

Developing a Perimenopausal Symptom Tracker to Aid in Symptom Awareness and Identification of Perimenopause

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Abstract

As the fields of medical technology and digital health advances, more can be done to support peri-menopausal women through this life transition. Without proper education for doctors or the public, the everyday woman increasingly turns to technology to track her symptoms and take care of herself. However, FemTech corporations are using surveillance capitalism to sell these women's personal information which can have extremely serious ramifications for the women whose data is sold. During this study, research is done to determine the best way to help these women, and to develop a perimenopausal symptom tracking app that focuses on privacy and education. The app is designed to be user-friendly and intuitive, with a clean and simple design. The app has been evaluated using the System Usability Scale (SUS) and the Mobile App Rating Scale (MARS) to determine its usability and effectiveness. The app has been compared to other apps on the market to determine its strengths and weaknesses. The results of this study show that the app is usable and effective, but to be most helpful to perimenopausal women, a classification quiz to determine which stage of menopause the user is in should be added along with more detailed analysis of user data, and more learn resources.

Acknowledgements

I would like to thank the participants who evaluated my project and my supervisor.

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1 Introduction

The perimenopause is an ill-defined time period that surrounds the final years of a woman's reproductive life[1]. Perimenopause is a transitional phase that is not well understood by many individuals including doctors, leading to a lack of awareness and knowledge about the symptoms and management strategies. Due to this lack of education and awareness, many individuals do not realise that the psychological, hormonal, and physical changes they are experiencing are due to perimenopause, leading to confusion and frustration[32]. There are many digital tools to support those currently in menopause, but there is a gap in the market for digital tools that support individuals who are entering the perimenopause phase of life. What makes these apps and tools useful to a perimenopausal women and what are the key features that are needed to support them during this time? This project aims to answer these questions by creating a user-friendly, educational, and privacy-focused perimenopausal symptom tracking app.

2 Background Literature

2.1 Perimenopause

The American Journal of Epidemiology[9] states that perimenopause is the transition period of a woman's life, which starts with a natural shift in ovulation and menstruation patterns and/or increased symptoms, and ends when a woman enters menopause. It classifies menopause as when a woman has not had her period for a year. This Lancashire and South Cumbria NHS Foundation Trust's article on Perimenopause, Menopause, and Pain[26] states that during perimenopause, the body's production of estrogen, testosterone, and progesterone fluctuates significantly and can stay low forever if no treatment is taken. This change in hormones drastically changes the way a woman's body and mind work. A Swiss Perimenopause study[44] found that women experiencing lower estrogen and progesterone levels had higher suicide intent scores and were more likely to develop depression, which is backed up by another study from the Journal of Psychiatric Research which found a correlation between low progesterone states and suicide[7]. Other effects of perimenopause are much more common, and perimenopause may not be the obvious source. During Perimenopause, 80% of women experience hot flashes[8], 77% joint pain[39], 60% memory issues[20], over 20% experience heart palpitations[41], 1/4 women have really heavy periods[24], 50% of women say it negatively impacts their sex lives[11], and 1/10 women leave their jobs because of menopausal symptoms[10]. It therefore comes as no surprise that almost 90% of women seek out their healthcare provider for advice on how to cope[23]. However, in the US, 3/4 of women who ask for medical help are left untreated, causing women to turn to other sources of help and information[45].

2.2 Menopause Education

A University College London publication on women's post reproductive health[4] explores the extent of knowledge women have about menopause. When it comes to menopause, most women are left untreated and unsupported. Without sufficient education, most are left suffering due to hormonal imbalance and lifestyle changes they are unprepared for and do not have the information they need to help them cope. In this study of 829 postmenopausal women, 90% were never educated about the menopause. It is rarely included in sexual

education received in school, and though awareness is increasing, it is still rarely talked about in the media and considered a taboo and private subject only to be talked about with your doctor[32]. Talking to the doctor is also problematic as doctors are also not well educated on menopause[30]. The NHS site on the treatment of menopause[36] states that many menopause symptoms can be effectively treated with hormone replacement therapy (HRT), even symptoms such as hot flushes can improve within a few weeks. However, a study of 3000 british menopausal women who complained to their doctors of low mood or anxiety symptoms found that 66% were offered anti-depresseants instead of hormones[35]. In fact, 1/4 of women are on anti-depresseants post menopause[12] despite the fact that antidepressants don't help low mood in menopausal women with hormone imbalances, and according to the National Institute for Health and Care Excellence[34] HRT should be offered first. This may be largely due to lack of education doctors receive about menopause. 41% of UK medical schools do not give any mandatory menopause education[30]. Professor Joyce Harper, an internationally renowned, award-winning scientist and a professor of reproductive science at UCL, states that "The data shows that women have a lack of education about this key life stage. Together with a reported lack of education from their healthcare professionals, women may be left undiagnosed and unsupported" [43].

2.3 Symptom Tracking Apps and Technology

When women do not receive education from school, their communities, or their doctors about peri-menopause, they will look for tools and education from other sources such as websites or apps to research, track, and analyse their experience. Over 50 million women worldwide use apps to track their menstrual cycle and examine a variety of other cycle-related factors[25]. There are 300 menstrual tracking applications available for download and an estimated 200 million downloads worldwide[16]. Symptom monitoring and appraisal methods are effective for reducing menopausal symptoms, and improving health awareness, shared decision-making, patient-doctor communication, and treatment goal setting[5].

While these apps can be effective tools for dealing with symptoms, one of the most prominent issues with these apps is the lack of privacy. The apps often earn profits by selling users' data to third parties, even if there is a promise of privacy advertised by the companies[21]. An article by the Director of Research for Sexual and Reproductive Health

and Rights, Population Institute in Washington, DC titled, "Missed period? The significance of period-tracking applications in a post-Roe America" [25] highlights the increased concerns around this surveillance capitalism since the June 2022 overturning of Roe vs Wade in the US stated that the right to abortion is not constitutionally protected[14]. It further explores how users personal tracking data may be used against them in court as evidence of having an abortion regardless of miscarriages, irregularities in menstrual cycles, and/or imperfect engagement with a period-tracking app. Some apps have even gone on record to say they will hand over users data to law enforcement if asked. The article even explains how some experts advise people who menstruate to track their periods on paper as opposed to using an app for their own protection. These 'FemTech' mobile apps currently fall outside of the scope of the Health Insurance Portability and Accountability Act, which protects sensitive health information from being disclosed by covered entities without the patient's consent or knowledge[19]. This highlights the ever increasing need for privacy in menstrual tracking apps.

A study[13] exploring the design experience of digital period trackers found that to best design digital period trackers for users, Hertzum's images of universal, situational and cultural usability should be used. This correlates with Dawsons concepts of evidence-based, usable, readable, interactive, and culturally sensitive design choices for health apps [15]. It found that a good period tracking app should know the users life stage, medical "situation", contraception, purpose of tracking, and tracking interests. It also highlights the need for education resources within these health apps and the importance of users having access to relevant, reliable health information such as including external links to information.

Not only do these peri-menopause apps have to be free, private, and personalised, but they must be accessible to all who want to use them. The European Accessibility Act (EAA) becomes law on the 28th of June 2025. The EAA is a landmark legal change that will improve the lives of disabled people by ensuring equal access to digital products and services for European Union (EU) consumers[2]. The EAA requires products and services to be Perceivable, Operable, Understandable, and Robust (known as POUR).

There are many app rating frameworks available including the Mobile Application Rating Scale (MARS), A-MARS, THESIS, App Quality Assessment tool for Health-Related Apps

(AQUA), the Digital Health Scorecard, the American Psychiatric Society App Evaluation Model, Beacon, Psyberguide, Haptique Health App Certification, Intercontinental Medical Statistics (IMS) Score, the EU Kitemark, and the FDA's procedures for approval of digital tools as medical devices[31]. MARS is designed to classifying and assessing the quality of mobile health apps[42]. In a studying reviewing many different mobile health app rating scales, MARS is one of the most popular scales and is one of the only scales designed to be used by the public or those with little to no experience reviewing health apps[6]. Since MARS is widely known, easy to use, and assesses apps based on engagement, functionality, aesthetics, and quality of information, MARS was ultimately the best fit for this project.

Table 1: App Search Terms and Results in order of appearance on the Apple App Store.

Terms	Perimenopause Tracker	Perimenopause	Menopause
Natural Cycles: Birth Control	Clue Period & Cycle Tracker	Flo Period & Pregnancy Tracker	
Clue Period & Cycle Tracker	Perry - perimenopause Community	John Hopkins Menopause Guide	
Health & Her Menopause App	Health & Her Menopause App	Health & Her Menopause App	
MenoLife - Menopause Tracker	Caria: Menopause & Midlife	MenoLife - Menopause Tracker	
Balance - Menopause Support	MenoLife - Menopause Tracker	Caria: Menopause & Midlife	
Perry - perimenopause Community	Clue Period & Cycle Tracker	Menopause Stage - Clearblue me	
Caria: Menopause & Midlife	Balance - Menopause Support	Balance - Menopause Support	
Flo Period & Pregnancy Tracker	Flo Period & Pregnancy Tracker	Joylux Menopausal Health App	
Period Tracker by GP Apps	Joylux Menopausal Health App	Clue Period & Cycle Tracker	
Moody Month: Cycle Tracker	Stardust: Period & Pregnancy Tracker	ACOG	

In order to decide what apps to rate, the top 10 results in the Apple App Store for the search terms “Perimenopause Tracker”, “Perimenopause”, and “Menopause” were listed (See table 1). These terms were then ranked by frequency of appearance across these search terms and a final ten apps were chosen to be rated using the MARS system. From the ratings (See table 2), it was concluded that Clue and Flo had the best app design as their apps was clear, intuitive, and fast. Balance and Health and Her were more tailored to menopause and had significantly more perimenopause features including classification quizzes to determine menopause stage, pop ups and notifications when changes in patterns are detected, and resources to learn more about perimenopause and menopause.

Table 2: MARS Quality Scores for Perimenopause Apps

App Name	Engagement	Functionality	Aesthetics	Information	App Quality	Subjective
Clue	3.6	4.5	4.3	3.6	4	3.75
Balance	4	3.5	3.66	3.5	3.66	3.75
Caria	2.8	3.5	4.33	3	3.4	1.5
Health and Her	3.8	4.25	3.66	3.16	3.71	3
Perry	2.6	2.5	2	2.1	2.3	1
Natural Cycles	2.6	4	3	3.1	3.17	1.25
Flo	3.8	4.25	5	3.5	4.13	2.5
JoyLux	2.6	5	3.6	4.1	3.8	1.75
MenoLife	0	0	0	0	0	0
John Hopkins Menopause Guide	1.6	5	2.6	5	3.55	2.5

2.4 Project Direction

Given the issues identified above, this project aims to address them by developing an app which allows women to track, analyse, and learn about peri-menopause while ensuring a focus on users privacy and anonymity.

The objective of this research is to determine if a symptom tracking app is considered helpful to perimenopausal women to ease their symptoms and create an awareness of perimenopause while maintaining their privacy.

3 Specification & Design

3.1 Methodology

In order to decide what software development framework to use when developing this app, two common Agile frameworks were considered: Scrum and Kanban. When comparing Scrum to Kanban methods, Kanban is found to often be better in terms of managing project schedules[27]. It also has the following benefits: increased visibility, improved workflow, and faster time to market[3]. Kanban boards and cards are easier to manage for a solo project compared to organising sprints, backlogs, and checkpoints for a Scrum system. Scrum also works better in teams of 3-9, not solo projects[33]. Kanban has even been shown to help student manage their workload and get assignments in on time[40]. Ultimately, Kanban was chosen as the best software development framework for this project for keeping the project on schedule, workload, increasing organisation, workflow, are easy to maintain for one person, and have been proven to work in a student setting.

GitLab Issue boards were selected as the platform to host the Kanban as each issue card can be linked to branches within repositories to keep track of which tasks and changes are for which branches to improve organisation. Three labels: Code, Writing and research, and Critical, were also added to signify the type of task for each issue card. The Kanban board included four sections, one for each label and one for closed tasks. Gitlab would automatically sort each task into the relevant section based on its labels. The board was updated regularly to reflect the current status of each task, and tasks were moved from one section to another as they were completed. This resulted in tasks that were easy to prioritise, order, track, and complete on time. See Figure 1 for the Kanban board.

3.2 Survey Specification and Design

3.2.1 Ethics Form

Before beginning the process of gathering user requirements, an ethics form was drafted and completed to ensure that the research follows ethical guidelines. This Ethics form included a summary of all progress to date, included how participants were recruited, what information participants received about the study and what they were expected to do, and

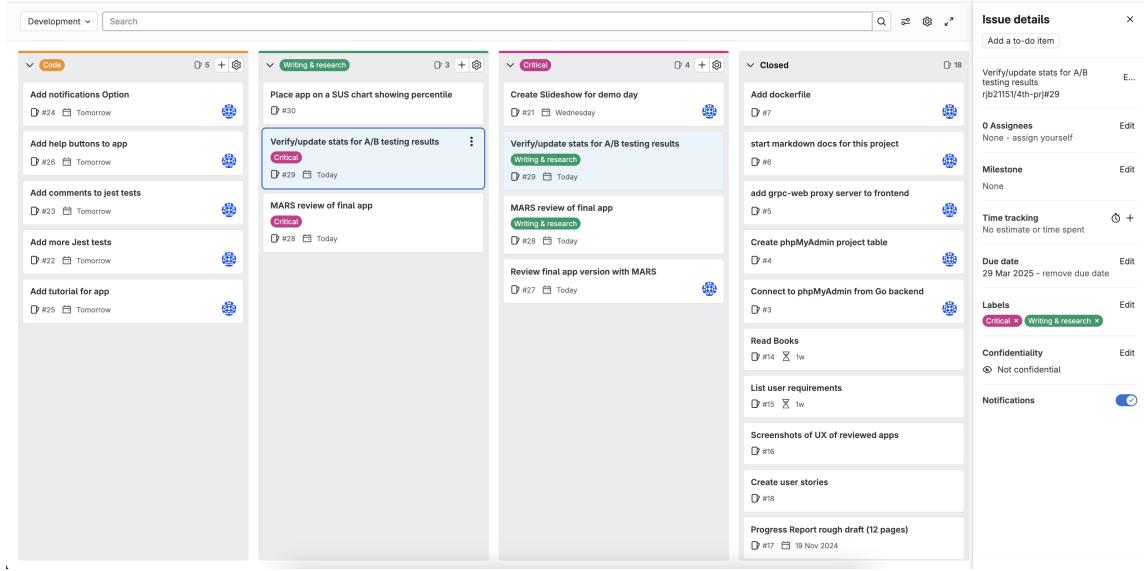


Figure 1: Kanban board on GitLab.

how user data was stored and processed.

3.2.2 Recruitment

To recruit participants for the study, personal contacts in this demographic (women between the ages of 30 and 60) were invited and the supervisor for this project utilised professional and colleague email contacts and distribution lists to identify and invite women to participate.

3.2.3 Survey Design

In preparation for building the product, the design and app testing stages were designed. Each testing stage involved participants completing a questionnaire via Microsoft Forms for User Requirements and app testing.

In preparation, research was conducted through books on women's experiences during perimenopause, including works by Kat Muir[32] and Davina McCall[29], as well as reviewing research papers on health-tracking applications and a review of existing apps on the market to assess current solutions. Privacy emerged as a significant concern, with many apps engaging in surveillance capitalism and selling user data, often without informing the user or by misleading the user[22][18]. Hackers are lured to health data such as that stored by

symptom tracking apps because on the black market, a person's medical data sells for 50 times what credit card information sells for[38]. This meant that the surveys must include opportunities for the users to give their opinions on privacy and their priorities in a tracking app.

The first page of all online surveys conducted during the study contained the consent form with text stated that by completing the survey, they were implying consent to take part in that phase.

The User Requirements questionnaire contained questions regarding the users age, menopause stage, symptoms they experience, if they track their symptoms/periods, how, and the frequency of tracking. It also included questions to see if they share tracking data with their healthcare provider and if it was helpful. Along with tracking challenges, triggers, menopause medication or treatment. The final questions included open ended questions about tracking frustrations, helpful aspects of tracking, challenges in understanding/identifying patterns, reminder preferences, and insights/features a user might like to see in a tracking app.

3.2.4 App feedback Survey Design

The app testing surveys were designed to gather feedback on the app's usability and user experience using a System Usability Scale (SUS) along with additional free response questions. The SUS is a widely used tool for measuring the usability of a product or system, and it consists of 10 questions that assess various aspects of the user experience. The SUS scores range from 0 to 100. The score number represents the percentile the app lands in with higher scores indicating better usability. The survey also included questions about the app's design, ease of use, and overall satisfaction. Participants were asked to provide open-ended feedback on what they liked and disliked about the app. The survey also included questions about the participants' demographics, such as age and experience with perimenopause, to better understand the target audience.

The app testing process was divided into 3 stages: prototype evaluation, and final app evaluation with Group A, and final app evaluation with Group B. The prototype evaluation was conducted using a web app version of the app, which was designed to be similar

to the final app but with fewer features and a simpler design. The final app evaluation was conducted in an A/B testing format. Participants were divided into two equal sized groups, Group A and Group B. Group A reviewed the React Native version of the app, which included all the features and design elements of the final product then provided their feedback. Group B would then evaluate an updated version of the Native App that implemented the feedback from Group A. The goal of this evaluation was to see if the changes made had a positive impact on the usability of the app. Both group A and B provided valuable feedback on the app's usability and user experience, as well as to identify areas for improvement. The Microsoft Form used for evaluation was the same for both the web and Native app for Group A and Group B.

3.3 Analysis

Given many peri-menopausal women are not receiving support from the government education system or their doctors[4][30][43], additional resources and tools must be provided to help them navigate this stage of life. With the rise of technology, several tools are now available to allow women to track their peri-menopausal symptoms. However, these tools are often not user-friendly, do not provide enough educational information, or are not privacy-focused. The issue around privacy is especially concerning as many apps are selling user data to third parties without user knowledge and consent, and in today's political climate this can result in the incarceration of the user in some parts of the US[25]. Since there are no apps that provide a comprehensive solution to these problems, the goal of this project is to create a user-friendly, educational, and privacy-focused peri-menopausal symptom tracking app.

3.4 Requirements

3.4.1 Functional Requirements

This App's functional requirements were prioritized based on user needs and the project goal. Essential functional requirements impacting usability such as being able to navigate to a screen were prioritised over design and content details. The following functional requirements were identified:

- Users must be able to log their period start and end dates to track cycle and period length.
- Users must be able to log their peri-menopausal symptoms and their severity daily to track changes over time.
- Users must be able to edit or delete logged symptoms and period data at any time.
- The app must store all user data locally using AsyncStorage on the users device, ensuring no data is stored on external servers.
- The app must include a calendar view where users can see logged symptoms and period data over time.
- The app must provide an option to reset user data to align with privacy-focused design principles
- The app must provide graph-based visualizations showing symptom frequency and period heaviness trends over time.
- The app must calculate and display the most common symptom based on user entries.
- The app must provide cycle length insights based on logged period data.
- The app must calculate average period length based on tracked cycles.
- Users must be able to access an Analysis Tab summarizing trends.
- The app must feature a Learn Page with information on perimenopause and related topics.
- Users must be able to access external links to trusted resources for more detailed information.
- The app must follow EU accessibility standards, including text scaling, color contrast, and screen reader compatibility.
- The app must support multiple languages to accommodate diverse users.
- Users must be able to enable or disable notifications/reminders for period tracking or symptom logging.

- The app must work fully offline, allowing users to track symptoms and view their data without an internet connection.
- The app must not crash or freeze during normal usage.

3.4.2 Non-Functional Requirements

- The app should be easy to use and navigate, with a clean and simple design.
- The app home page should load within 3 seconds.
- All data visualization such as graphs, calendar, and analysis charts should render in under 2 seconds.
- The app should allow easy localization to support multiple languages.
- The UI should offer a dark mode and high-contrast mode to improve readability for all users.
- All text elements must support dynamic font resizing based on user preferences.
- The app should look the same for various screen sizes, including tablets and smaller phones.
- The app must be designed with easy language switching to support multiple languages in the future.
- The app should maintain consistent navigation and UI patterns across all features to reduce confusion.

As the project developed, user requirements were designed to be continually adjusted to best reflect the goal of this project.

3.5 Design

3.5.1 Interface Design

At the beginning of the design process, low fidelity wireframes were created using Figma (See Figure 2).

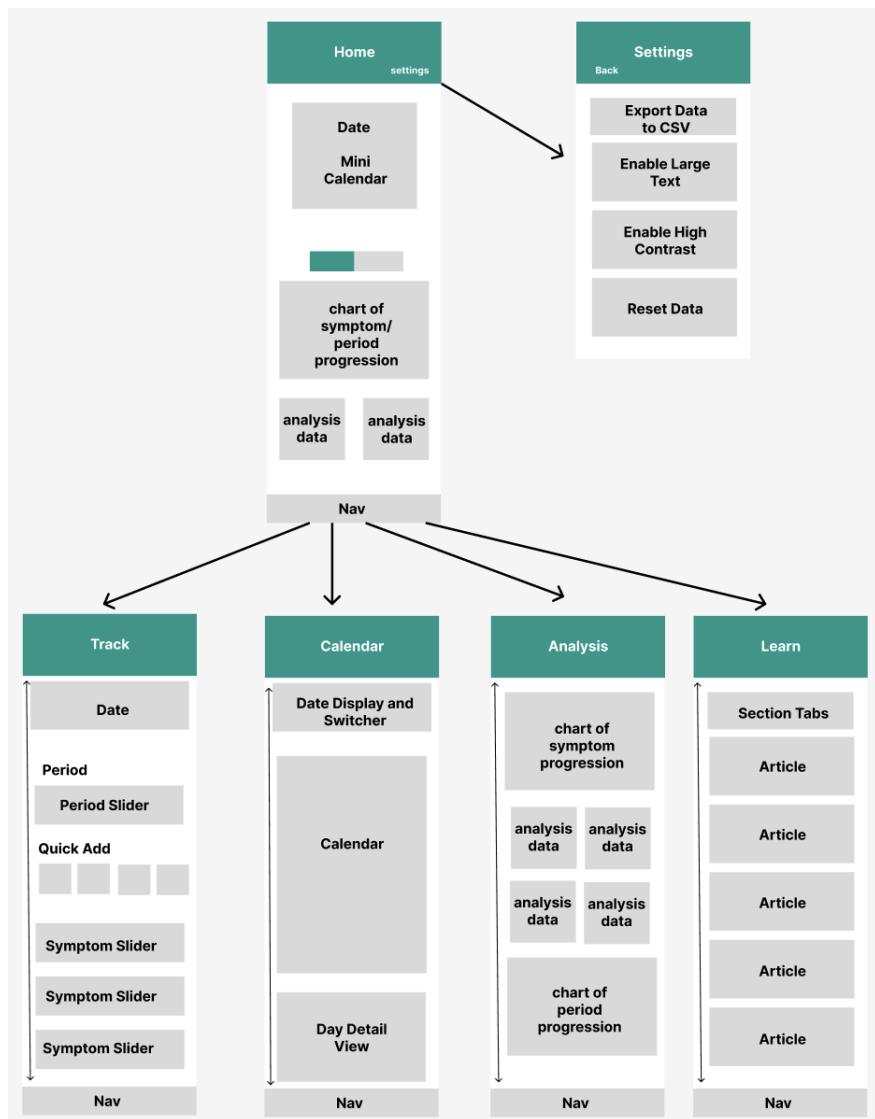


Figure 2: Wireframe of App on Figma.

The colour scheme was chosen to be relaxing and calming through the use of blue and green tones. The app was designed to be user-friendly and intuitive, with a focus on simplicity and ease of use. The design was also created with the goal of making it easy for users to navigate the app and find the information they need, as well as be responsive and work well on different screen sizes, including tablets and smaller phones.

The design was then fleshed out into a more detailed figma design. See Figure 3.

The final design as seen in figure4 was created with a focus on simplicity and ease of use. The app was designed to be user-friendly and intuitive, with a clean and simple design. The

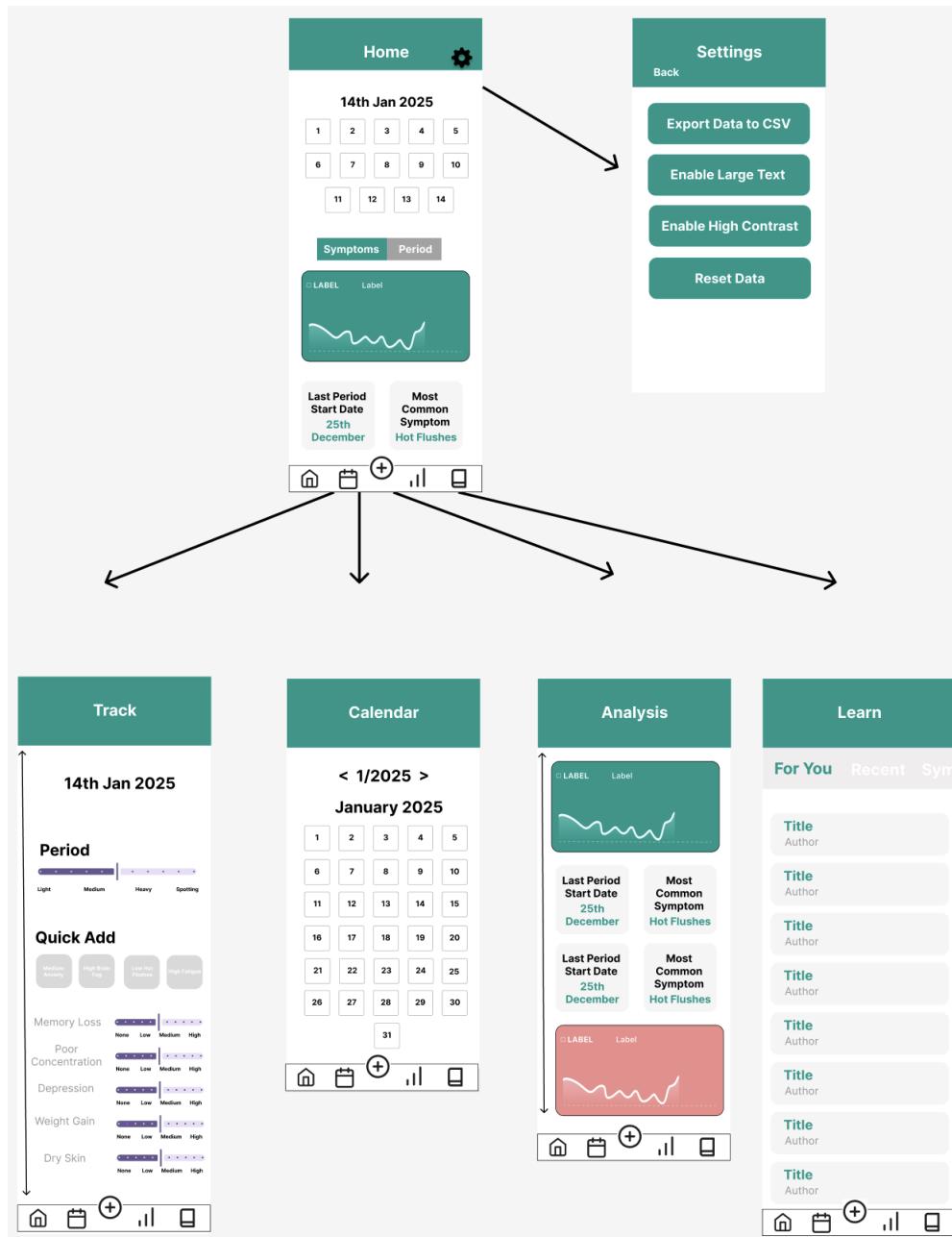


Figure 3: Detailed Draft of App on Figma.

final color scheme was chosen to be calming and easy on the eyes, with a focus on blues and greens. Feedback from user evaluations was incorporated into the design to ensure that it met the needs of the target audience. Some user feedback that was implemented includes adding days of the week to the mini calendar in the home page, making the track button in the nav bar larger and a different color to make it more visible, ability to refresh

the home page, and ability to track by clicking a day in the calendar.

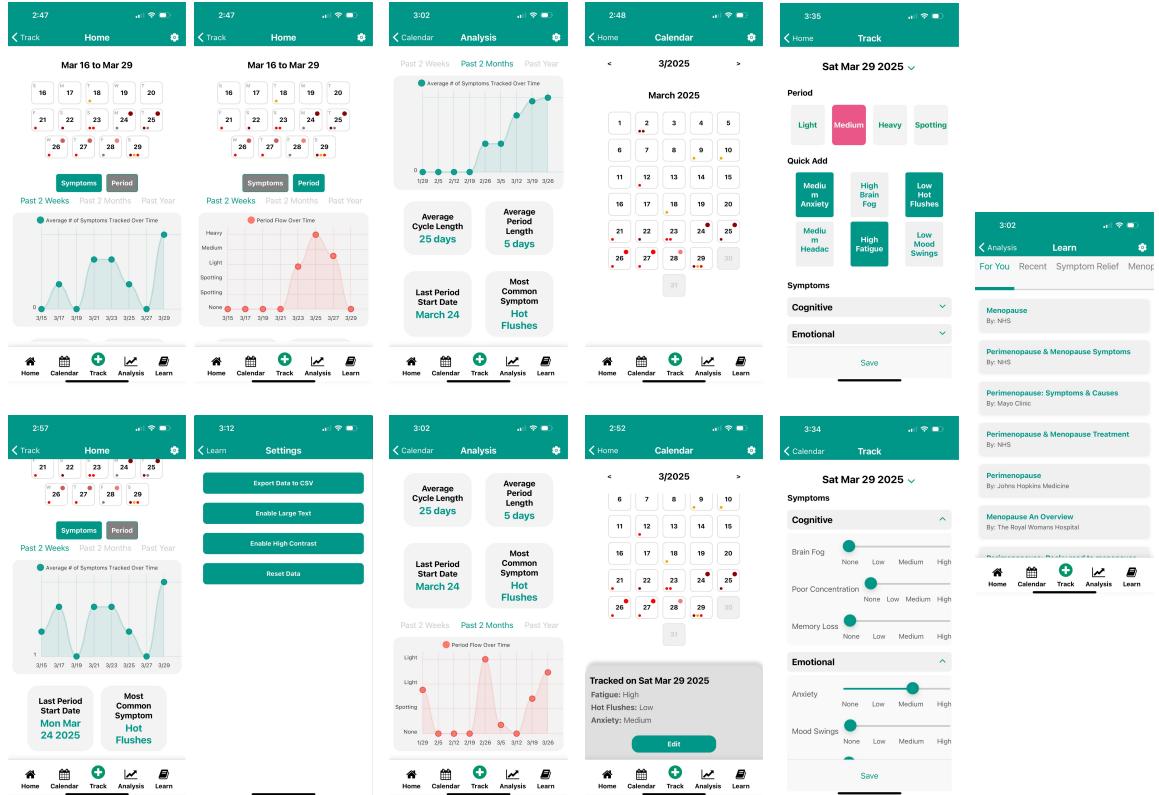


Figure 4: Final React Native App Design.

The app was then compared to the EU WAG 2.1 accessibility standards and adjusted to be accessible to all users, with large text and color contrast options in the settings. Figure 5 shows the app in dark mode with high contrast and large text mode enabled.

3.5.2 System Design

In the interest of protecting user privacy, there is no database and all data is stored on the user's local device. The data that is saved in AsyncStorage on their device is formatted as featured in table3.

3.6 Mid Project Organisation

After around a month of progress, a network diagram was made to find the critical path in order to correctly prioritise work. Once a list of the main activities was made, the

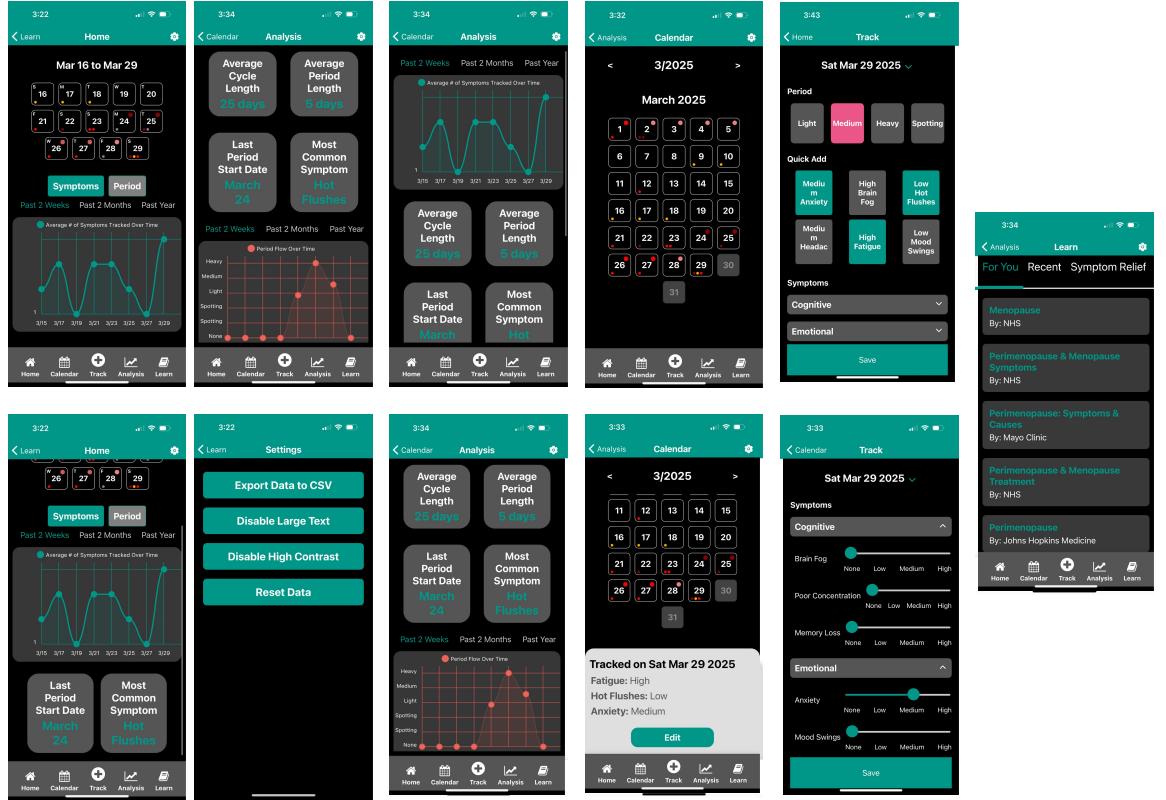


Figure 5: Final React Native App Design with high contrast and large text on.

Table 3: Structure of User Data Stored in AsyncStorage

Anonymous User

	Date1		
		Symptom1	Severity
		Symptom2	Severity
	Date2		
		Symptom1	Severity
		Symptom2	Severity
	Date n		
		Symptom1	Severity
		Symptom2	Severity

dependencies of each activity were identified and the time it would take to complete each activity was estimated. The critical path was then identified by finding the path through the network diagram with a float or leeway of zero. The critical path is the sequence of activities that must be completed on time for the project to be completed on schedule. The critical path is important because it helps to identify which activities are most important for

the success of the project and which activities can be delayed without affecting the overall project timeline. See Figure 6 for the network diagram. The critical path activities are highlighted in red. From the network diagram, it was concluded that writing the report and obtaining feedback was the most important aspect of this project and should be prioritised over other tasks. The network diagram also helped to identify potential bottlenecks in the project timeline and allowed for better planning and scheduling of tasks.

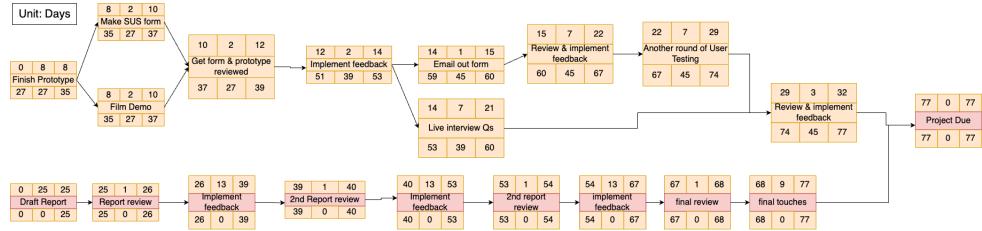


Figure 6: Network Diagram showing critical path.

4 Product

4.1 Implementation

4.1.1 Prototyping

During the design and initial development phase, a prototype was first made using React and js with an npm node.js server as a web app. This was extremely sucessfull and the first round of user testing was conducted with this React and node.js web version of the app. However, a change from this React prototype to a different solution was much needed. Since React is a web based framework AsyncStorage is not available, meaning localstorage or a database must be used. Both these options come with many privacy and security concerns that don't align with the functional requirements of this project.

The next Implementation was using Go and React with typescript for more security but due to typescript being a more strict language development was significantly slowed down along with the complexities of safely sending data back and forth between Go and React. A GoLang Envoy Proxy was considered but became increasing complex and was not compatible with the timeline of the project. While more secure, it still did not address the issue of privacy and security of the data as a database would still need to be used.

4.1.2 Expo & React Native

The final implementation decided on was a React native app that uses both typescript and javascript. This allowed for a lot of work to be moved over without rewriting files, as well as having the ability to use typescript's strict type checking for more complex files to make debugging easier and faster through type safety and reduced runtime errors. Expo was used for the react native app due to its easy routing capabilities, intuitive and easy testing setups, and debuggers. Nicola Corti who is on the React Native team at Meta said at the 2024 React keynote conference, *Expo today, is the fastest way to bring your apps from idea, to production:* With Expo, code was transferred from the prototypes to a working React Native IOS Expo app that could be tested on iPhone in less than a day. Not only is it fast, a react Native setup allows the use of AsyncStorage where the user data is safely stored on their device. This allowed user data to be stored without a username or password or any

other identifiable details making the app completely anonymous.

4.1.3 The new React Native

This app uses React Native 0.76.0, which is the latest version of React Native at the time of writing and has been in the works since 2018. This version includes many new features and improvements. The old react native used a bridge to asynchronously pass messages between the apps javascript and native code for IOS and Android, the new react native uses a JavaScript Interface (JSI) which allows direct method calls without the overhead of serializing data which greatly improves efficiency[37]. The new react native supports concurrent rendering which means the UI of the app looks smoother when applying updates. This new version of react native is enabled in this project and made development and the user experience much more enjoyable. See Figure 7 for a comparison of the old and new React Native.

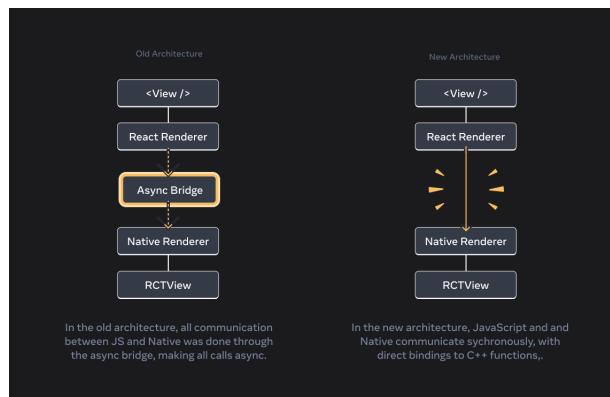


Figure 7: The old and new React Native[37]

4.1.4 React Navigation

In order to handle navigation within the app, React Navigation was used. React Navigation is a completely customisable routing and navigation library that works with React Native. The library supports both stack and tab navigation, making it easy to create a variety of navigation patterns such as the nav bar at the bottom of the app, and handling page switching via buttons in the app such as pressing on a calendar day box or a back button.

4.1.5 Widgets

This app had many reusable components throughout the app. These components are called widgets and are used to create a consistent look and feel across the app while making the code easier to read and understand. The widgets are also used to create a consistent user experience, making it easy for users to navigate the app and find the information they need. Another pro of using widgets is that they can be easily tested and debugged, making it easier to identify and fix any issues that arise. Changing the widget definition in one place will change the look and feel of the app in all places where the widget is used making the code easier to change, update, and understand for future developers.

4.1.6 Chart Kit

Given many Doctors and women lack knowledge about perimenopause and the symptoms, the app uses a data analysis library called react-native-chart-kit to display the data in a visual way. This library is used to create charts and graphs that help users understand their data and identify patterns. The library supports a variety of chart types, including line charts, bar charts, and pie charts, making it easy to create a variety of visualizations.

Two charts were created for the app: a symptom chart and a period chart. Since perimenopause is the time in a woman's life when their period begins to change, the period chart is used to show the users period cycle and how it changes over time. This way, when a user bleeds inconsistently or has a missed period, they can see how their cycle has changed over time and if it is normal for them. This data can then be exported to a csv file and shared with their doctor who can provide them with their expert opinion based on the users data. The period chart has three options, view data for the past two weeks, two months, or the past year. An algorithm was implemented that averages the data over time so it displays in an aesthetically pleasing way for the user. When two weeks is selected, data from every two days is averaged and showed on the chart. When two months is selected, data from every 7 days is averaged and showed on the chart. When a year is selected, data from every month is averaged and shown on the chart. Likewise, the Symptom chart averages the number of symptoms tracked over time and displays it on the chart.

4.1.7 Data Analysis

To further support women in perimenopause, the analysis page in the app displays data that is relevant to a perimenopausal woman. This includes data commonly asked about by a doctor such as the last period start date, average cycle length, most common symptoms, and average period length. The average cycle length is found by calculating the average number of days between the start of each period. The most common symptoms are found by counting the number of times each symptom is tracked and displaying the one with the highest count. The average period length is found by calculating the average number of days between the start and end of each period. This data is displayed in wigits, making it easy for users to understand, and easily accessible to share with their doctor. The analysis wigits are shown in Figure 8.



Figure 8: Data Analysis Widgets

4.1.8 Settings Context

As women enter perimenopause, they may experience symptoms such as brain fog, poor concentration, memory loss, dry eyes, blurred vision, and increased sensitivity to light. To help users manage their symptoms, the app includes a settings page that allows users to change the font size and colour contrast of the app. This is done using a context provider that stores the user's settings in Async Storage. A settings-context typescript file was created that specifies the context type and the types of settings that the user can change which were specified as two booleans, one for large text and one for high contrast. It creates a context provider that wraps the app (used in layout.tsx) and passes the state of the user's settings and a function to update the settings, making it easy to access the settings from within each component. These components have been written to dynamically

change depending on the setting used in line css.

4.1.9 Expo FileSystem

In order for users to export their data to a csv, Expo FileSystem was used. This allows the app to create a file on the user's device that can be opened in a spreadsheet program. FileSystem provides an API for accessing the file system, making it easy to work with files in a cross-platform way. The library also provides support for reading and writing files in different formats, such as JSON and CSV, making it easy to work with the user's JSON data stored in Async Storage. The FileSystem architecture is shown in Figure 9.

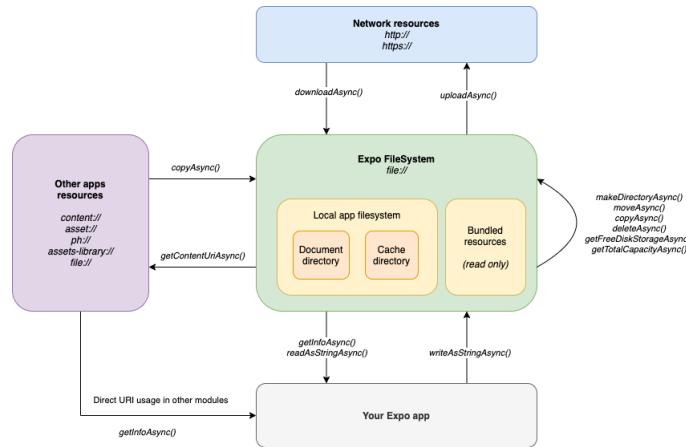


Figure 9: The Expo File System[17]

In order to implement FileSystem, the expo-file-system library was integrated into the app. When the user selects the export data to CSV button in settings, their data is fetched from Async Storage. Rows are defined for the CSV file for date, user, key, and value. Each object in the user data is iterated over to check if there is any null or empty data before adding the data to the CSV file using `writeAsStringAsync()`. The data is then shared with the user using `shareAsync()` which allows the user to specify where to store the file.

4.2 Verification & Validation

Using Expo, the app was trialed and tested on mobile devices and emulators to ensure that the app was functioning as expected. The app was tested on iOS devices with different screen sizes to ensure that it was responsive and that the UI was consistent across all devices. The app was also tested for performance, and adjustments were made to ensure

that it was fast and responsive by using a timer to measure the time it takes for the app and its different pages to load on click, conforming with the non-functional requirements.

4.2.1 Testing with Jest

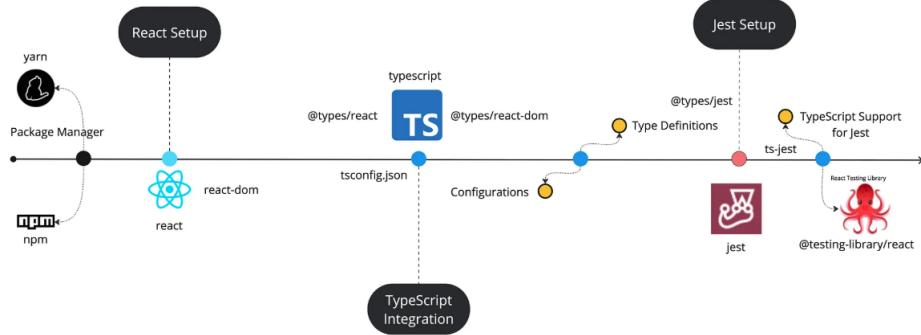


Figure 10: The Expo Jest React Native Testing Setup[28]

Jest (A JavaScript Testing Framework that works with React Native and Expo) was also used to make unit tests to validate whether components render and if they render correctly. The use of Jest was made even easier as Jest comes pre setup with a react native expo project so minimal setup is required and there is copious documentation for reference while developing (See Figure 10 for Jest setup details). Jest tests were written in the components/tests/ directory in typescript to ensure strong type checking while validating the app. A common test is to be able to render a component and check if it is the correct component. This is done by using the `toBeTruthy()` method to check if the component is rendered correctly. The tests were run using the command line and the results were checked to ensure that all tests passed.

5 Results & Evaluation

5.1 Evaluation Process

5.1.1 User Requirements Results

The user requirements survey was sent out to 11 participants, and the results are shown in Table 4. The survey was designed to gather information about the participants' experiences with perimenopause and menopause, as well as their preferences for tracking symptoms.

Table 4: User Requirements Survey Results

User Requirements Survey Results (n = 11)		
What stage of menopause are you in?	Premenopausal	9%
	PeriMenopausal	55%
	Menopausal	0%
	PostMenopausal	18%
	Other	18%
Do you experience any Period, Perimenopause, or Menopause symptoms?	Yes	82%
	No	18%
What peri-menopausal / menopausal symptoms do you currently experience, if any?	Hot Flashes	9%
	Mood Swings	13%
	Irregular Periods	4%
	Sleep Problems	13%
	Joint and Muscle Aches	16%
	Vaginal Dryness	13%
	Night Sweats	6%
	Have to pee often	9%
	Other	9%
How do you track your symptoms or periods?	Smartwatch	18%
	Manually recorded	36%
	No tracking	18%

The results show that the majority of participants are in the perimenopausal stage, and most experience symptoms related to this stage. The survey also revealed that many participants do not currently track their symptoms, indicating a potential need for a user-friendly tracking app.

5.1.2 Round 1: Web App Evaluation

For the first round of app evaluation, 5 users who were women between the ages of 30 and 65 were recruited to watch a demo video of the app and fill out a SUS and a few long answer questions with their feedback. These participants were recruited via email and were asked to read through a participant information sheet before participating.

From the average SUS score of 73.5, it is clear that the app is usable as it's in the top 27% of scores, but it could be improved.

SUS Scores(n=5)	
67.5	
85	
72.5	
77.5	
65	
Average Score	73.5

5.1.3 Round 2: React Native Evaluation with Group A

After obtaining these results, changes were made to the app's look and feel and more instructions were included. AB Testing was then conducted with more participants to see if the changes made had a positive impact on the SUS score.

Will put results here

5.1.4 Round 3: React Native Evaluation with Group B

After implementing the feedback from Group A, the app was then tested with a new group of participants. This group was also asked to fill out a SUS and long answer questions about their experience with the app. The goal of this round of testing was to see if the changes made had a positive impact on the usability of the app.

The changes made included:

The app was then rated according to the MARS rating system and compared to the other app rated at the beginning of the study. **Results here**

5.2 Results of Evaluation

This Section includes a direct interpretation of the gathered data and evaluation processes.

5.2.1 User Requirements Results

5.2.2 Round 1: Web App Evaluation

The results mean...

5.2.3 Round 2: React Native Evaluation with Group A

The results mean...

5.2.4 Round 3: React Native Evaluation with Group B

The results mean...

6 Discussion & Reflection

6.1 Interpreting the Results

Here you will discuss your findings. This is especially relevant for research projects. You might interpret what the data and evaluation implies, both for future research and for practice (if appropriate).

The discussion is **not** a review of literature. You should try to compare research findings with previous work, provide explanations for your findings, discuss research findings, in terms of their contribution.

The initial research shows many women prefer to write down their symptoms manually instead of using an app, but were hesitant to specify why.

While this may be a helpful symptom tracking app to show data to your doctor, this will not make a big impact on the overall knowledge and awareness of peri-menopause and the struggle that perimenopausal women go through during this transition. Better education in school about menopause and perimenopause along with mandatory and detailed education for doctors would be a better and more effective solution to the problem.

6.2 Reflection

Trying different implementation strategies, while worthwhile, meant much time was wasted switching between different languages and frameworks. This was a valuable learning experience, but it did slow down the project. Future projects should have a more clear implementation plan from the start to avoid this issue.

6.3 Challenges

Version control practices became lax at one point during the project which had repercussions on the project timeline. Future projects should have a more strict version control policy.

6.4 Limitations

The small number of participants did make the data collected less reliable and not necessarily representative. The app was also not fully tested on all devices and platforms, so there may

be some bugs or inconsistencies that were not caught.

6.5 Future Work

Transitioning the application to use only typescript instead of a combination of typescript and javascript would be a good next step. This would allow for more strict type checking and reduce runtime errors. While researching, many good points were discovered about Expo router instead of React Navigation. While React Navigation did not pose any major issues and was easy to use, Expo Router may prove to be more sustainable for long term development and should be considered. More analysis data should be added to the analysis page to provide the user with possible triggers or which symptoms are commonly tracked together or to notify the user when an unusual pattern is detected. The app could also be expanded to include more detailed analysis of user data, such as predicting when a user's next period will start based on their previous data, or include a quiz to indicate what stage of menopause they may be in and why. Finally, the app could be expanded to include more educational resources on perimenopause and related topics, such as articles, videos, and podcasts. A database connection could also be added so that those who want to back up their data can do so. Integrating the app with Apple Health or health watches and other apps to reduce the amount of work a user has to go through to input data may make the app more popular and give the app more data to increase analysis accuracy. Creating compatibility with the NHS digital front door app that is currently in the works would also be a good next step to increase the app's reach and usability. This could be accomplished in the form of easy data exporting from the tracking app to the NHS app so doctors are more aware of what their patients are going through and are better equipped to help perimenopausal individuals.

7 Conclusion

The conclusion is similar to when a plane lands. You don't rewrite the introduction. You say something like - I addressed the problem outlined in the introduction, and I built some software to do this. I tested the software like this ADD FEW WORDS.

Summarize main findings drawn from the project work. Mention the objectives or research questions. Do not repeat points raised in the discussion and reflection Section. If applicable, you can make recommendations. The conclusion should NOT contain any references.

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A Appendix

This is where you can include your documentation.

Remember that the marker is not required to read this, but might well check to ensure that you have included product documentation, and ethical approval, as required.

A.1 Ethical Approval Form

Title of Research: Navigating Perimenopause: A Study on Symptom Tracking, Healthcare Communication, and Effective Tools Among Women in Transition

Summary

This study aims to explore the experiences of women in perimenopause regarding symptom tracking and communication with healthcare providers. With a focus on identifying effective tools and strategies, the research seeks to gather insights that can improve support systems for women navigating this transitional phase of life. By understanding the methods women use to track their symptoms and engage with healthcare, the study aims to enhance their mental and physical health, ultimately providing recommendations for resources and tools that empower women during this significant life stage.

How will participants be recruited?

I will recruit women between the ages of 30-60 through the following methods:

- Inviting personal contacts in this demographic
- Ask my supervisor to utilise professional and colleague email contacts and distribution lists to identify and invite women to participate
- posting a link to the form on social media groups and forums dedicated to women's health and menopause (only if struggling with recruitment).

I am to recruit up to 20 participants across the three phases of this project.

To the participants that will be recruited via email, the email will be structured as follows:

Dear possible participant,

I am a 4th-year undergraduate computer science student making an app to help women through the perimenopausal phase. You are being contacted because you are a woman between the ages of 30-60. This study aims to provide a helpful tool to help women navigate this transitional phase of life. If you decide to participate, you may be asked to either fill out an online survey, test the app, or provide feedback via an online form or interview. You will not be required to participate in all the phases of the study if you do not wish to. To find out more information please see the attached Participant Information Sheet.

Thank you for your time,

*Kiran Mahn
4th Year Computer Science Student
University of Strathclyde*

What will the participants be told about the proposed research study?

Please see the attached Participant Information Sheet.

How will consent be demonstrated?

Please see the attached Consent Form.

What will participants be expected to do?

Participants are expected to answer questions relative to each phase and some will be asked to use an app developed during the study:

User Requirements Phase (Nov 20 – Dec 31): In preparation for building the product, participants will be asked to complete a questionnaire via Microsoft Forms. This online questionnaire will contain the following questions. The first page of all online surveys done will be the consent form with text saying that by completing the survey, they are implying consent to take part in that phase. The survey is here:

<https://forms.office.com/Pages/ResponsePage.aspx?id=YwceYzMV60elzQRXvuWUTmZRiFbzRbxNrl7mdBlWOx9URE4zV1hGSVNREY1WEFPMzYwNENNNDNHQy4u>

Testing and evaluation (Jan 1 – March 25):

After creating the initial product, users will be asked to use the app. This will involve creating an account with the app (username, password, and email) and tracking their perimenopausal symptoms for up to one week. If time allows another round of testing and evaluation will be carried out.

This does not have to be a real email, and they are advised that their password should not be an existing password that you use for another site or service. Their email, username, password, and any information they provide in using the app will be stored on the university run server. Only the researcher and their supervisor will have access to this data which will be deleted in April of 2025 when the study is complete.

A few participants will be asked to complete an online system usability survey with questions from the SUS provided by the Agency for Healthcare Research and Quality (.gov) at this link:

https://digital.ahrq.gov/sites/default/files/docs/survey/systemusabilityscale%2528sus%2529_comp%255B1%255D.pdf.

In addition, a small selection of participants may be asked to do in-person/online interviews. I will share my screen with a copy of the consent form and orally ask for the participant's verbal consent. There will be an audio recording of the live interviews done on Microsoft Teams that will be transcribed after without attaching the participants name to their transcription to keep the data anonymous. Once the transcription has been made, the original audio will be deleted. The transcription will be deleted at the end of the study. They may be asked some of the following questions:

- 1. What were your initial impressions of the app when you first started using it?**
What aspects stood out to you, either positively or negatively?
- 2. How did the app meet or not meet your expectations for tracking symptoms?**
Was there anything specific that exceeded or fell short of what you were looking for?
- 3. Can you walk me through how you typically use the app? What's your process for logging symptoms or accessing insights, and how does it fit into your daily routine?**
- 4. Which features or tools within the app did you find the most useful, and why?**
Were there specific aspects that made tracking easier or more insightful?
- 5. Did any part of using the app feel confusing or difficult?**
Was there anything in the navigation, terminology, or setup that caused hesitation?
- 6. Were there any features you found yourself wanting or expecting that the app didn't offer?**
Any specific data views, customization options, or reports?
- 7. Can you describe any new insights or patterns you discovered using the app?**
Did the app help reveal any previously unnoticed trends in your symptoms?
- 8. Would you use the app data to share tracking information and trends with your healthcare provider (hypothetically)?**
If yes, how did that go? Did the app provide helpful information for that discussion?
- 9. How has the app impacted your understanding of your symptoms or perimenopausal experience overall?**
Do you feel more in control, knowledgeable, or equipped to handle certain symptoms?
- 10. How did you feel about the app's notifications or reminders to log symptoms?**
Were they helpful, or annoying, or did you need them to be more customizable?
- 11. What, if any, impact has using the app had on your self-care or symptom management practices?**
Have you implemented any new strategies or approaches because of tracking?
- 12. Do you feel the app sufficiently addresses your mental and emotional well-being, or is it more focused on physical symptoms?**
Would you want more emphasis on mental health tracking or support?
- 13. Can you describe any specific frustrations, or pain points you've encountered when using the app?**
Are there things that interrupt your experience or make you less likely to use the app consistently?
- 14. If you could change one thing about the app, what would it be and why?**
This could include design, functionality, or specific features.
- 15. Would you continue using the app long-term? Why or why not?**
What would encourage or discourage continued use?
- 16. Are there any other comments or suggestions you have for improving the app?**
Anything about the experience that hasn't yet been covered?
- 17. Is there anything else you would like to discuss or tell me about your experience?**
(if overtime ask for consent to continue, like do you have an extra 10 minutes)

What data will be collected and how will it be captured and stored and disposed of?

The data collected via spreadsheet will include participant age, email, username, password, symptoms, and responses to the questionnaire/interview questions. All data

will be anonymized, and only the researcher and supervisor will have access to it. All data will be securely stored in a university-hosted database and deleted upon study completion. The user's email will be asked for when signing up for an account with the application and will be stored in the app database, separate from their research responses. Their email will also be optionally recorded if they choose to opt-in to be part of more than one phase of the study, this will also be stored separately from their results in their university OneDrive system.

How will the data be processed?

All the data collected will be aggregated and analysed for trends using varying Python algorithms for the app. This data will be visualised in graphs and charts. Since no participant's names are collected their data remains anonymous. For the descriptive analysis of the surveys and interviews, thematic analysis of free-text responses will be used to describe the data in Microsoft Word.

A.2 Participant Information Sheet

Participant Information Sheet

Navigating Perimenopause: A Study on Symptom Tracking, Healthcare Communication, and Effective Tools Among Women in Transition

Department: Computer and Information Sciences

Study Title: Navigating Perimenopause: A Study on Symptom Tracking, Healthcare Communication, and Effective Tools Among Women in Transition

Introduction

Hello, and thank you for your interest in this study! My name is Kiran Mahn, and I am a 4th-year Computer Science undergraduate at the University of Strathclyde. I am conducting this research study to understand how women navigate perimenopause, focusing on how they track their symptoms, communicate with healthcare providers, discover their perimenopausal status, and identify which tools and strategies work best for them. This study aims to gather insights that could help improve support systems and resources for women transitioning into perimenopause and will develop a new prototype app. If you have any questions or need additional information, please feel free to reach me at my email: kiran.mahn.2021@uni.strath.ac.uk. Thank you for taking the time to consider this invitation.

Purpose of the Research

The purpose of this research is to understand how perimenopausal women track symptoms, identify patterns, and communicate with healthcare providers. By examining the tools and methods they currently use, the study aims to develop a new prototype app to support women record their symptoms, which could help support their mental and physical health. Insights from this research will provide recommendations for a new prototype app which will aim to empower women to recognize health patterns, triggers and enhance self-care and medical discussions.

Voluntary Participation

Participation in this research is entirely voluntary, and it is each your choice whether to take part. Choosing not to participate or deciding to withdraw at any point will not affect any other aspect of your care experiences. You have the right to withdraw from the study at any time without any negative consequences.

What will you do in the project?

This research is being conducted for an Undergraduate Dissertation Project between November 2024 – April 2025 and has three parts. You do not have to participate in all 3 if you do not wish to.

User Requirements (Nov 20 – Dec 31): In preparation for building the product you will be asked to complete an online questionnaire that takes about 7 minutes to complete. This online questionnaire will contain questions aimed at trying to understand your premenopausal, perimenopause, or menopause

experiences and requirements for the prototype app. At the end of the survey if you will to be contacted about the next steps such as app testing and feedback, there will be a section for you to provide your email and by doing so you will be giving your consent to be contacted about your interest in participating in any of the next steps.

Testing and evaluation (Jan 1 – March 25):

After the prototype application has been made, you will be asked to use the app. This will involve creating an account with the app (username, password, and email) and tracking your premenopausal, perimenopausal, or menopausal symptoms for up to one week. This does not have to be a real email, and your password should not be an existing password that you use for another site or service. Your email, username, password, and any information you provide in using the app will be stored on the university run server. Only the researcher and their supervisor will have access to this data which will be deleted in April of 2025 when the study is complete. You may also be asked to complete an online survey about your experience using the app. You may be contacted again for round of testing and feedback after improvements to the app are made.

Why have you been invited to take part?

You have been invited to take part because you are a woman between the ages of 30-60.

What information is being collected in the project?

The following information will be collected from each participant:

- Age
- Responses to questionnaire and interview questions
- Email (if you choose to allow us to contact you about future stages of testing and feedback. If so your survey responses will be completely separate from the email you provide us with)
- Email (if you choose to participate in the app testing stage)

Data Security and Access

Your data will be anonymized, and only the researcher and supervisor will have access to it. All data will be securely stored and deleted upon study completion.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

All personal data will be processed in accordance with data protection legislation. Please read our Privacy Notice for Research Participants for more information about your rights under the legislation.

What happens next?

If you would like to learn more about the project or participate, please contact Kiran Mahn at the University of Strathclyde. You will be asked to sign a consent form before starting. Results will form part of the dissertation report and may be published in

external dissemination activities (e.g. conference or publication); if you decide not to participate, thank you for your time and attention.

Contact Information:

- **Researcher:** Kiran Mahn, kiran.mahn.2021@uni.strath.ac.uk
- **Chief Investigator and Dissertation Supervisor:** Dr Lisa McCann, lisa.mccann@strath.ac.uk
- **Ethics Committee Contact:** ethics@cis.strath.ac.uk

This research was granted ethical approval by the Department of Computer and Information Sciences Ethics Committee.

If you have any questions/concerns, during or after the research, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact: ethics@cis.strath.ac.uk

A.3 Consent Form

Consent Form for Navigating Perimenopause: A Study on Symptom Tracking, Healthcare Communication, and Effective Tools Among Women in Transition

Name of department: Computer and Information Sciences

Title of the study: Navigating Perimenopause: A Study on Symptom Tracking, Healthcare Communication, and Effective Tools Among Women in Transition

- I confirm that I have read and understood the Participant Information Sheet for the above project and the researcher has answered any queries to my satisfaction.
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, up to the point of completion, without having to give a reason and without any consequences.
- I understand that I can request the withdrawal from the study of some personal information and that whenever possible researchers will comply with my request. This may include the following personal data:
 - Audio recordings of interviews (if participating)
 - Any data the application collects
- I understand that anonymised data (i.e. data that do not identify me personally) including my email cannot be withdrawn once they have been included in the study.
- I understand that any information recorded in the research will remain confidential and no information that identifies me will be made publicly available.
- I consent to being a participant in the project.
- I consent to being audio recorded as part of the project if I choose to participate in the live interview phase