Development of mobile application for cervical cancer screening in women: Protocol of a multi-phase study

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Abstract:

BACKGROUND: Cervical cancer is one of the most common cancers in women. It is considered preventable due to the possibility of screening. The common barriers to cervical cancer screening include lack of knowledge, lack of time, and wrong beliefs. The use of e-Health technologies is one of the approaches for health promotion. The present study is aimed to the development of a mobile application for cervical cancer screening in women.

MATERIALS AND METHOD: This is a multi-phase study. In the first step, a literature review will be conducted to examine factors related to cervical cancer screening and existing applications related to cervical cancer and its screening. Then, in the second step, a cross-sectional study will be conducted to investigate the factors related to cervical cancer screening in 246 women referred to comprehensive health centers and women's clinics in teaching hospitals in Isfahan, Iran. The comprehensive health centers and women's clinics in teaching hospitals will be randomly selected using a lottery method. Using convenience sampling, women who meet the inclusion criteria will be included in the study, provided they provide informed consent. The data will be collected using a questionnaire, and then the descriptive and inferential statistical tests and SPSS18 software will be used to analyze the data. In the third step, specialists (gynecologists, reproductive health specialists, and midwives) will prioritize the application content by filling out a questionnaire. Then, the research team will compile the application content draft, and this draft will be reviewed and approved by experts on the expert panel. The prototype of the application will be prepared, and experts will evaluate it in the fifth step.

DISCUSSION: The results of this study will result in the development of applications for cervical cancer screening. The use of mobile applications can be useful in lifting some of the barriers to screening. Therefore, developing such applications may help improve cervical cancer screening.

Keywords:
Cancer, cervical, medical informatics application, protocol, screening, women

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Received: 08-11-2022
Accepted: 30-01-2023
Published: 07-02-2024

Introduction

Women's health is one of the fundamental concepts in development. The condition of women's health has a significant effect on the health of children, family, and society.[1,2]

Cervical cancer is the fourth most common cancer among women worldwide.[3] In Iran, cervical cancer is the second most common reproductive system cancer in women, after ovarian cancer.[4] The World Health Organization has predicted that if no appropriate measures are taken for the prevention and early treatment of cervical cancer, deaths from cervical cancer will rise by almost 50% by 2040.[5] According to the results of studies, the prevalence of cervical cancer in Iran increased between 2003 and 2010.[6-8] One of the ways to prevent cervical cancer is to have screening tests. A screening program is a low-cost and effective way to

How to cite this article: Ghasemi-Gujani M, Savabi-Esfahani M, Noroozi M, Satari M. Development of mobile application for cervical cancer screening in women: Protocol of a multi-phase study. J Edu Health Promot 2024;13:5.

reduce cervical cancer.[9] In countries where there is no screening program or women's participation in screening is low, cervical cancer and deaths associated with it are on the rise.[10] The negative impact of cervical cancer is more prominent in developing countries, and the mortality rate for women in these countries is reported to be higher.[11]

Despite the availability of a cervical cancer screening program in Iran, Iranian women's participation rate in the screening program is low.[9,12] Mohebi *et al*. (2016)[12] showed that only 11.5% of women had done Pap smear screening regularly. Although Iran is one of the countries with a low incidence rate of cervical cancer, most cases of cervical cancer are diagnosed in the advanced stages of the disease. Also, the death rate caused by this cancer in Iran is reported to be high.[13] Women's perceived threat to cervical cancer and their awareness about cervical cancer and its prevention are very weak.[14,15]

In Iran, women experience several barriers regarding cancer screening, such as lack of awareness, wrong beliefs, fear of cancer diagnosis, pain,[16] lack of correct information, lack of free time to do the test, and the cost of the test.[17] Also, some studies in other countries indicate that the most important barriers regarding screening are lack of knowledge, fear of screening results, inadequate services, unavailability of quality services, lack of respect for women's privacy, high costs, and religious, cultural, and social barriers.[18-20] In this context, measures such as increasing public awareness, providing necessary information to women about cervical cancer prevention, and providing accessible and affordable services have been proposed to promote cervical cancer screening.[21]

Mobile-Health (m-Health) is one of the technologies that can be used to raise public awareness about cervical cancer. In recent years, m-Health has been developed, and this technology has increased patients' participation in health programs.[22] The penetration rate of smart mobile phones has also increased in Iran. Global statistics have shown that Iran was in the twelfth place in the world in the field of smart mobile phone penetration in 2019.[23]

The use of mobile apps can also help lift some barriers to receiving health services. The results of studies have shown that the use of a mobile app can improve people's knowledge, attitude, and performance in various fields, including providing care to mothers and children, patients with diabetes, and people with cancer.[24-26] Lee *et al*. (2018)[27] showed that mobile apps could effectively increase women's participation in breast cancer screening. The results of Munoz-Zuluaga *et al*. (2018)[22]

also showed that mobile app use could be a low-cost and accessible tool for identifying women at risk of breast and cervical cancer. The results of the studies showed that about 41% of mobile apps related to cancer were weak in terms of scientific content and information sources.[28] On the other hand, many mobile apps associated with women's cancers were not up to date and did not have acceptable scientific validity.[29,30]

It is necessary to design mobile apps based on user needs to increase the efficiency and stability of using electronic health programs.[31] M-Health apps are beneficial for solving problems that require changing health behaviors.[32] However, health interventions should take place in socio-cultural contexts that are acceptable to people.[33] Knowing the target group's demand and acting based on cultural and social sensitivities is necessary for the success of a screening program. On the other hand, to increase the participation of people in cervical cancer screening as a health behavior, it is necessary to consider the social and cultural aspects related to that behavior.[33]

In general, cervical cancer is still a health issue in some countries, including Iran.[5,11] Although screening has been proposed as a preventive method to reduce cervical cancer,[9] many obstacles have been reported, including the low participation of women in screening programs, lack of knowledge to perform screening, and the advanced stage of the disease in a significant percentage of women.[18-20]

Since mobile apps have been proposed as low-cost and effective tools to increase people's participation in cancer screening programs and lift some barriers.[34] This multi-phase study aims to developing such applications that may help improve cervical cancer screening.

Aim

1. Determining factors associated with cervical cancer screening and existing software associated with cervical cancer and its screening based on a literature review
2. Determining factors associated with cervical cancer screening in women by referring to comprehensive health centers and women's clinics in teaching hospitals
3. Writing the content of the app
4. Preparation of the prototype of the mobile app
5. Evaluation of the prototype of a mobile app based on experts' opinion

Materials and Method

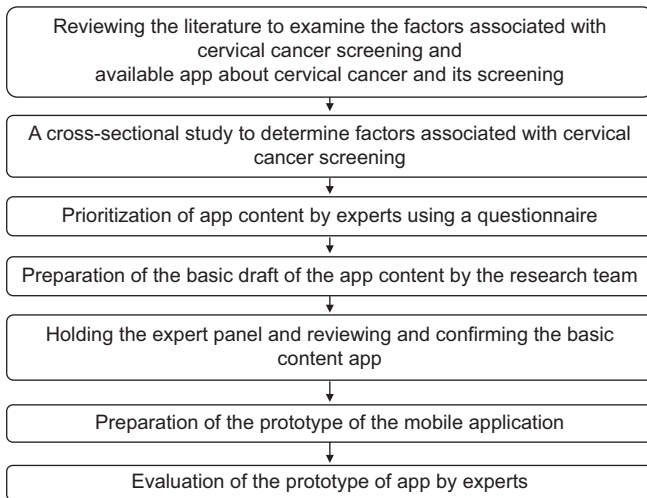This study will be done in 5 stages [Figure 1].

Figure 1: Flow diagram of study protocol

Step 1: Literature review

To assess the available studies addressing the factors associated with cervical cancer screening as well as the available applications for cervical cancer and its screening, the literature review will be conducted narratively. The search will be conducted between 1900 and 2021. First, keywords will be determined based on MeSH. Then, by combining keywords such as "Pap test," "Pap smear," "Papanicolaou smear," "barrier," "uterine cervical neoplasm," "cervix neoplasms," "cancer of the uterine cervix," "cancer of the cervix," "cervical cancer," and "uterine cervical cancer," the search will be performed in Persian databases like IranMedex, SID, Magiran, Google Scholar, and English databases like PubMed, Web of Science, Cochrane, Science Direct, Proquest, and Scopus.

Published articles that have investigated the factors associated with cervical cancer screening and contain clear objectives, methodology, and findings will be included in the study. The exclusion criteria include irrelevant content and insufficient data.

In this step, the available software about cervical cancer and its screening will also be reviewed. The software will be searched with the keywords "Pap test," "cancer of the uterine cervix," "cancer of the cervix," "cervical cancer," "screening," "Pap smear," and "Papanicolaou smear."

Software in Persian and English associated with cervical cancer and its screening will be included in the study. Applications that are inaccessible or are incompatible with Android systems will be excluded.

Step 2: Cross-sectional study

In this step, factors associated with cervical cancer screening in women will be determined.

Research population

The research population will be women eligible for cervical cancer screening who refer to comprehensive health centers and women's clinics of teaching hospitals in Isfahan.

Sampling method and research

The samples will be selected randomly using a lottery method from comprehensive health centers and women's clinics of teaching hospitals in Isfahan. Using convenience sampling, women who meet the inclusion criteria will be included in the study. Written informed consent will be obtained. Then, factors associated with cervical cancer screening will be collected using a questionnaire.

Inclusion criteria

Those who are Iranian, married, 20–60 years old, and willing to participate in the study will be included in the study.

Sample size

The sample size has been calculated based on similar articles[35] and a 95% confidence level, $d = 0.05$, and $P = 0.8$, using the sample size formula.

In this study, at least 246 women eligible for cervical cancer screening will be included.

$$N = \frac{(Z^2_{1-\frac{\alpha}{2}}) \times (P(1-P))}{d^2}$$

$$N = \frac{1.96^2 \times (0.8 \times 0.2)}{0.05^2} = 246$$

Data analysis

The data will be entered into the computer after compilation and coding. The data will be analyzed with descriptive and inferential statistical tests using SPSS18 software.

Step 3: Drafting mobile application

In this step, first, the application content will be prioritized by experts using a questionnaire. Then, the content draft of the application will be compiled by the research team based on the determined priorities. This draft will be reviewed and approved by experts on the expert panel.

A researcher-made questionnaire will be designed based on the results of the previous steps to prioritize the content and capabilities of the application. The questionnaire will be scored on a 5-point Likert scale, from very important (5) to very unimportant (1). Specialists (gynecologists, reproductive health specialists, midwives, and PhDs of health information technology) will be asked to prioritize the content and capabilities of the application. When

the experts complete the questionnaire, the data will be collected and entered into the computer after coding. Data will be analyzed using descriptive statistics and SPSS18 software. After determining the priorities, the research team will develop the content draft of the cervical cancer screening application. In this step, the expert panel will review and approve the application content. In this step, we will invite 5–20 specialists with experience in providing services and cervical cancer screening. The research community in this step consists of gynecologists, reproductive health specialists, and midwives. Specialists will be asked to participate in the expert panel meeting, which will be held at the Faculty of Nursing and Midwifery of Isfahan University of Medical Sciences. The specialists will be provided with the application content draft. After the panel discusses and summarizes the opinions in the expert panel meeting, the content of the application will be approved.

Step 4: Preparation of the app prototype
First, based on the priorities specified in the previous step, the conceptual model of the mobile application will be prepared. Then the research team will present the prototype of the mobile application.

Step 5: Evaluation of the mobile application prototype
After preparing the initial model of the mobile application, this model will be reviewed by specialists in terms of the content and usability of the software. Then, expert opinions will be collected using a questionnaire. The experts will include gynecologists, reproductive health specialists, and midwives with experience in providing services in cervical cancer screening, as well as faculty members of the reproductive health department, school of nursing and midwifery, and school of health information technology of Isfahan University of Medical Sciences.

Discussion

Electronic technologies are a new opportunity for education, research, and health care. This type of technology is proposed as a solution to face the challenges of the health system and increase the coverage and quality of health measures.[36] On the other hand, advances in technology have been associated with increased participation of patients in health programs.[37] Additionally, eHealth can effectively change health behavior and prevent diseases. Some studies have investigated the utilization of mobile apps in various fields, such as providing care to mothers and children and self-care for diabetic patients and people with cancer, and the results of the studies have shown that the utilization of apps facilitates the provision of services and increases patients' participation.[24-26] On the other hand,

the results of studies have shown that the utilization of mobile-app can be useful in improving the knowledge, attitude, performance, and empowerment of patients by giving them a more active role in the treatment path, lifting obstacles, and helping them access health information.[24-27,29,38]

Electronic health can be used to increase women's awareness of cancer and increase participation in cervical cancer screening and HPV[1] vaccination.[22,39] Since increasing women's awareness of cervical cancer has been associated with the success of cervical cancer programs,[40,41] applications have been increasingly used to increase cancer information. On the other hand, this tool has been proposed as a method for educational interventions to improve people's health.[29,38]

In addition, the use of applications to raise awareness may encourage women to participate in cancer prevention programs.[30,38] The use of applications in developing countries is also beneficial to solving the health problems in these countries, and their utilization can improve the health of mothers.[34] A systematic review by Salmani *et al*. (2020)[38] showed that using mobile applications positively promotes cancer screening and people's health. Kessel *et al*. (2016)[42] showed that most healthcare service providers have a positive attitude toward the use of mobile applications in the field of cancer.

One of the goals of using mobile applications is to empower patients. Patient empowerment in medical care is only possible if it meets the needs of patients.[25] Therefore, the design and development of mobile applications should be based on the target group's needs. If the application is not based on the target group's needs, it will lead to a waste of money and time and dissatisfaction among users.[43] Awareness of cultural factors is one of the most effective factors in policymaking and planning to improve people's health.[44] Neglecting people's culture in health care is the biggest obstacle to improving people's health worldwide. The failure of many cervical cancer prevention programs is related to the lack of attention to the cultural and social norms among the people.[45]

Literature reviews provide the best information available in a particular field. These studies aimed to identify and summarize what has already been published, avoid repetition, and identify aspects that have not yet been addressed.[46] After reviewing the literature and examining the factors associated with mobile software screening, the cross-sectional studies can assess the identified factors. Many cross-sectional studies are done using questionnaires. This type of study is relatively cheap.[47] On the other hand, in cases where there is not enough information about the subject or statistical

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1 Human papillomavirus

techniques are not applicable or practical, it is beneficial to use the opinions of experts. Using expert opinions can be an accurate guide for decision-making.[48] Therefore, it is necessary to conduct a multi-phase study for the development of cervical cancer screening applications. The use of mobile app can be beneficial to lifting barriers to screening. Therefore, developing such an application may help improve cervical cancer screening.

Conflicts of interest
There are no conflicts of interest.

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