



Research article

Design and development of the content of a mobile application to reduce risk factors of the metabolic syndrome in the climacteric

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ABSTRACT

Objective: To describe the design and development of the content of the “*Metamorfosis*” technological application to control and reduce clinical risk factors of the Metabolic Syndrome in women in climacteric stage.

Method: A multidisciplinary approach was used, guided by the Self-care Deficit Theory and a combination of methods that included literature review, interviews with women in climacteric stage who were potential users (n = 10), interviews with experts in information technologies (n = 4), and with health professionals (n = 5). During the process, a systematic evaluation was carried out to improve the acceptancy of this eHealth technology.

Results: Four modules were generated with the “*Metamorfosis*” technological application based on findings from the literature review and interviews with patients and health professionals: Module I, Self-care: Knowing your body; Module II: Self-control: Adaptation to new changes; Module III: Deviation from Health; and Module IV: Self-care Agency. In addition to the above, there are windows that provide information regarding the Dash diet and exercises with a pedometer and the link to access remote physical activity.

Conclusion: The importance of including in the design and development of the application a multidisciplinary approach and the perspectives of the potential users of the application and professionals was evidenced, in order to facilitate the use and acceptance of the application, as well as in the future the implementation of a Nursing Intervention in risk factors of metabolic syndrome in the climacteric.

1. Introduction

The climacteric stage is a physiologically normal period that is between 40 and 59 years of age, that can be observed due to the permanent cessation of menstruation, after the disappearance of ovarian activity [1]. This process is caused by the estrogenic decline, marking reproductive life, experiencing physical and emotional changes, as a result of a series of endocrinological, biological and

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emotional changes [1]. The hormonal deficit [1], typical of this stage is accompanied by a high incidence of health problems of the woman, such as the presence of some metabolic risk factors that contribute to the increase of cardiovascular diseases [2].

In this context, the so-called Metabolic Syndrome (MS) or Syndrome X arises. This is characterized by the presence of abdominal obesity, high blood pressure (HBP), insulin resistance, glucose metabolism disorder, and atherogenic dyslipidemia [2]. All these are related to metabolic, vascular, inflammatory, fibrinolytic and coagulation abnormalities [3]. There are studies that indicate that the prevalence of MS is found in 60 % of the female population [1,2], which increases in the menopause. A high prevalence of MS has been reported in pre- and post-menopausal women, ranging from 26.1 % to 50.5 % [1]. This is according to NCEP/ATPIII criteria, with high figures for Latin American postmenopausal women (42.9 %) [4], including 50.5 % in Ecuador [5].

To improve this condition, the technology-based interventions could be effective by influencing health behaviors, promoting healthy eating. Effective physical activity, and recommendations to promote the cessation of inadequate lifestyles, monitoring the presence of signs and symptoms of diseases, drug administration and facilitating the exchange of information. This would allow both users and interested parties (health authorities and health team) to be directly linked [6] at a lower cost than conventional methods [7]. These applications can be integrated into the design of an innovative system of care and can also allow better individual adaptation of an intervention to meet the needs of a population, which can also improve success rates [8]. This is how mobile applications are currently available that have been effective strategies for health control, potentially profitable and of wide scope in health surveillance [7].

In addition to this, data generated from the operative system, with its important time advantage could detect other alterations in health. With this, individualized care can be carried out in the lifestyles of the population, allowing public health providers to carry out actions to minimize risks [7]. This increases the availability of disease prevention programs through the support of mobile applications to optimize surveillance, prevention, treatment and health communication to a large number of people [8].

However, despite the great potential of eHealth interventions and the development of mobile self-care tools, there are few eHealth studies on menopause, which have been carried out mainly in white women of Anglo-Saxon countries [9,10].

Literature reviews recommend that technology-based intervention designs include a relevant theoretical basis, in order to understand and explain the barriers to health behaviors, designing applications to overcome such barriers [11]. The use of different methodologies such as the design of user-centered services and design principles of persuasive systems will be of great help [12]. For the design and development of the mobile application, a multidisciplinary approach was used, which is guided by the Self-care Deficit Theory [13]. This theory is addressed by the three sub-theories that are involved: self-care theory, self-care deficit, and nursing systems, confirming the person, well-being, nursing, and environment as meta-paradigm.

1.1. Objective

To describe design and development of the content of the “*Metamorfosis*” technological application to control and reduce clinical factors of metabolic syndrome in women in climacteric stage.

2. Method

The development of the mobile application was part of the elaboration of the nursing intervention in clinical risk factors for MS in climacteric stage (ClinicalTrials.gov ID: NCT05387174). Here, in each of the processes participated health professionals as stakeholders, directly involving the user as a key actor of the application. A combination of methods was also used, including literature review in the databases MEDLINE, PUBMED, and SciELO from 2015 to 2022 with the keywords “eHealth”, “Mobile health”, “Metabolic Syndrome”, “Menopausia”, as well as in the applications Google Play and Apple App Store [14,15]. On the other hand, interviews were carried out with experts in information technology (n = 4), and with women in climacteric stage who were potential users (n = 10), and with health professionals (n = 5). In addition, a systematic evaluation was carried out to improve the acceptancy of this eHealth technology.

The development work of the mobile application was in charge of the main researchers of the study. The multidisciplinary team held meetings during the design and development phase, and it was made up of expert nurses in climacteric and cardiovascular health, a physical education teacher, an information technology developer (IT), and a graphic designer. User-centered service design methodologies [16,17] were used to ensure user participation through the entire design and development process. At each moment, users,

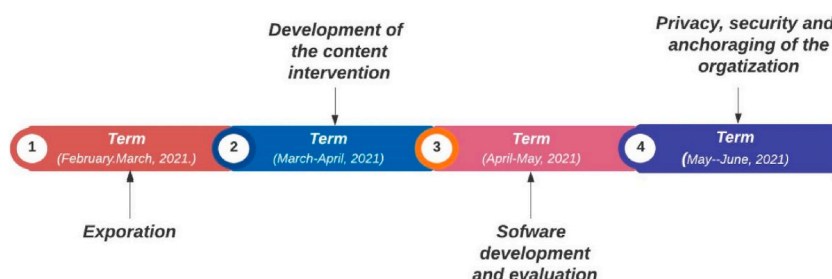


Fig. 1. Stages fulfilled for the elaboration of the mobile application.

health care providers, graphic designer and system engineer were consulted.

The development of the mobile application was carried out at various times, as shown in Fig. 1.

2.1. Exploration

2.1.1. Contribution of the users with risk factors for metabolic syndrome and climacteric

To identify the needs and requirements of users, women who receive care in a health center were invited to participate in individual interviews. Along with this, observations in the Health Center were carried out, which allowed the recognition of the real context of users and the unexpressed needs. The recruitment was performed in a Health Center of Quito (Ecuador). Data were obtained from the Automated Daily Register of Outpatient Consultations (PRASS), a digital operating system, where care appointments and complete clinical history are evidenced, obtaining a list of users seen in outpatient consultation and the Hypertensive Club. The inclusion criteria for participation in the interviews were the following: being between 40 and 59 years of age, abdominal circumference equal or greater than 80 cm, blood pressure equal or greater than 130/85 mmHg or under antihypertensive treatment, being able to walk without help, population residing in the sector in which it is registered and access to mobile or fixed internet service. The participants received oral information about the study, asking them if they were interested.

The users in this stage could choose whether they wanted to be interviewed at the Health Center or at home, being interviewed at home for 30–60 min by the main researcher (SR). Participants completed a sociodemographic questionnaire, Menopause Rating Scale (MRS) and the short version of the International Physical Activity Questionnaire (IPAQ). MRS assessed the quality of life during menopause based on the negative impact of physical, psychological, and urogenital symptoms. The psychometric properties have been reported in various studies [18–20]. IPAQ was used by the Health and Nutrition Survey (ENSANUT) to the Ecuadorian Population by age groups, as well as in national and international research, where the level of physical activity performed (high, medium/low and inactive) is considered [21–23]. They were also asked about aspects related expectations and suggestions of how to approach health care and the use of technology based on questions asked by the main researcher. Among the questions, the following were present: Who do you live with? What would you like to know about the subject? Have you searched for information on the internet? Would you like to have Access to more individualized, safe, and supportive information? Do you have cell phone? Do you have mobile or landline internet? In addition to the above, they were asked for suggestions regarding the design and development of the intervention with technological support. The interviews were recorded on audio, then transcribed, focusing on essential parts for the development of the application [24,25].

2.1.2. Collaboration of health care providers

Health care providers (nurses, doctor, nutritionist, and physical education teacher) with experience in working with women in climacteric stage and women with presence of MS risk factors were consulted. The session lasted approximately 60 min, was recorded and the verbatim transcription was performed. The content, technology, and time of applicability of the mobile application were consulted.

The *Metamorfosis* app in Menopause was approved for content validity through a process that involved the participation of experts and Professionals in the field. Two different sessions were held for this purpose: a virtual session a recognized expert in menopause, and another face-to-face session with a multidisciplinary team of Ecuadorian professionals composed of a nutritionist, a general practitioner, a nurse and a physical culture teacher. All of them are experienced and familiar with the topic of menopause and its management in the context of women's health.

During these sessions, various aspects related to the content of the application were discussed, including each of the modules, terminology, images, typography, and colors. Participants provided suggestions and feedback to improve the quality and relevance of the *Metamorfosis* app content. In addition, the feedback from these experts, pilot tests were conducted with selected participants, who used the app and provided their comments. Among the observations, the attraction to the colors used was highlighted and it was suggested to increase the font size to improve legibility. These comments were considered in the process of validating the content of the application, thus contributing to its approval. On the other hand, the content, technology and the time of applicability of the mobile application was consulted and the session lasted approximately 60 min, was recorded and the literal transcription was performed.

The support of an Information Technology (IT) provider was available, as well as a graphic designer, who collaborated with the project team. All of them with extensive experience in the development of technological tools, who were in charge of the development of the application software and the backup of information. Approximately 5 sessions lasting 60 min were held to perform changes according to suggestions of both users and health professionals.

2.1.2.1. Data analysis. Descriptive statistics were used for the information analysis of sociodemographic questionnaire and MRS and IPAQ instruments. For the analysis of the interviews, Giorgi's approach was used, which consists of four steps: 1) Read the complete description to have a general sense; 2) The text is returned to the beginning and re-read with the intention to explore the "units of meaning"; 3) Depending on these units, their "psychological insight" is expressed; and 4) the transformations of these units are synthesized in a statement that contemplates the structure of the participant's experience [26].

Regarding the methodological rigor, the following criteria were taken into consideration: Dependency during recollection and analysis of the data, and multiple adjustments were performed by the researchers (ASM, VVB), in order to achieve consistent interpretations [27]. This aspect is closely related to the credibility of the data and it is referred to capturing the full and deep meaning of the experiences of the people who participated in the study and transmitting it [27]. Another criterium was transference, which

considers that part of the results or their essence can be applied in other contexts. This provides a guideline to achieve a general idea of the problem investigated and to apply the solution that arose in another context [27].

Finally, the confirmability criterion, which is referred to the fact that it must be demonstrated that the researchers' biases and tendencies have been minimized [27]. This was achieved by clearly stating the entire process of selection, collection, and analysis of the data.

2.1.3. Mobile app content development

For the development of the content, a review of research was carried out regarding concepts related to climacteric, risk factors of MS and interventions carried out in other contexts that have given positive results [9,10,28].

2.1.3.1. Software development and formative evaluation

2.1.3.1.1. Development of low-fidelity prototype. Once the necessary content adjustments and the contributions of participants that were identified in the exploration phase were obtained, the first version of the low-fidelity software was developed. This consists of the hard copy prototype that provided the home page, menu page and design screens of the first intervention and content module.

In the first meeting, the eHealth experts tested and gave their opinion about the prototype to ensure the logical creation, in order to meet the requirements of the participants. Then, the researcher met with health experts to socialize the contents of the module and provide feedback on its development. After some adjustments, the paper prototype was implemented in power point (Microsoft office 2016) for better understanding based on the Marvel paper prototype [29] (Fig. 2).

In a second meeting, the users of the Health Center were asked to review the prototype and provide feedback and suggestions. During this test of the prototype, observations and asked were performed and notes were taken of what the users reported. Recommendations to adjust the prototype were provided to the team and then, the development of the high-fidelity prototype began.

2.1.3.1.2. Development of the high-fidelity prototype. The high-fidelity prototype was developed with the actual software homepage, menu page and 4 modules. To ensure usability, a third meeting was held with users, thematic expert health providers and eHealth experts to test it. Usability is referred to the ability of an application to be attractive, understood, learned, and used by the participants provided for in certain conditions of use [30].

A record of possible risks and errors was kept; a pilot model was defined on which adjustments were made and follow-up questions were asked (for example, can you enter the start menu? Can you go to the exercise module/my page/contacts?). Thus, observations and feedback from stakeholders were taken and used to evaluate, adjust and update the prototype. All functionalities, content descriptions and modules were tested to verify their functionality and finally their implementation throughout the Nursing Intervention process in clinical risk factors for MS in the climacteric (Fig. 3).

2.1.4. Privacy, safety and anchoring to the organization

Privacy and security were guaranteed for the project. The institution that hosted the consulted information was consulted from the initial stage, regarding the issues of personal data storing, as well as the access keys to enter the system safely. Likewise, users were trained to log out after finishing. The security, privacy and confidentiality of the data depended on the operating software, the device, network and servers. Security issues related to the behavior of the user were addressed based on the context and national policy, where the Ministerial Agreement 5216, articles 8, 10, 11 and 18 of the Ministry of Public Health of Ecuador indicates the security and

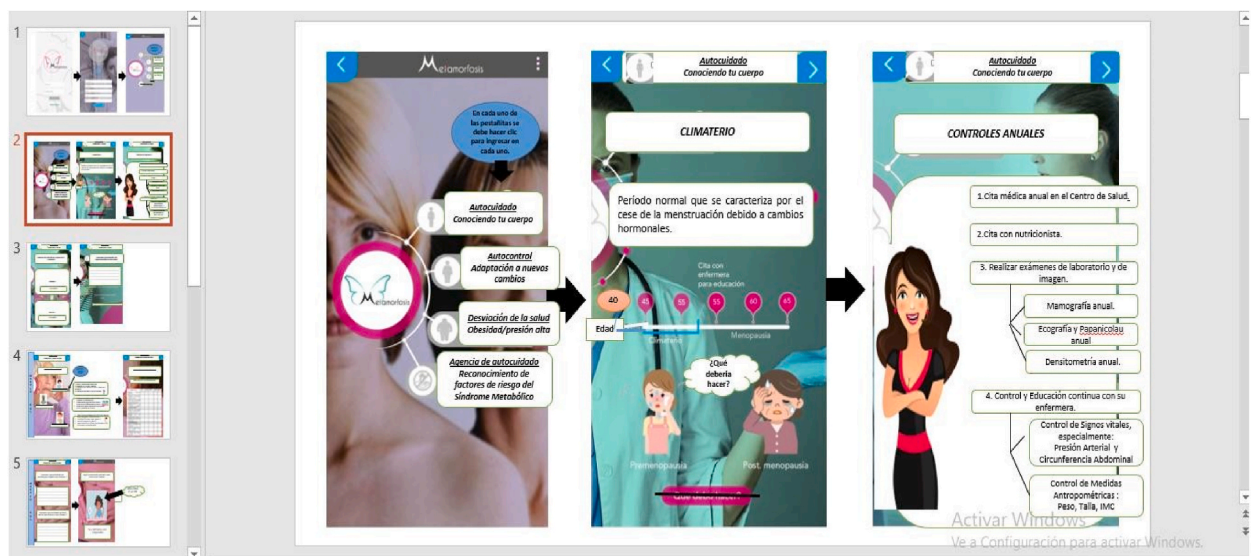


Fig. 2. Power point design of the mobile application.

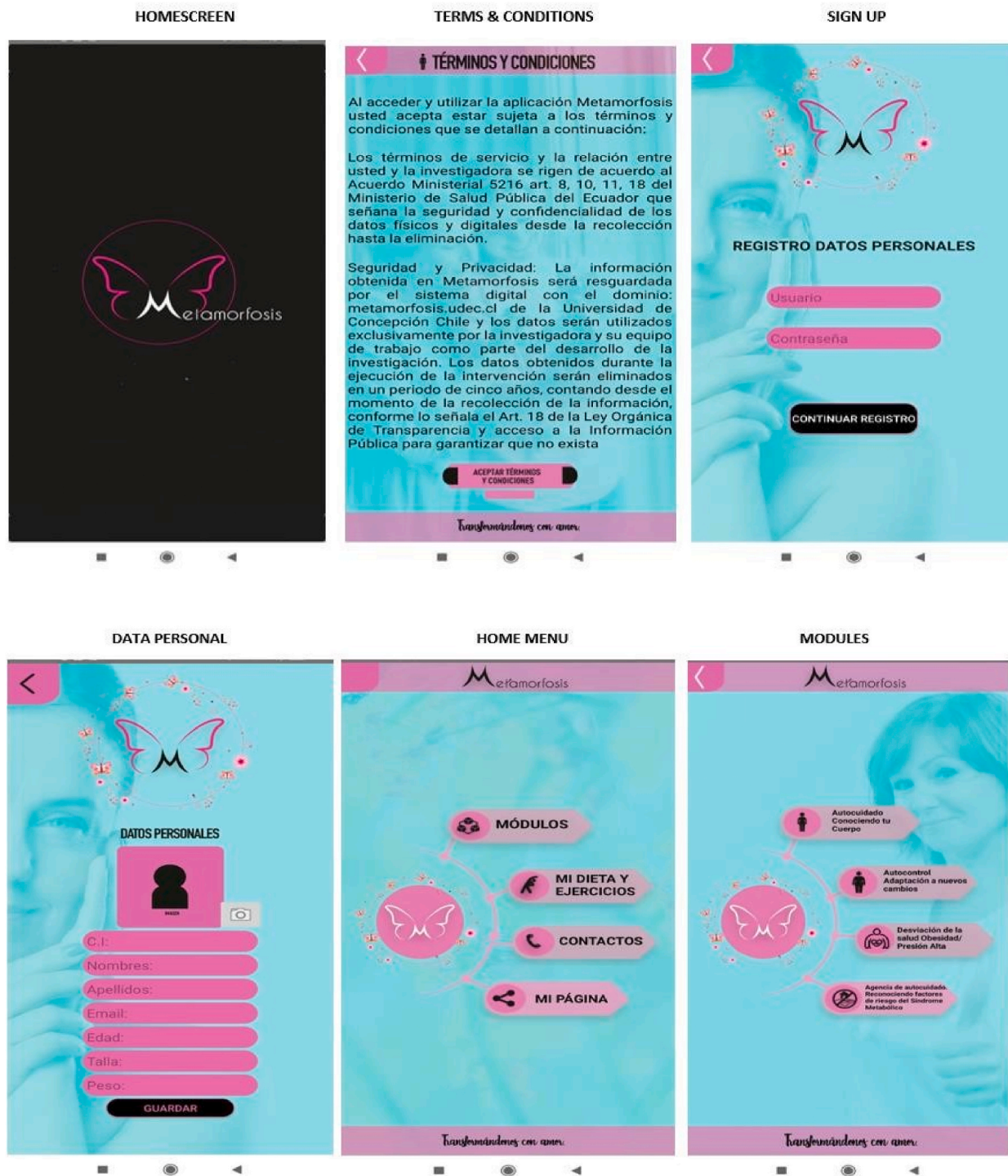


Fig. 3. High-fidelity prototype.

confidentiality of physical and digital data from collection to elimination.

In addition to the above, to safeguard the security of sensitive data, the amount of data that is collected and stored on the device was limited, including internal memory or removable storage, such as the SD card. Data was encrypted using the standard advanced encryption algorithm and a backup or file of the data was created to avoid their loss.

All these procedures were carried out following the ethical considerations by Emanuel [31]. The study was approved by the Ethical Scientific Committee of the Universidad de Concepción, Chile, and the Universidad Central del Ecuador.

3. Results

3.1. Participants

The participants were women between 40 and 59 years old (Mean 51.3; Median 49; SD 4.81) (n = 10) with clinical risk factors of MS who participated in individual interviews in their homes providing information about sociodemographic characteristics, quality of life in the climacteric and physical activity (Table 1).

The educational need to obtain "Knowledge" was evidenced, being considered for both design and development of the app. This is illustrated with the patients cited: "what is the climacteric and what does that mean for women", "what is menopause", "what should I do with the symptoms and what is metabolic syndrome", "until when should I menstruate".

Additionally, an interview was conducted about the importance of having information for the climacteric and about abdominal obesity and arterial hypertension, the use of technology and health information, the needs, and requirements to improve the condition.

Health care providers (n = 5), one nurse, one climacteric specialist, one doctor, one nutritionist, and one physical education teacher. Three of them were women and an average experience of 9.2 years in the approach to women in climacteric stage and women with presence of MS risk factors (Median 5; Min. 3 Max. 23).

Two eHealth experts, one graphic designer, and one web developer also provided their opinion on how would be the best way to present and provide the content of the application regarding MS risk factors that can affect the quality of life of these women.

3.2. Contributions of the participants, health care providers and eHealth experts

During the interviews, participants asked a series of questions about the transition from reproductive to non-reproductive life and how to recognize risk factors such as abdominal obesity and blood hypertension, and fear of climacteric changes. These include memory loss, doubts regarding menstruation, sleep disorders, depression, worries, new image of themselves, weight gain, presence of high blood pressure and how to treat it, the feeling of empty nest, lack of work, and social isolation and its negative effects on the quality of life. In addition, they reported that the family has served as a fundamental pillar to cope these changes. They reported that health providers should provide further information regarding the climacteric and MS risk factors. Furthermore, the system should provide the necessary medication to treat the disease, expressing some dissatisfaction with the information received in the consultations. In this way, they should solve their doubts in internet portals.

In addition to the above, the participants indicated that they had cell phones to enter the internet and search for information regarding the changes presented in the climacteric, such as diet and exercise. On the other hand, they also mentioned that their children helped them to download applications related to health, but almost never they used it due to difficulty in navigating or because of the language. The frequency of cell phone use is from one to two times a day, making it more useful for distraction and communication with family and friends. During the interviews, it was evident that all the women had cell phones with an Android

Table 1
Characteristics of participants (n = 10).

Characteristics	n	
Civil status	Single	4
	Married	2
	Divorced	2
	Widow	2
Level of studies	Incomplete primary	1
	Complete primary	3
	Incomplete high school	3
	Complete high school	1
	Incomplete university education	1
Ethnic group	Complete university education	1
	Half blood	7
	Indigenous	1
	Montubia	1
Physical activity and Health-related quality of life (n = 10)	Afro-Ecuadorian	1
	Inactive	3
	Low activity	4
	Medium and high activity	3
Menopause Rating Scale category	Absent	1
	Moderate	1
	Severe	3
	Very severe	1
Have you searched for information on the Internet?	Yes	5
	No	5
Would you like to have access to information more individualized, safe and supportive?	Yes	10
Do you have a mobile phone?	Yes	10
Do you have mobile or fixed Internet?	Yes	10

system, so the cell phone application was created based on these parameters. When asked about the interest of having an application related to the climacteric and the risk factors of MS, such as abdominal obesity and hypertension, they pointed out that the application should: meet the needs of women; be attractive; easy to understand; with clear and pleasant images; content should be based on your needs; with quick access and in Spanish.

The health providers pointed out that the users of the Health Center are people with a medium and low socioeconomic level. In addition, the changes of age bring with them problems of concentration, mood changes, so they suggest with respect to the content of the application that it be easily accessible, as understandable as possible, and written in a common non-academic language. In addition, windows should not have too much content that can confuse them and maintain clear language. Regarding the design that the images, that are clear and pleasing to the eye, attractive and dynamic. With regard to the design that the images, these should be clear and pleasing to the eye, attractive and dynamic. In the physical activity window, which allows them to access without difficulty the sessions created, and the pedometer can record the steps taken on the established days. To increase adherence and engagement, it was considered to ensure easy download of the app on the cell phone (Table 2: summarizes participant comments in the exploration phase).

The app offers a combination of text, the integration of a pedometer, images and video. Participants were asked to provide suggestions for the name of the application, three options were provided such as “metamorphosis”, “new life”, “women’s health”, the final name of “*Metamorfosis*” was chosen for the transformation women must experience, though in a harmonious and beautiful way, incorporating the figure of a butterfly as the central image.

To facilitate the installation and management of the mobile application, an individual face-to-face session was held to help in the download, installation and management of the application. In some cell phones due to their low capacity, adjustments were made to download the application.

3.3. Mobile app content development

The content of the “*Metamorfosis*” application was designed in accordance with the evidence from the literature review related to climacteric and MS [2,5,9,32]. This incorporates the Self-care Deficit Theory, as well as the recommendations to integrate elements that allow overcoming the barriers for health behaviors. Thus, the recommendation to monitor the parameters and promote a healthy lifestyle is established [6,8,12]. In addition, it was investigated regarding programs and technological applications in eHealth, such as “NutriGenomeDB” [33–36], in order to solve personal requirements, including “The Body- Q” and “Crcoder” [36] interventions.

The content of the initial application was developed by the researchers of the present study and then adapted to the needs of Ecuadorian women. The team worked in four windows (modules, my diet and exercises, contacts, and my page). Within the “Modules” window, four informative modules are evidenced, each with the commitments of the participants.

Module I, Self-care: Knowing your body, where topics related to the climacteric stage, annual exams and life histories of women are addressed.

Module II, Self-control: Adaptation to new changes, assessing symptoms of this stage and evaluating the quality of life related to health in menopause with Spanish version of the MRS, which has been validated in Ecuador and Chile [18,37].

Module III, Health Deviation: addressing two risk factors for MS (abdominal obesity and arterial hypertension) in the climacteric stage.

Module IV, Self-Care Agency: recognizing women’s modifiable and non-modifiable risk factors to improve health status.

The “My diet and exercise” window provides information regarding the Dash diet [36] and the exercise tab includes step counters and online exercise sessions, according to the 1x2x3method [38].

In the “Contacts” window, the telephone numbers of health assistance (call center for medical appointment, emergency and researcher) were installed. To finish the Windows, “My page” can be found. “My page” where an explanation of the perceived changes and the importance of self-care was worked on. In case of doubts or concerns, the email of one of the researchers was added.

Each version was approved by the participants, using personal information (biodemographic background), to meet the requirements described above. A work was carried out to create a friendly application format, where the content was easy to access and to ensure that the scientific base was up to date. As the modules were created, they worked together with the programming of the application and the adjustments were made based on the usability tests. Fig. 4 shows a summary of the 4 modules and the topics

Table 2
Exploration phase and user requirements.

Exploration phase: user requirements		
Topics of importance to users	Participants (n = 10)	eHealth experts and health care providers (n = 5)
Content	Clear images Easy access Clear content Needs-based content Easy to understand text Spanish language	Quick access Clear language Easy to understand
Design	Smartphone required Android system	Attractive Clear and visually pleasing images
Commitment and adherence	N/A ^a	Fast download Technical support offered

^a N/A: Not applied.

addressed.

3.4. Software development and evaluation

The usability tests of the app both in the paper and the high-fidelity allowed prototypes allowed adjustments to ensure an easier navigation, new icons, standard window sizes with a clear and attractive design to allow adherence. Adjustments were made in terms of language clarity two videos of real-life stories were installed and changes were performed to show more friendly images. Within the My diet and exercises module, modifications were made so that, in addition to providing a button to join the physical activity session, it would be possible to enter blood pressure and heart rate data before and after each physical activity session [39].

Based on the suggestions of the participants, the following adjustments were produced: clear and accurate information to understand presented in a common language without academic or medical terminology; the type of content should be educational and dynamic, favorite exercises should be easy to locate and access; the pedometer should be easy and practical for hiking and its records should be constant.

3.5. Anchoring privacy, safety and confidentiality

The security, privacy, confidentiality, and storage of physical and digital eHealth data were carried out on the servers of the Information Technology Department of the Universidad de Concepción-Chile.

The data obtained will be eliminated in a period of five years, counting from the moment of collecting the information, as indicated in Art. 18 of the Organic Law of Transparency and access to Public Information, to guarantee that there is no risk of exhibition.

4. Discussion

Both design and development of “*Metamorfosis*” identified a series of challenges and needs for the researchers, since the requirements of the climacteric women with clinical risks for MS are evident over the years. This is where scientific evidence and use of technology focused on the needs of the participants is essential for the creation of this type of technological support. An integrative review of eHealth studies focused on chronic diseases showed 33 studies that used mobile applications for monitoring daily care in the general population [40].

Risk factors for MS such as abdominal obesity and high blood pressure cause long-term negative results in the quality of life [1], and along with this, an increase of the cardiovascular diseases. When conducting the interview in each of the households it was evidenced in the results of the “Menopause Rating Scale” a symptom that negatively affects the health-related quality of life (HRQL). Regarding the results of the instrument (IPAQ) similar results were established between the high, middle/low and inactive levels of physical activity.

In addition, a series of needs was evidenced in all interviewees. These include a change in the body image, depression due to diseases such as hypertension, the onset of a pharmacological treatment, and somatic symptoms. Similar results have been found in other studies, where sedentarism and negative changes in the quality of life have been observed, related to health in the short and long term, when presenting abdominal obesity and hypertension [18,41].



Fig. 4. Screenshots of the “*Metamorfosis*” application.

For nursing professionals, addressing these problems through interventions has a great potential, so the process of involving stakeholders in the design and development of the intervention is crucial [8].

In addition to the above, interviews and comments of the eHealth providers and the health expert assertively directed both design and development of the app, allowing the quality of the operating of the operating system based on requirements evidenced on health care. This provides a higher level of user acceptance, improving functionality and ease of use, thus increasing the probability of promoting healthy lifestyles [16].

The process was carried out through user-centered service design methodologies [16,17] and persuasive system design elements [12], in order to influence the behavior of those women. This was achieved by motivating them in a positive way by motivating them to participate in their self-care and promoting changes in their health behavior. These elements included: personalization, an animated figure (butterfly) accompanying the use, feedback, goal-settings, reminders, and social support. These elements allow to contribute to the adherence of the care processes [12].

The content of the app was based on the Self-care Deficit Theory, where the health needs of the participants were evidenced, in agreement with a systematic review that indicates that interventions are better designed when relevant theories are used [11]. The app contains informative modules regarding self-care, each with the commitments of the participants. A module regarding “My diet and exercise” using the $1 \times 2 \times 3$ method, whose benefits are focused on reducing cardiovascular stress, reaching high intensities that actually produce histochemical and physiological adaptations and develop, maintaining and developing muscular mass avoiding sarcopenia. Thus, the physiological alterations produced by poor muscle capacity are avoided in order to reduce body weight [38,42]. The participants mentioned that the information obtained in the mobile application is easy to access, useful, with clear language and easy to understand and that it will help them to be informed each time about their health situation, which will increase the knowledge of women and contribute to reducing their risks regarding MS and cardiovascular diseases. These results are consistent with some mobile applications created for women in the climacteric stage and with cardiovascular risk, such as “Menopause”, “Hacking Menopause”, and “MenoPro”. These apps have allowed decision-making to modify inefficient or inadequate lifestyles and provide suggestions to keep a full attention and physical conditioning [14].

Therefore, it is considered that the multidisciplinary method focused on the user allowed to identify a series of needs and requirements for the cell application provides positive results and improve the possibilities of success in the future implementation [16].

“*Metamorfosis*”, as technological support of an intervention aimed to climacteric women with clinical risks factors for MS (abdominal obesity and high blood pressure) is based on proven scientific evidence. This provides a new option based on the needs of the women to generate changes, reduce and control blood pressure and weight. However, its success will depend on whether the participants consider that the app is useful and easy use and adhere to, which will be reviewed in further studies [10]. A new version incorporating the creation of commitments, notifications or reminders, adherence rewards, and a health monitoring history has been considered to improve adherence [43].

There are other applications available in English or French language to address symptoms associated to menopause. Among them, Vita Nova is highlighted, which has been designed to reduce cardiovascular disease, decrease depression symptoms, and improve lifestyles to enhance the quality of life of the participants [9,10]. Therefore, “*Metamorfosis*” along with other eHealth apps have great potential to support self-care, and improve patient experiences, besides providing a review of the content under the scientific knowledge of health professionals who offer the opportunity to reach women at this stage [14].

Regarding web-based interventions to address menopause, a review of the studies concluded that: the most used systems have been decision support systems; that there was a lack of guidance on the use of the interventions; face-to-face counseling was combined with web-based interventions and that the pros and cons were similar to those of web-based methods, in general. Finally, they point out that women of multiple ethnicities and/or from various countries should be included in future research [9].

In the Latin American case, there are no cell apps in Spanish language, aimed to women in climacteric stage with MS risk factors. Therefore, acceptability and utilization in other languages in these countries is difficult. A poorly designed intervention or with scientific evidence that is not well systematized, decreases the interest of using this type of applications in the participants, not providing good results [44]. Evidence-based strategies, user input, and easy-to-use technology must work in harmony for an app to be widely used and effective.

4.1. Strengths, limitations and future directions

Regarding the strengths in the design and development of the application, the joint work of climacteric women with clinical risk factors of MS (abdominal obesity and blood hypertension) together with the multidisciplinary team, nurse, doctor, health expert, physical education teacher, systems engineer and graphic designer is evident. The Security and Privacy Protection Committee of the operating system of the Universidad de Concepción of Chile, allowed to increase the potential for the development of the application to be more effective and harmonious. In addition, the initial involvement of all stakeholders can increase the potential for further implementation of the application in other institutions.

The study has some limitations that must be considered: difficulties in the recruitment of participants, especially those with low socioeconomic level [9]. The educational level influenced at the moment of informing on regarding the handling of the cell application. Telephones were not very advanced, so adjustments were performed in each one for the installation. The usability test in the first instance had not all the modules, so it was difficult to navigate, and the number of participants was limited. However, these are aspects that usually occur in the tool design process and Internet access [16,17].

Finally, future updates are expected to incorporate the monitoring and recording of other risk factors for MS (glycemia, cholesterol, triglycerides) and variables such as sleep quality. It will also be necessary to examine the effect of app-based interventions such as

Metamorphosis in a randomized controlled trial (RCTs).

5. Conclusion

The importance of including in the design and development of the application a multidisciplinary approach and the perspectives of the potential users of the application and professionals was evidenced, to facilitate the use and acceptance of the application, as well as in the future the implementation of a Nursing Intervention in risk factors of MS in the climacteric.

CRedit authorship contribution statement

Sandra Riofrío Terrazas: Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Alide Salazar Molina:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Vivian Vélchez Barboza:** Writing – review & editing, Writing – original draft, Validation, Software, Project administration, Methodology, Investigation. **Liliana Cuadra Montoya:** Investigation. **Geovanny Riofrío Terrazas:** Visualization, Software, Resources. **Indira López Izurieta:** Supervision, Investigation.

Ethics committee

Approved by Universidad de Concepción Chile and Universidad Central del Ecuador on April 21, 2020, Ref Resolution N 095-20.

Patents and intellectual property

Sandra Riofrío Terrazas has patent # Intellectual Property Registry N 2023-A-12735 year 2023, granted to the Universidad de Concepcion-Sandra Riofrío Terrazas.

Availability of data and materials

Data included in article/supp. material/referenced in article.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Sandra Riofrío Terrazas has patent #Registro de Propiedad Intelectual N° 2023-A-12735 año 2023 issued to Universidad de Concepción-Sandra Riofrío Terrazas. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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