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Original Article

Development of a mobile application about cervical cancer and cytopathological screening for pregnant women*

Desenvolvimento de aplicativo móvel acerca do câncer de colo de útero e exame citopatológico para gestantes

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ABSTRACT

Objective: to develop and evaluate evidence of the validity of a mobile application on the importance of cytopathological examination for pregnant women. **Methods:** this is a methodological study developed in four stages: literature review, design, development, and evidence of the application's validity. The Content Validity Index was used to analyze content and appearance validity. The binomial test was applied to establish the proportion of agreement among experts. **Results:** the application was developed with an easy-to-view interface and pleasing appearance, using clear language and consisting of four topics (cervical cancer, cervical screening, cancer in pregnancy, and routine). After analyzing the content and functional performance, it was evident that the mobile application, My cervix® ("*Meu colo*®", in Portuguese), showed good evidence of validity, with overall content and appearance validity indices above 0.80. **Conclusion:** the mobile application developed and validated proved to be a technological innovation with the potential to promote knowledge about cytopathological screening for pregnant women. **Contributions to practice:** the mobile application can be a valuable tool in clinical and nursing care practice to guide pregnant women about cervical cancer.
Descriptors: Educational Technology; Papanicolaou Test; Uterine Cervical Neoplasms; Nursing Care; Prenatal Care.

RESUMO

Objetivo: desenvolver e avaliar as evidências de validade de aplicativo móvel acerca da importância do exame citopatológico para gestantes. **Métodos:** trata-se de estudo metodológico desenvolvido em quatro etapas: revisão de literatura, *design*, desenvolvimento e evidências de validade do aplicativo. Utilizou-se o Índice de Validade de Conteúdo para análise de validade de conteúdo e aparência. Aplicou-se o teste binomial para estabelecer a proporção de concordância entre os especialistas. **Resultados:** o aplicativo foi desenvolvido com uma interface de fácil visualização e boa aparência, dispondo de uma linguagem clara, sendo composto por 4 tópicos (câncer de colo do útero, exame do colo do útero, câncer na gravidez e rotina). Após a análise de evidência de conteúdo e desempenho funcional, evidenciou-se que o aplicativo móvel "Meu colo®" apresentou boa evidência de validade, com índices gerais de validade de conteúdo e de aparência, superiores a 0,80. **Conclusão:** o aplicativo móvel desenvolvido e validado mostrou-se uma inovação tecnológica com o potencial de favorecer o conhecimento sobre o exame citopatológico para as gestantes. **Contribuições para a prática:** o aplicativo móvel na prática clínica e assistencial de enfermagem poderá ser uma ferramenta necessária para orientar as gestantes sobre o câncer de colo de útero.
Descritores: Tecnologia Educacional; Teste de Papanicolaou; Neoplasias do Colo do Útero; Cuidados de Enfermagem; Cuidado Pré-Natal.

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Introduction

Cervical cancer is characterized by the rapid abnormal multiplication of cells that make up the squamocolumnar junction of the cervix, with a high potential to invade neighboring structures and organs and spread to distant sites. The primary risk factor is persistent exposure to human papillomavirus (HPV), specifically the oncogenic types 16 and 18[1]. It is a slow-progressing disease with high potential for prevention and cure when diagnosed early. However, prevalence and mortality rates remain high in underdeveloped countries, which account for about 83% of cervical cancer cases[2].

The cytopathological examination, also known as the Pap test, is still the leading test for screening for precursor lesions of cervical cancer. It is a painless and simple test offered free of charge by the Brazilian Unified Health System (SUS) and recommended for women who have had sexual intercourse and are between the ages of 25 and 64. It is recommended that it be performed annually; however, women who have had two consecutive negative results may perform it every three years[3]. For pregnant women, ministerial recommendations regarding the age and frequency of the test are like those for the general population[4].

In this context, it is noteworthy that when women lack knowledge about the purpose of cytopathology, combined with inappropriate attitudes and practices, these factors contribute to low adherence. Despite educational initiatives implemented by health professionals, knowledge about the subject remains limited[5].

All women, especially pregnant women and transgender men, should undergo cytopathological examination, as data show that cervical neoplasia occurs in 1 to 12 cases per 10,000 pregnancies, becoming prevalent during the gestational period[6]. The gestational period, through prenatal care, is a unique time for cytopathological examination[7].

It is known that the main factors influencing the non-performance of cytopathological examinations in pregnant women are related to socioeconomic factors, a low number of prenatal consultations, impersonality during consultations, and a lack of knowledge about the examination[8].

Thus, the use of educational technologies has become an essential strategy for disseminating knowledge about cytopathological examinations and promoting awareness among women, including pregnant women. Therefore, the development of a mobile application is increasingly necessary, as it is an attractive, accessible, and practical everyday tool with the potential to provide pregnant women with knowledge about cytopathological testing and its performance during pregnancy, thereby encouraging their adherence to the test[9].

Therefore, the development of educational technology can help fill possible gaps in pregnant women's knowledge about cytopathology and, thus, contribute to the performance of this test to impact the incidence, morbidity, and mortality rates of cervical cancer in pregnant women.

Given the above, the objective was to develop and evaluate evidence of the validity of a mobile application on the importance of cytopathological examination for pregnant women.

Methods

This is a methodological study developed in four stages, namely: 1) literature review, 2) design, 3) application development, and 4) evidence of application validity[10]. In this study, we adopted the recommendations of the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0).

The mobile application was developed between November 2021 and March 2022. The book "Teaching Patients with Low Literacy Skills"[11] served as a theoretical reference for the development of the mobile application, which offers recommendations on written communication used in health education

practices, with an emphasis on the vocabulary to be used in dialogue with the target audience. In addition, it is recommended that the writing be attractive and easy to understand by the intended audience, avoiding technical, lengthy, and complex terms that hinder readability, legibility, and comprehension.

The first stage involved gathering scientific evidence on factors related to pregnant women's knowledge, attitudes, and practices regarding cytopathological testing to inform the selection of content for the mobile application. To this end, an integrative literature review was conducted, following the six fundamental steps[12], to answer the following research question: What factors related to the knowledge, attitudes, and practices of pregnant women influence their adherence to cytopathological screening during prenatal care? The search for articles was conducted in the following databases: Latin American and Caribbean Health Sciences Literature (LILACS), Nursing Database (BDENF), Medical Literature Analysis and Retrieval System Online (MEDLINE), SCOPUS, and EMBASE.

The PVO mnemonic strategy (P – Population/Pregnant women; V – Variable of interest/knowledge, attitude, and practice; O – Outcome/Cytopathological examination) was employed to define the MeSH and DeCS terms, which were cross-referenced in the databases using the Boolean operators "AND" and "OR."

It should be noted that, in addition to the evidence found, the manual containing the Brazilian Guidelines for Cervical Cancer Screening[4] was also consulted for the composition of the app's content.

Based on the content available through the integrative review and outlined in the guidelines, it was possible to develop the textual material and topics that comprise the mobile application. From this, a roadmap was constructed with an outline of the content to be addressed, breaking it down into sections for each interface of the application with the necessary guidelines on how to perform cytopathological testing during pregnancy. Given this, clear and succinct language was adopted to facilitate the target audience's understanding of the content.

In the design phase, the content was organized to promote knowledge, attitudes, and practices among pregnant women regarding cytopathological testing, based on the evidence obtained in the first stage. Simple, easy-to-read, and easy-to-understand language was adopted.

Thus, the selected and schematized content was sent to an information technology professional with experience in drawing up graphics designer, who was also responsible for creating and developing the interface, determining the system's appearance, and specifying which interface objects the user should see.

The illustrations were created using Adobe Illustrator CS3, featuring clear and straightforward visuals designed to enhance the target audience's understanding of the textual content.

Periodic meetings were held between the researchers and the IT technician to discuss and align the characteristics and aspects related to the layout and operation of the mobile prototype. Subsequently, construction of the first version of the mobile application began.

The layout was carried out by the same professional who performed the previous stage, utilizing the TypeScript programming language with the React Native framework[13] to facilitate the development of the mobile application and interaction with the mobile device. The first version of the application was sent to the researcher for evaluation.

It is essential to note that in the current technological landscape, two digital platforms dominate the smartphone market: Android and iOS, the latter being primarily used on iPhones[14]. Given this, the mobile application was developed with the initial intention of serving the Android digital platform, as this operating system currently dominates 74% of the mobile device market[15], meaning that the app can be made available in the Google Play Store, the official app store. To download the app to their smartphone, users will

need internet access. Once downloaded, it can be used offline.

After completing the development of the application interface prototype, which contained textual content, we proceeded to the phase of analyzing the application's content evidence with a group of experts in the fields of women's health, prenatal care, and information and communication. Regarding the number of experts, there is still no consensus on the ideal number in the international scientific literature; however, it is recommended that at least six experts be involved in the stage of analyzing evidence for the validity of health technologies and instruments. In addition, it is recommended that there be an odd number of experts to avoid a tie in expert opinions[16]. This recommendation was adopted for the analysis of evidence of content and functional performance of the mobile application.

The experts were selected through network sampling or snowball sampling, a valuable method for locating samples that are difficult to find by other means[17]. The first participants were selected through the Lattes Platform, based on a search for topics of interest (women's health and prenatal care). The first selected participants were then asked to recommend other possible experts.

For the selection of content validity experts, the following inclusion criteria were adopted: a nursing degree with professional experience in caring for the target audience and *lato sensu* and/or *stricto sensu* postgraduate degree in women's health. Thus, only those who met these two criteria were considered experts for evaluating the mobile application. Given this, 15 experts in the field of nursing were selected[18].

Regarding the selection of experts for functional performance validity, the following criteria were adopted: a degree in science or technology, experience in the development and implementation of systems, experience in validation studies, and authorship of scientific papers published in reputable journals. Thus, seven experts in the field of information and communication technology were selected. For both experts, the exclusion criterion was failure to update their Lattes curriculum vitae in the last six months.

After identifying and selecting the experts, a letter of invitation was sent by email, explaining the research objectives and inviting them to participate voluntarily. The experts who agreed to participate in the study received the Free and Informed Consent Form, the professional characterization, and the mobile application validation instrument through a form made available via Google Forms. The experts were asked to return the material within 20 days.

Data was collected between March and April 2022. Two instruments were used to collect the data: the first for nursing specialists and the second for information and communication technology specialists. The instruments were constructed by adapting an instrument that had already been validated[19].

The experts answered the nine questions on the instrument, choosing between "agree" and "disagree," and at the end of the instrument, there was a space for suggestions on how to improve the device. The following aspects were evaluated: 1) organization: mode of access, operation, and whether it meets the desired objective; 2) interface: appearance of screens, logical structure of data, and visual comfort for handling the application; 3) system content: clear, objective, and up-to-date information; and 4) technical: structure of data presentation and proper functioning of the system.

The data regarding the characteristics of the specialists were organized and tabulated using Excel® software version 2016, through double data entry, followed by validation to ensure data reliability. It is worth noting that the database underwent statistical analysis using Epi Info™ software version 7.2 and SPSS software version 26.0.

During the data analysis stage, absolute and relative frequencies, measures of central tendency, and measures of dispersion were calculated to describe the profile of the study experts. In addition,

the Content Validation Index (CVI) was calculated for each item evaluated[20]. It should be noted that the CVI determines the proportion and/or percentage of experts who attribute relevance to the technology or item. To specify a valid item, a concordance index greater than 0.80 is desirable. Therefore, responses to the instrument that achieved a CVI ≥ 0.80 among the experts were considered valid[21]. Using SPSS version 26.0 software, a binomial test was performed to measure the proportion of agreement among the experts, which was statistically equal to or greater than 0.80[22].

The study was conducted in accordance with all ethical recommendations outlined in Resolution 466/12 of the National Health Council. It was submitted for evaluation and approved by the Ethics and Research Committee of the Regional University of Cariri (*Universidade Regional do Cariri*), as evidenced by the Certificate of Ethical Appraisal: 50317821.0.0000.5055 and opinion number 4,964,490/2021.

Results

According to the findings of the integrative review, it was discovered that socioeconomic factors, including low educational attainment, low socioeconomic status, a lack of knowledge about the importance of cytological testing, and impersonal relationships between professionals and pregnant women, can negatively impact the performance of cytopathological testing during pregnancy.

In addition, there is a need to develop educational technologies aimed at preventing cervical cancer by addressing issues related to disease during pregnancy and cytopathological testing. This is to disseminate knowledge to the target audience, increasing this clientele's adherence to testing, and reducing morbidity and mortality rates caused by cervical cancer.

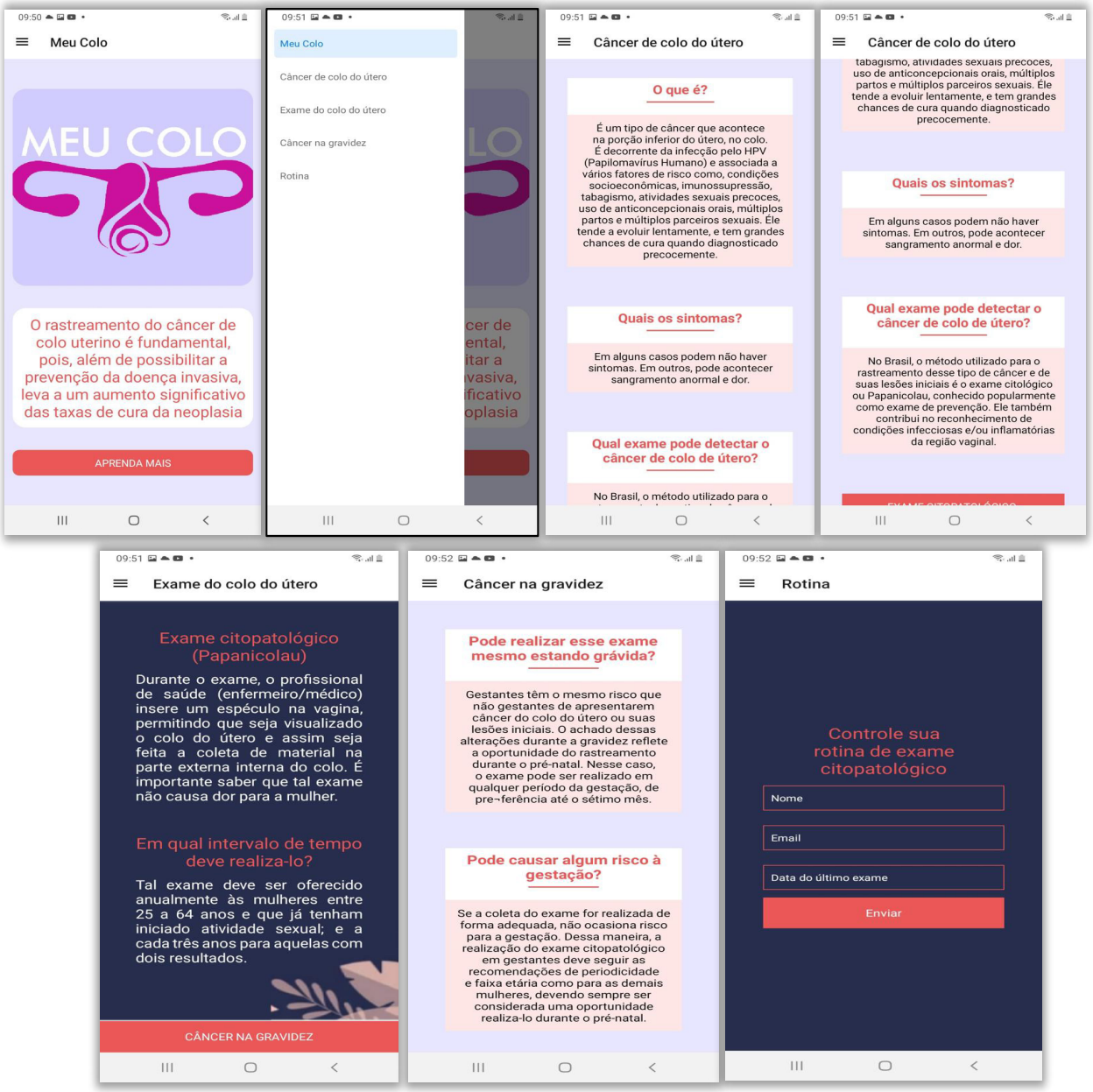
The icon developed to represent the My cervix® ("*Meu colo*®", in Portuguese) app was a uterus. The app's home screen features a brief comment on the importance of screening for cervical cancer, intending to reduce morbidity and mortality caused by the disease. On this screen, pregnant women can begin their learning process by clicking on the "learn more" icon.

On the home screen, pregnant women can click a button on the left side of the screen, which directs them to the second screen of the app and provides them with available reading options. Next, the following topics from the integrative review findings are displayed: (1) Cervical cancer, (2) cervical exam, (3) cancer in pregnancy, and (4) routine. When clicking on the topic cervical cancer, pregnant women are directed to a tab containing information about this neoplasm, highlighting risk factors, signs and symptoms, and the test that can detect it promptly.

When clicking on the second topic, pregnant women are directed to the second tab, which addresses cytopathological testing, how it is performed, and how often it should be performed. The third topic contains relevant information on cervical cancer during pregnancy, highlighting that cytopathological testing can be performed during pregnancy without complications for the mother and child. The same topic presents evidence that pregnant women have the same risk as non-pregnant women of developing this type of cancer, reinforcing the importance of keeping cytopathological exams up to date, according to current ministerial recommendations.

Topic four, which concerns routine, provides features for pregnant women to record the date of their last cytopathological exam, allowing the app to send reminders indicating when the exam should be performed again, in accordance with the Ministry of Health's recommendations.

It should be noted that none of the data for this registration, such as name, email, and date of the last exam, is mandatory, which ensures that pregnant women have access to all the content contained in the app. The mobile app interface is shown in Figure 1.



Note: the illustrations above (screenshots from the mobile app) were only available in Portuguese

Figure 1 – Screenshots from the "*Meu colo*®»(My cervix®) mobile application. Crato, CE, Brazil, 2022

The first version of the mobile application was sent to a group of experts for analysis of content validity and functional performance. The content validity stage involved 15 experts in the field of nursing, while seven experts in information and communication technology participated in the functional performance stage. Among the content experts, female nurses prevailed (66.7%) in the 25-35 age group (73.3%), with the majority working in the healthcare field (60%) and 33.3% working in teaching. In terms of qualifications, specialists prevailed (46.6%), followed by those with a master's degree (26.6%). Among these specialists, 66.6% had experience in conducting and publishing scientific research on the topic investigated in

scientific event proceedings and national journals.

Among the specialists in the field of computing, the majority were male (85.7%), with a median age of 18 to 35 (57.1%). In terms of their work, 71.4% worked in technical assistance and 14.2% in teaching. Regarding qualifications, 85.7% held an undergraduate degree, and 14.2% held a specialist degree. Regarding mobile application development, 85.7% stated that they had previous experience; 57.1% had experience conducting scientific research on the content of the evaluated application, and 42.8% reported having authored scientific articles related to the application's topics of interest. In this sense, the qualification of content and appearance specialists to evaluate the mobile application is recognized.

The data on the critical evaluation of nursing experts regarding the mobile application are shown in Table 1.

Table 1 – Objective evaluation by nursing specialists of the "*Meu colo*®»(My Cervix) mobile application. Crato, CE, Brazil, 2022

Item	n (%)	CVI
Does the app provide clear information about what the cytopathology test is?	15 (100.0)	1.0
Does the app provide pertinent information about the importance of taking the exam?	15 (100.0)	1.0
Does the app provide information on how often the test should be carried out?	15 (100.0)	1.0
Does the app explain how the exam is carried out?	14 (93.3)	0.9
Does the app clearly and objectively cover the aspects inherent in carrying out the test during pregnancy?	14 (93.3)	0.9
Does the app use clear and direct language to address the proposed topic?	15 (100.0)	1.0
Does the application present logical structures in the information?	15 (100.0)	1.0
Does the application have an easy-to-view and visually appealing interface (screens)?	14 (93.3)	0.9
Does the app meet the objective of improving pregnant women's knowledge, attitudes, and practices regarding cytopathology?	15 (100.0)	1.0
Total CVI		0.97

CVI: Content Validation Index

Almost all experts (93.3%) stated that the app explains how the exam is performed, addressing aspects inherent to conducting the exam during pregnancy clearly and objectively, and features easy-to-view and attractive interfaces (screens).

The experts reported that the app is practical, easy to access, uses clear and objective language, and provides essential information about cervical cancer and cytopathological testing. However, some experts suggested improvements to the mobile device, namely: 1) briefly introducing the concept of cancer on the home screen; 2) providing information on vaginal inflammation/infections that can be detected with cytopathology; 3) displaying the recommended frequency of the test in a table; and 4) replacing some technical terms used in the app's informational text.

Regarding the CVI, it can be observed that all nine evaluated items obtained a CVI greater than 0.80, which is considered valid by the specialists. This suggests satisfaction with the theoretical content of the application, as well as its practicality and ability to provide objective and transparent information about the cytopathological examination. Regarding the total CVI of the APP prototype, it was 0.97. It should be noted that there was disagreement on the items that evaluated the clarity of information about the cytopathological exam, the clarity and objectivity of information about performing the exam during pregnancy, and the good visualization and appearance of the mobile application interfaces.

Regarding the stage of analysis of the mobile application's validity by information and communication technology specialists, Table 2 presents the data from the critical evaluation of the application's appearance.

Table 2 – Objective evaluation by information and communication technology specialists of the appearance of the "*Meu Colo*®»(My Cervix) mobile application. Crato, CE, Brazil, 2022

Evaluated item	n (%)	CVI
Is the application precise in the execution of its functions?	7 (100.0)	1.0
Is it easy to learn how to use the app?	7 (100.0)	1.0
Are the resources available in the app adequate?	7 (100.0)	1.0
Does the interface look good? Is it easy to read and understand?	7 (100.0)	1.0
Is the data structure well-organized?	7 (100.0)	1.0
Does the application function efficiently on the platform without any interference?	7 (100.0)	1.0
Can the user easily access the application? Is the structure of the information provided viable and easy to use?	7 (100.0)	1.0
Does the application have an easy-to-view and visually appealing interface (screens)?	7 (100.0)	1.0
Does the app meet the objective of improving pregnant women's knowledge, attitudes, and practices regarding cytopathology?	7 (100.0)	1.0
Total CVI		1.0

CVI: Content Validation Index

Computer experts have said that the app is accurate in performing its functions, easy to use, and has adequate features. Its screens are visually appealing, easy to read, and understandable. The app provides well-organized data, operates without interference, and allows users to access it easily. Additionally, 100% respondents stated that the application effectively meets its objective of promoting knowledge, attitudes, and practices among pregnant women regarding cytopathological testing.

The experts noted that the application is straightforward, dynamic, and easy to access and understand, featuring an intuitive layout and straightforward operation, with text in appropriate sizes. However, they mentioned that the functionality of the buttons at the end of each page is compromised. Thus, they suggested that the layout of the buttons be reviewed to ensure proper handling. Regarding the CVI, it was found that the nine items evaluated by experts in the field of information and communication technology obtained a CVI greater than 0.80, confirming its validity. The total CVI of the APP prototype was 1.0.

Given this, the changes requested by the experts were implemented in the mobile application, which made it valid for subsequent validation with the target audience.

Discussion

On the international stage, the use of technologies offered by mobile applications has brought about significant changes in users' daily lives by enabling successful learning experiences, communication, and entertainment, with the potential to positively impact healthcare, especially in the health education process, as it promotes collective knowledge, encourages self-care, and prevents chronic diseases, including in the context of pregnancy[22].

In this sense, the "*Meu Colo*®" (My Cervix) app, developed to provide pregnant women with knowledge about cytopathological testing and its benefits by providing information about the test, is a tool that can be utilized in the context of primary healthcare, especially during prenatal care. It serves as a means of facilitating and disseminating information about cervical cancer so that pregnant women have appropriate knowledge about the disease and the screening method capable of detecting the precursor lesions of this type of cancer[2].

It should be noted that the application interface was conceived and designed with the help of a technical professional with experience in graphic design, with an attractive visual appearance, easy to use, on

a white background with clear information based on the best scientific evidence, as well as corroborating the premises of mHealth technologies[23]. The interface was considered valid in terms of content and appearance for disseminating information about cervical cancer, allowing pregnant women to learn about this neoplasm and its primary screening method. All the information provided in the app was strategically designed to offer educational content that helps clarify questions pregnant women may have about cytopathological testing.

The use of apps in health interventions is essential, as they facilitate the dissemination of knowledge, enhance user awareness of specific phenomena, and promote appropriate self-care. In addition, they provide better therapeutic conduct and training for health professionals, especially those working in primary healthcare services[23]. Thus, the mobile application "Meu Colo®"(My Cervix) has the potential to guide pregnant women about cytopathological examinations and the importance of undergoing them, as well as to demystify the beliefs surrounding their practice during pregnancy, which may encourage this population to adhere to the examination[24].

Thus, for the development of this mobile application, all aspects of cervical cancer prevention at any stage of the female life cycle, including during pregnancy, as well as those related to health education/promotion, were considered.

It is worth noting that educational practices in prenatal routines, utilizing mobile applications, are essential, as these technologies facilitate the construction of collective knowledge, autonomy, and self-care among pregnant women and their partners. These mobile technologies have helped prevent diseases in the context of the female life cycle, including gynecological cancers[25].

Thus, educational technologies, with an emphasis on mobile applications tailored to the context of pregnancy that utilize everyday language spoken by pregnant women, represent an intriguing possibility for sharing knowledge during health education activities, collective groups, and prenatal consultations[26].

The illustrations in the mobile application "*Meu Colo®*"(My Cervix) were an essential aspect in guiding cytopathological examination during pregnancy and in the health education process with the target audience. The sequence of illustrations in the app is easy to view and assimilate, which enables better textual comprehension, as well as the involvement of pregnant women, making them feel comfortable viewing and reading the information presented in the app interface.

The phase of analyzing the validity of the content and functional performance of these technologies with experts is an essential aspect of mobile application development. This assessment evaluates whether the developed tool can meet the proposed objectives and the relevance of its properties, potential, and innovative nature[27]. In the study in question, experts evaluated the theoretical content of the application as relevant, logically structured, and written in clear language that was understandable and appropriate for the target audience.

In this study, the items analyzed in the final version of mobile technology showed evidence of validity, content, and appearance, as all pre-established recommendations were met, according to national and international literature. Similar results are reported in a national study that proposed the development of a mobile application for families of children/adolescents with cancer, obtaining a CVI ≥ 0.80, which confirmed its validity in terms of content and appearance[28].

Given this, it is worth noting that the "*Meu Colo®*"(My Cervix) app, when used by professionals responsible for prenatal care, especially nurses in prenatal consultations and/or educational groups for pregnant women, can be an indispensable educational tool for disseminating information about cervical cancer and cytopathological examination, so that pregnant women can learn about the disease and screening for precursor lesions, as well as raise awareness about the importance of undergoing this test during pregnancy.

From this perspective, the mobile application

will also contribute to raising awareness among women and transgender men about oncogenic HPV DNA testing, a new method for screening cervical cancer introduced in the SUS, through the information provided about cervical neoplasia. Currently, this test is considered the most effective, as evidence has shown a lower incidence and mortality rate from this type of cancer[29].

Therefore, it is incumbent upon professionals responsible for prenatal care, particularly nurses, to embrace this technological resource to provide comprehensive care, promote health, and strengthen the development of the profession.

Study limitations

The study's limitations include the fact that no new evaluation of the prototype was conducted after the adjustments made by the experts; the application's availability is limited to the Android operating system; and the absence of a validation stage for the application's functionality and usability with the target audience. Therefore, it is not yet possible to recommend its use due to the potential difficulties that may arise from handling the tool or understanding the provided information.

Contributions to practice

The mobile application "*Meu Colo*®" (My Cervix), after validation with the target audience and registration, represents a tool that can be used in the health education process by primary health care professionals, with the aim of guiding pregnant women about cervical cancer and cytopathological examination, to contribute to raising awareness among pregnant women about the importance of adhering to screening tests during pregnancy.

Conclusion

The "*Meu Colo*®" (My Cervix) mobile technology underwent a rigorous development process, from its construction to the analysis of evidence by nursing and information and communication technology experts, and includes relevant information about cervical cancer and its screening methods. The tool utilizes accessible language and features seven educational screens, aiming to promote health and enhance pregnant women's understanding of cytopathological testing. All items in the app were considered valid in terms of content and functional performance, demonstrating acceptable evidence of validity and fulfilling their purpose of guiding pregnant women about cytopathological testing and its importance.

Authors´ contributions

Conception and design or analysis and interpretation of data: Silva NG, Oliveira DR, Cruz RSBLC. Writing of the manuscript or critical review of the intellectual content; final approval of the version to be published and responsibility for all aspects of the content and integrity of the published article: Silva NG, Silva TM, Oliveira DR, Pinheiro AKB, Quirino GS, Calou CGP, Cruz RSBLC.

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