i>
Unsuitability of recording symptoms
<i>I thought the apps had an overwhelming number of fields, making it more difficult to find the info I was interested in</i>
<i>Sometimes asks for too much information (like all the associated symptoms of bloating, acne blah blah, I don't care about those)</i>
<i>Need more options, i.e., where pain is located</i>
Theme 2: Showing cycle dates and symptoms to healthcare providers
Calendar history
<i>Help improve communication in consultation</i>
<i>Easy to share the information tracked with specialist</i>
<i>One stop shop for years of records when seeing specialists</i>
<i>If you have any problems there is a good record to share with your health professional</i>
<i>Having a chronological reference of the dates and length of my periods when I need that info for doctors etc</i>
<i>Easy to track symptoms/side effects of periods to take to the GP [general practitioner]/ specialists when trying to work out why everything hurts</i>

Table 2 (continued): Menstrual apps as record-keeping – illustrative quotes from survey respondents.

Theme 2: Showing cycle dates and symptoms to healthcare providers
Calendar history
<i>They could provide a longitudinal report of women's health for HCPs [healthcare providers] to draw from instead of simply treating symptoms</i>
<i>As a practitioner myself I find it super helpful to look through the history of the app if a woman presents with inconsistent periods, infertility or even pregnancy that needs to be dated</i>
Credible evidence
<i>As a doctor, it gives me an objective record of a patient's cycles, rather than relying on them to remember their LMP [last menstrual period] or cycle regularity</i>
<i>Having a good way of recording symptoms regularly might help with getting an earlier diagnosis – help get doctors to take people more seriously</i>
<i>Having used a tracking app for years, I could rely on objective data to convince doctors that I need surgery to confirm and remove endometriosis</i>
<i>If patients present this information to a doctor, it could help them get a diagnosis more quickly</i>
<i>If you need to go see a fertility specialist, it's incredibly helpful to have information around usual cycle lengths and symptoms to help them diagnose any issues, rather than uncertain answers</i>
Theme 3: Problems with record keeping using apps
Inaccurate data
<i>When you forgot got track and the data gets mucked up</i>
<i>Trying to remember to actually update it</i>
<i>Targeted to people with normal cycles</i>
<i>Data security and 3rd party use</i>
<i>Huge security issue – what is [the] company doing with my data?</i>
<i>Who else is using the information you input</i>
<i>Information not being secure – and sold to 3rd parties</i>
<i>I guess I don't really know where the data goes</i>
<i>My only concern is having the data wiped or hacked</i>

Table 3: Apps as management – illustrative quotes from survey respondents.

Theme 1: Currently helpful
Helpful
<i>Helpful when facing issues</i>
Tracking symptoms
<i>To record issues with pain or other symptoms</i>
<i>Can track when you experience symptoms</i>
<i>Tracking severity of symptoms</i>
<i>Endo/PCOS – pain locations and weight gain, also a guide/info of symptoms of both</i>
Preparing for symptom onset
<i>A way to track your symptoms leading up to and during [menstruation] so [you] can prepare to manage</i>
<i>Helping woman track periods better – could mean having more information on when periods is due – and can take medications earlier which may help symptoms</i>
<i>Tracking has been really helpful in me identifying and understanding some of the physical premenstrual symptoms I get. As I take [medication] for these symptoms and there is an option to just take these for one premenstrual week it would be good for that</i>
Information and advice
<i>Offer advice on things one can do to lessen the symptoms or to support symptoms</i>
<i>Comfort in reading the associated information and advice</i>
<i>Has forum where other people [are] going through same problems</i>
<i>Also, it shows that you are not alone in this, more often than not, there are a lot of women out there with the same issues</i>
Theme 2: Potentially helpful but need to be more suitable
Potentially helpful
<i>They could ... support a better understanding of future health</i>
<i>Tracking menstruation could help you prepare for life with menopause</i>
<i>They should help to bring those topics into the society</i>
Need to suit place
<i>It's still a bit generic, not NZ [New Zealand] based</i>
<i>Information is ... often not specific to country – mostly American based</i>
Need to suit life stages
<i>It would be great to have an option that is simple for younger girls not interested in fertility</i>
<i>Apps that aren't age appropriate (for teens but not suitable for older women)</i>
<i>I could picture an app that was targeted at 13-year-olds, once they're just starting to get their period, versus an app that's targeted at people wanting to get pregnant</i>

Table 3 (continued): Apps as management – illustrative quotes from survey respondents.

Theme 2: Potentially helpful but need to be more suitable
Need to be more suitable
<i>Current one doesn't work for IVF [in-vitro fertilisation]</i>
<i>When you battle with fertility and a [message] comes up that you may need to consider a pregnancy test, because you are a few days late</i>
<i>They can be very rigid. The one I use is unable to understand why I had a very long cycle immediately after the birth of my baby</i>
<i>I have endometriosis, and there's not much info about it or what women can expect to experience on each day of the cycle if you are an endo sufferer</i>
<i>A lot of them do not adapt very well to things like PCOS, where your period isn't very regular</i>
<i>Not a one-size-fits-all, especially with PCOS</i>
<i>Not too informative or helpful for someone with PCOS like myself</i>
<i>More focused on normal bodies not really with health related i.e, pcos</i>
<i>Everyone might want different things. So surely you need different apps, which is why there are heaps of different apps out there</i>

Showing cycle dates and symptoms to healthcare providers is the second theme when considering the record-keeping role of menstrual apps. Both app users and healthcare providers used app information to “improve communication in consultation.” This was described in general terms as a calendar history, having “a good record to share with your health professional.” This data can be particularly useful in reproductive healthcare: “As a practitioner myself I find it super helpful to look through the history of the app if a woman presents with inconsistent periods, infertility or even pregnancy that needs to be dated.” Calendar histories on apps are further recognised as credible evidence by healthcare providers. Date of last menstrual period (LMP) is used frequently in healthcare: “As a doctor, it gives me an objective record of a patient's cycles, rather than relying on them to remember their LMP or cycle regularity.” App users recognised that the app data is viewed as credible evidence when they present it to their healthcare provider: “Having used a tracking app for years, I could rely on objective data to convince doctors.” Using the app data to “help get doctors to take people more seriously ... might help with getting an earlier diagnosis.”

Problems with record keeping using apps were expressed by study participants in two main areas. Some noted that histories (and predic-

tions) will only be accurate if the app is used correctly and consistently. As a healthcare provider in the focus group noted: “you're only gonna get out of your app, what you put into it as well. So if you're not inputting the right information or enough information, it can't tell you anything.” Survey participants noted that difficulties occur: “When you forget to track and the data gets mucked up.” Apps may be less suitable for use by those with irregular cycles, as they are “targeted to people with normal cycles.” There was also concern about this data being collected by apps. Accidental data loss or leaks were mentioned by a few respondents: “My only concern is having the data wiped or hacked.” Most of respondents' concern was for how the data was being used by the app companies, with some unsure: “I guess I don't really know where the data goes”; and other participants aware that their data and information was being shared but with no transparency about who it was being sold or released to: “Huge security issue- what is [the] company doing with my data?”

Menstrual apps as management

Analysis of survey responses and focus group discussions relating to the role of apps in managing menstrual disorders and diseases showed two main themes: 1) *Currently helpful for man-*

agement; and 2) *Potentially helpful but need to be more suitable*. Descriptions of these themes are given in the following text and illustrative quotes are presented in Table 3.

Apps are *currently helpful for management* in some descriptions offered by survey respondents. There were a few broad statements such as: *“helpful when facing issues.”* Participants described three ways that menstrual apps could help. One way was through tracking symptoms specific to the disease or disorder. Some noted specific symptoms such as pain, others noted tracking options such as timing or severity of symptoms. Another way was tracking cycles to prepare for symptom onset. As one survey respondent described, the app offers *“a way to track your symptoms leading up to and during [menstruation] so [you] can prepare to manage.”* A further way is through providing information and advice. The apps *“offer advice on things one can do to lessen the symptoms or to support symptoms”* as well as having a *“forum where other people [are] going through same problems.”*

A greater number of participants noted that menstrual apps are *potentially helpful but need to be more suitable*. These respondents were more speculative about app benefits, writing about what apps “could” and “should” do. They described apps as unsuitable in several aspects. Apps need to suit Aotearoa New Zealand context. Respondents noted that *“it’s still a bit generic, not NZ based.”* Apps also need to suit age and stage. In particular, there was a call for apps to be better suited to younger users: *“It would be great to have an option that is simple for younger girls not interested in fertility.”* In addition, apps need to suit menstrual disorders and diseases. Many respondents noted that apps were unsuited to those experiencing specific menstrual disorders and diseases along with their symptoms and treatments. App predictions *“do not adapt very well to things like PCOS, where your period isn’t very regular.”* This echoes the theme in the previous section where respondents noted that apps appear to be designed for those with “normal” cycles and are not well-suited to anyone with longer, shorter, or irregular cycles. App notifications may also be unsuitable, such as: *“When you battle with fertility and a [message] comes up that you may need to consider a pregnancy test, because you are a few days late.”*

Summing up these observations, a participant in the healthcare provider focus group noted that *“everyone might want different things. So surely*

you need different apps, which is why there are heaps of different apps out there.”

Discussion and conclusion

Our study invited expert stakeholders to offer perspectives about the medical information provided by menstrual apps and the possible role of this information in healthcare. These 144 participants included healthcare providers, menstrual app users, and patients with menstrual disorders and diseases linked to the menstrual cycle including endometriosis, PCOS, infertility, and perimenopause. Our analysis of their statements in qualitative surveys and focus groups conceptualised four ways that menstrual apps could play a role in healthcare: as record keeping, management, self-knowledge, and self-diagnosis. This paper focused on the first two of these roles, with the final two roles the focus of a separate paper.

For record-keeping, participants reported that menstrual apps are currently used in healthcare as calendar histories of menstrual cycle dates and symptoms. As these records are viewed as reliable and credible, the overall perspective was that apps can improve communication between healthcare providers and patients. This improved communication may offer a way to address existing delays in recognising and diagnosing menstrual disorders and diseases.^{21,22,23} Concerns remain, however, about potential inaccuracies and misuses of data and information collected and provided by the menstrual apps, highlighting this problematic aspect of apps.^{4,10,13,14}

The participants in our study called for assistance in managing menstrual disorders and diseases. Although they viewed apps as currently able to help to a limited extent, they noted substantial need for more appropriate support. This indicates that, at this point, apps do not appear to be a viable answer to patient calls for more effective treatment and management options.²⁴

This research provided an initial look at the perspectives held by experts and stakeholders about the uses of menstrual apps and their medical information in healthcare. The limits of our small, localised, and self-selected sample and qualitative responses means that we have kept our conclusions focused on demonstrating the existence of menstrual app use in healthcare, conceptualising the possible role of app information, and offering a starting point for developing further research questions.

What we can do now

Our findings suggest that healthcare providers may consider the calendar record on apps as an additional form of menstrual cycle history. These calendars may be able to supplement and corroborate, but not replace, patient experiences. Those who have concerns about their cycles and/or symptoms can create a calendar record to aid communication with healthcare providers. Existing apps could possibly play a role in helping those diagnosed with menstrual disorders and diseases to manage their symptoms (e.g., by preparing for menstrual cycle phases). We advise that any recommendations or suggestions about menstrual apps should disclose that apps may not be suitable for those with nonstandard cycles and may not be applicable to Aotearoa New Zealand. Apps and recommendations also need to be transparent about the potential for harm through apps sending inappropriate and distressing notifications, as well as the potential for patient information being leaked or stolen, used for commercial and advertising purposes, and/or shared with agencies and law enforcement.

What is still needed

App users, patients, and healthcare providers in our study are calling for the development of suitable apps. All apps need to be able to account for variable and irregular cycles. Further, there is a need for apps that support treatment and management of menstrual disorders, diseases and symptoms. Although there may be apps designed for some menstrual disorders and diseases, our participants were not aware of these, indicating a need for more information about any existing apps. Our respondents also sought apps applicable to Aotearoa New Zealand and life course stages. To rely on these apps, patients and healthcare providers must be assured of the accuracy and effectiveness of menstrual app predications and information. Our research suggests that further research should focus on evaluating app functionality, comprehensively assessing how apps are used in healthcare, and establishing education and guidance for patients and providers on whether, when, and how to use menstrual apps in healthcare.

COMPETING INTERESTS

Nil.

ACKNOWLEDGEMENTS

This research was supported by a Health Delivery Research Activation Grant from the Health Research Council of Aotearoa New Zealand. The authors would like to acknowledge additional members of the research team: Dr Stella Cameron, Romulo Nieva Jr, and Agayunus Asby.

AUTHOR INFORMATION

Bryndl E Hohmann-Marriott: Associate Professor of Sociology, School of Social Sciences, University of Otago, Dunedin, Aotearoa New Zealand

Tiffany A Williams: Faculty of Medical and Health Sciences, University of Auckland, Auckland, Aotearoa New Zealand.

Jane E Girling: Associate Professor in Anatomy, Department of Anatomy, School of Biomedical Sciences, University of Otago, Dunedin, Aotearoa New Zealand.

CORRESPONDING AUTHOR

Bryndl Hohmann-Marriott: Sociology, Gender Studies and Criminology, University of Otago, PO Box 56, Dunedin 9054, New Zealand. Ph: +64 3 479 8447. E: bryndl.hohmann-marriott@otago.ac.nz

REFERENCES

- Rampazzo F, Raybould A, Rampazzo P, Barker R. From the stork to fertility apps. Poster presented at the annual meeting of the Population Association of America; 2021 May.
- Munro MG, Critchley HO, Fraser IS, et al. The two FIGO systems for normal and abnormal uterine bleeding symptoms and classification of causes of abnormal uterine bleeding in the reproductive years: 2018 revisions. *BJOG*. 2018;143(3):393-408.
- Vitonis AF, Vincent K, Rahmioglu N, et al. World Endometriosis Research Foundation Endometriosis Phenome and biobanking harmonization project: II. Clinical and covariate phenotype data collection in endometriosis research. *Fertil Steril*. 2014;102(5):1223-32.
- Johnson S, Marriott L, Zinaman M. Can apps and calendar methods predict ovulation with accuracy? *Curr Med Res Opin*. 2018;34(9):1587-94.
- Ali R, Gürtin ZB, Harper JC. Do fertility tracking applications offer women useful information about their fertile window? *Reprod Biomed Online*. 2021;42(1):273-81.
- Singer N. Period-Tracking Apps Say You May Have a Disorder. What if They're Wrong? *New York Times*. 2019.
- Pozniak H. From menopause to anxiety: the new tech tackling women's health problems. *The Guardian*. 2021, 21 May.
- Earle S, Marston HR, Hadley R, Banks D. Use of menstruation and fertility app trackers: a scoping review of the evidence. *BMJ Sex Reprod Health*. 2021;47(2):90-101.
- Broad A, Biswakarma R, Harper JC. A survey of women's experiences of using period tracker applications: Attitudes, ovulation prediction and how the accuracy of the app in predicting period start dates affects their feelings and behaviours. *Womens Health (Lond)*. 2022;18:1-16.
- Hohmann-Marriott B. Periods as powerful data: User understandings of menstrual app data and information. *New Media Soc*. 2021:1-19.
- Hohmann-Marriott B, Starling L. "What if it's wrong?" Ovulation and fertility understanding of menstrual app users. *SSM Qual Res Health*. 2022;2.
- Epstein DA, Lee NB, Kang JH, et al. Examining menstrual tracking to inform the design of personal informatics tools. *2017 CHI Conference on Human Factors in Computing Systems*; 2017; Denver, CO, USA: Personal Informatics & Self-Tracking.
- Freis A, Freundl-Schütt T, Wallwiener L-M, et al. Plausibility of menstrual cycle apps claiming to support conception. *Front Public Health*. 2018;6(98).
- Worsfold L, Marriott L, Johnson S, Harper JC. Period tracker applications: What menstrual cycle information are they giving women? *Womens Health (Lond)*. 2021;17.
- Privacy International. No Body's Business But Mine: How Menstruation Apps Are Sharing Your Data: Privacy International; 2019. Available from: <https://privacyinternational.org/long-read/3196/no-bodys-business-mine-how-menstruations-apps-are-sharing-your-data>.
- Zondervan KT, Becker CM, Koga K, et al. Endometriosis. *Nat Rev Dis Primers*. 2018;4(1):9.
- Rowlands IJ, Abbott JA, Montgomery GW, et al. Prevalence and incidence of endometriosis in Australian women: a data linkage cohort study. *BJOG*. 2021;128(4):657-65.
- Zondervan KT, Becker CM, Missmer SA. Endometriosis. *N Engl J Med*. 2020;382(13):1244-56.
- Escobar-Morreale HF. Polycystic ovary syndrome: definition, aetiology, diagnosis and treatment. *Nat Rev Endocrinol*. 2018;14(5):270-84.
- Zegers-Hochschild F, Adamson GD, Dyer S, et al. The international glossary on infertility and fertility care, 2017. *Hum Reprod Open*. 2017;32(9):1786-801.
- van Roode T, Dickson NP, Righarts AA, Gillett

- WR. Cumulative incidence of infertility in a New Zealand birth cohort to age 38 by sex and the relationship with family formation. *Fertil Steril*. 2015;103(4):1053-8.
22. Davis SR, Baber RJ. Treating menopause — MHT and beyond. *Nat Rev Endocrinol*. 2022; Advance online publication:1-13.
23. Tewhaiti-Smith J, Semprini A, Bush D, et al. An Aotearoa New Zealand survey of the impact and diagnostic delay for endometriosis and chronic pelvic pain. *Sci Rep*. 2022;12:1-9.
24. Werner A, Malterud K. It is hard work behaving as a credible patient: encounters between women with chronic pain and their doctors. *Soc Sci Med*. 2003;57(8):1409-19.
25. Jia SZ, Leng JH, Shi JH, et al. Health-related quality of life in women with endometriosis: a systematic review. *J Ovarian Res*. 2012;5(1):1-9.
26. Armour M, Lawson K, Wood A, et al. The cost of illness and economic burden of endometriosis and chronic pelvic pain in Australia: a national online survey. *PLoS One*. 2019;14(10):1-12.
27. Simoens S, Dunselman G, Dirksen C, et al. The burden of endometriosis: costs and quality of life of women with endometriosis and treated in referral centres. *Hum Reprod Open*. 2012;27(5):1292-9.
28. Braun V, Clarke V. *Thematic analysis: A practical guide*. London, United Kingdom: Sage Publications; 2021.
29. QSR International Pty Ltd. NVivo (released in March 2020): Available at: <https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home>.