

## REVIEW

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# A Systematic Review of Cervical Cancer Mobile Applications and a Future Directions for Developers

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## Abstract

**Objective:** The objective of this study is to evaluate the quality of mobile health (mHealth) applications that promote cervical cancer awareness and provide screening assistance, with an emphasis on apps available on the Google Play Store and iOS. **Methods:** From December 2023 to February 2024, we assessed mobile applications focused on cervical cancer screening that are available on Google Play and Apple iTunes. The “Cervical Cancer,” “Mobile Application,” “Pap Test,” “Cervical Cancer Guide,” “Human Papillomavirus,” plus “Cervical Screening are the keywords used to search the applications.” Data collection includes features such as application name, pricing, download metrics, invention date, last update, affiliation, online access, login requirements, and notification functionality, which were gathered in Excel. Interrater reliability based on four reviewers’ independent judgments, varied from 0.75 to 0.83. **Result:** In our research, we found 25 apps (16 on the Google Play Store and 9 on iOS). After a thorough review, only 14 relevant apps were included. According to the MARS rating, Rise Against Cancer received the highest score (3.9), followed by FightHPV and Cervical Cancer Forum (3.8). Rise Against Cancer (29), HPV Vaccine (28), and CDC STI Tx Guidelines (28) scored highest in the APPLICATIONS rating system. Hope 4 All and OCI Cervibreast closely matched the statements, meeting seven of the thirteen requirements each. **Conclusion:** Future app developers should produce user-friendly, often updated mHealth applications that include high-quality cervical cancer awareness and screening content. These apps should provide validated information and pleasant graphic effects.

**Keywords:** Cervical cancer- screening- mobile Rating Scale- APPLICATIONS scoring system- specific statements

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## Introduction

Cervical Cancer remains a significant global concern, affecting approximately 453 million women in India aged 15 and above face the risk of cancer. Despite the prevalence of the disease, there exists an evident gap between awareness and preventive measures among Indian women [1]. Lack of appropriate information and insufficient precautions have contributed to alarming figures: data from the HPV Information Centre indicates that annually, 96,922 women are diagnosed with cervical cancer, resulting in 60,078 fatalities from this disease in the country [2]. This dire scenario requires progressive answers that may correctly disseminate knowledge, raise screening rates, and enhance care adherence amongst healthy girls and survivors.

In recent years, abundant adoption of mobile phones in urban as well as rural areas has facilitated delivery of services through mobile applications [3]. Mobile health applications have become more effective and faster ways

to raise awareness and circulate healthcare information. Some of the studies show that these health-related apps are very useful and give positive results. By delivering accurate and up-to-date information, mHealth apps have the potential to bridge the knowledge gap and empower survivors to take proactive steps towards safeguarding their health [1]. Finding applications that help spread knowledge while simultaneously boosting screening rates and enhancing care adherence among survivors and healthy women is a crucial component of our review. When it comes to cancer the apps should give proper information about it, its early stages and its prevention. But some of the apps don’t have up to date information which can create a problem [1]. To evaluate these applications, there are tools including of Mobile App Rating Scale (MARS), the APPLICATION Scoring System, and App specific Scoring system which assist to evaluate if the apps are reliable and beneficial. By carefully examining several facets of mHealth applications, such as content accuracy, engagement, functionality, user interface, and

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user engagement, these grading systems allow researchers to perform comprehensive evaluations [4].

Researchers can ascertain the general quality of an app and whether it is appropriate for meeting certain user needs by methodically examining these parameters. The MARS and APPLICATION Scoring System review procedure entails a thorough analysis of each app's performance in a number of areas. The assurance of content accuracy guarantees that the data shown in the application is dependable, supported by evidence, and current. Engagement measures how well an app captures and holds users' attention to promote frequent use and interaction. Functionality evaluates the usability and technical performance of the app to guarantee seamless functioning and navigation. The success of the app in promoting user interaction, feedback, and community participation is measured by user engagement. Finally, the user interface assesses the app's accessibility, intuitiveness, and design aesthetics [5]. Apart from the generic app rating systems comprising of the APPLICATION Scoring System, the MARS, and app-specific statement scoring systems that are designed to evaluate the effectiveness of applications in certain sectors including healthcare.

The World Health Organisation (WHO) and the National Cancer Institute (NCI) are two examples of healthcare organizations whose evidence-based guidelines and recommendations may be integrated into app-specific statement grading systems. Healthcare apps can help consumers feel more credible and trustworthy by providing them with accurate and evidence-based information by adhering to established criteria and best practices. App-specific claims rating systems help to create high-quality content by taking into account elements including the accuracy of health information, the addition of interactive features, and the incorporation of evidence-based guidelines [6]. Apps that achieve high ratings on these scoring systems are said to be high quality apps. Evaluating the quality of apps can help researchers identify high-quality apps which meet the needs of users. Our study aims to identify existing cervical cancer apps available on Android and iOS platforms and also which are available in India. By using different scoring systems, we seek to assess the quality and effectiveness of these identified apps in order to address the needs of Indian women [7].

By drawing comparisons between Android and iOS applications, we aim to find potential disparities between accessibility, features and user experience. Our research aims to draw insights regarding strengths and weaknesses of these apps, identifying areas for future improvement.

## Materials and Methods

### *Study design and setting*

In our investigation, we complied with the five suggested methods for evaluating the performance of mHealth applications that offer details about CC and can be found on the iTunes Store (iOS) and Google Play Store (Android).

### *Search Strategy*

All six authors utilized the Google Play Store and iOS

search bars to find CC-related apps. The app identification process carried out for two months, namely between December 30, 2023 and February 28, 2023. The keywords used in the search for these apps included "Cervical Cancer," "Mobile Application," "Pap Test," "Cervical Cancer Guide," "Human Papillomavirus," and "Cervical Screening."

### *Selection Criteria*

Figure 1 depicts the mechanism of screening the mobile applications, after three screening phases, during the initial screening phase, the general descriptions and fundamental requirements for each app were reviewed. During this phase, any app that required a patient registration number or could only be used in specific hospitals was excluded. This stage guaranteed that only universally accessible apps progressed through the process.

The second phase of screening focused on examining the apps' target population and core users. Apps developed specifically for medical professionals, such as those that require a medical license to use, were excluded at this level. This process helped to ensure that the apps chosen were appropriate for the general public rather than specialized professional use.

The third phase of screening included a thorough examination of the content and services offered by each app. Apps that provided no information or services linked to cervical cancer (CC) were excluded. This key step guaranteed that all remaining apps were appropriate for the scope of our research. Furthermore, it was highlighted that all apps assessed were available for free on the Play Store, eliminating the requirement for financial verification. An important factor in the selection process was that all recognized apps were accessible to Indian users, ensuring that the findings were relevant to the target market.

### *Data Collection and App Characteristics*

The Microsoft Excel spreadsheet (Office 365) was used to collect basic information about many applications. The recorded data comprises the app's name, platform compatibility (Android or iOS), pricing details, download metrics (especially for Android), invention date, last update, affiliation, web access requirement, login/password requirement, and notification capacity. This large dataset serves as the foundation for the following analytical techniques.

To calculate interrater reliability, four reviewers independently evaluated four randomly chosen apps using a data extraction form. The reliability was determined to be within acceptable ranges, ranging from 0.75 to 0.83. During the evaluation process, the reviewers rated four randomly selected submissions on a scale of 1 to 10. New columns were added for each pair of reviewers (reviewer 1/reviewer 2, reviewer 1/reviewer 3, reviewer 2/reviewer 3, and reviewer 3/reviewer 4). Each couple was assigned a score of "1" for agreement and "0" for disagreement. For example, reviewer 1 and reviewer 2 disagreed (0) on the second app, whereas reviewer 1 and reviewer 3 agreed (1) on all applications. Reviewer 2 and reviewer 3 disagreed (0) on the second app, and reviewer 3 and reviewer 4 agreed (1) on the fourth. The interrater reliability for this

review was calculated to be 0.83.

### *Apps Evaluation*

Each app included in this study was initially tested offline to see if it could function without internet access. It was then evaluated using the MARS scoring system, with scores based mostly on the app's features and augmented by app-specific questions. Following a shared knowledge of MARS, the items in the APPLICATIONS scoring system, and the app ratings based on particular claims, an independent review of a few apps was conducted. The scores were then discussed in order to determine their quality (Figure 2).

### *MARS evaluation*

The Mobile App Rating Scale (MARS) is a system of scores designed to evaluate the quality of mobile applications across many platforms. It offers a scientific approach to evaluating quality based on a variety of criteria, including engagement, usefulness, aesthetics, and information. MARS provides a systematic methodology for measuring and assessing user satisfaction with mobile applications. It enables detailed evaluations, which can aid in picking the best applications [8]. The table 1 depicts the mean values of engagement, functionality, aesthetics, and information. "Rise Against Cancer" ranks first overall, with great ratings across all categories.

### *APPLICATION Scoring System*

Assessing the quality of mobile health applications involves focusing on specific health-related behaviors and concerns related to cervical cancer (CC). Apps are evaluated based on their alignment with criteria related to target health behavior. The relevance and accuracy of the app are assessed across six categories: Awareness, Knowledge, Attitudes, Intention to Change, Help Seeking, and Behavior Change [9]. Apps are scored as follows: Strongly Disagree = 1, Disagree = 2, Slightly Agree = 3, Agree = 4, Strongly Agree = 5. Table 2 shows CC app APPLICATION scores. "Rise Against Cancer" and "Hope 4 all" score highest across all aspects, showing substantial potential to impact CC awareness, attitudes, intention to change, help-seeking, and behavior change.

### *Features*

The quality of feature-based mobile applications is determined by a variety of factors. The first and most critical consideration is update frequency; apps must remain relevant and up to date with current information and innovations. Second, ratings and downloads help determine the app's popularity. Affiliation or endorsement by renowned groups can boost credibility. Features like requiring online access, logging in, and the app delivering notifications are vital for user engagement. Finally, whether the app is paid or free has an impact on its popularity and the number of people who engage. By taking these characteristics together, the overall quality and utility of the software may be assessed.

### *App specific statements*

Apps are assessed based on a set of 13 statements

derived from experts that are relevant to the target audience. The app with content that perfectly matches each statement is given 1 point for each statement.

### *Comparison of scoring systems*

The scores of all apps identified by each assessment tool are shown in Table 5. 'Rise Against Cancer' and 'Belong' demonstrated a strong performance overall with the highest rating in the MARS and APPLICATIONS scoring system. However, in terms of the app specific statements, the scoring system 'OCI Cervibreast' showed the highest score.

## **Results**

### *App Identification*

Following a thorough assessment based on the 3 screenings as mentioned earlier, only 14 relevant apps (9 Android and 5 iOS) were identified collectively from both operating systems [10].

### *App Characteristics*

The Table 3 shows the features of the apps that were found. Among all the applications, initially identified, 3 were available both on Android and iOS. The most important apps were categorised as medicine lead by health and fitness and entertainment. All the apps are in English. Only one of them is available in three regional languages. Most Apps have been updated in 2023 and almost all apps are free to download except one 'ASCCP' on iOS which is paid and costs 900 Rs [11].

### *App evaluation using MARS*

Table 1 shows the App evaluation using Mars, it shows that the app "Rise Against Cancer" scored the highest overall mean rating of 3.9 followed by "FightHPV" and "Cervical Cancer Forum" with a 3.8 rating. In terms of Engagement, "Rise Against Cancer" got a 3.9 rating followed by "FightHPV" with a 3.8. For Functionality, and aesthetics, "Rise Against Cancer" and "CDC tx guidelines" tied with the highest score of 3.8 and also scored 3.9 for information followed by "OCI cervibreast" with close rating of 3.6. "Cervical cancer Tips" achieves a commendable score of 3.5 in the same category [5].

### *APPLICATIONS scoring system*

Table 2 shows the APPLICATIONS scoring system of 14 apps. The mean score of apps is 24.73 out of 30. 'Rise Against Cancer'(29), 'HPV Vaccine'

(28) and 'CDC STI Tx Guidelines'(28) were the apps that demonstrated strong performance but apps like 'MFHP Cancer' and 'Cervical Cancer Forum' showed weaker performance in terms of help seeking and behavior change.

### *Features*

Table 3 shows evaluation of apps based on Features. "Rise Against Cancer" stands out for its recent update and a focus on health and fitness, with features such as sending notifications and requiring login/password for personalized inter- action. "Belong Beating Cancer Together" boasts a

Table 1. Evaluation of Cervical Cancer Applications by MARS

Application's Name	Engagement	Functionality	Aesthetics	Information	Objective quality score	Subjective quality score	Overall MARS quality score
Rise Against Cancer	3.9	3.8	3.9	3.9	3.85	3.9	3.875
Belong	3.5	3.4	3	3.2	3.3	3.35	3.275
Hope 4 all	2.6	2.5	3.3	3.4	2.95	2.95	2.95
OCI Cervibrest	3.5	3.5	3.7	3.4	3.45	3.6	3.525
CDC STI Tx guidelines	3.5	3.8	3.9	3.7	3.75	3.7	3.725
Cervical Cancer Symptoms	3.5	3.4	3.3	3.3	3.35	3.4	3.375
MFHP Cancer	3.5	3.3	3.6	3.3	3.3	3.55	3.425
Cervical Cancer Tips	3.4	3.5	3.7	3.6	3.55	3.55	3.55
Cervical Cancer News	2.4	3.7	3.7	2.7	3.2	3.05	3.125
BSCCP Colposcopy Guide	3.5	3.5	3.4	3.3	3.4	3.45	3.425
Cervical cancer Forum	3.7	3.9	3.8	3.9	3.9	3.75	3.825
HPV vaccine	3.5	3.2	3.3	3.2	3.2	3.4	3.3
FightHPV	3.8	3.8	3.9	3.6	3.7	3.85	3.775
FIGO Gyn Cancer Management	3.2	3.3	3	3.4	3.35	3.1	3.225

high number of downloads and affiliation with the medical field, offering comprehensive support for users. "Hope 4 all" prioritizes social engagement but lacks updates compared to other apps. Meanwhile, "Cervical Cancer Symptoms" and "Cervical Cancer Tips" cater to specific informational needs but lack recent updates. 'CDC STI Tx Guidelines' showcases popularity and endorsement from a reputable source, but its recent updating date could be improved [12]. Figure 1, count plot showed app attributes such internet connectivity, login, notifications, and information. Seven of 14 apps needed online access, eight needed logins, eight gave notifications, and thirteen provided information.

#### App Specific Statements

Table 4 shows evaluation of apps based on app specific statements. The apps 'Hope 4 all' and 'OCI Cervibrest' show strong alignment with the statements, matching 7 out of 13 criteria each, followed by 'Rise Against Cancer'

and 'Belong App' that match 6 out of 13 statements. 'Hope 4 all' has integration of AI - a chatbot which guides you whereas 'OCI Cervibrest' provides information about gender availability of doctors [1]. The indicators of the table 4 as follows ; a. Site of the cervix b. cervical cancer meaning c. causes, d. Symptoms e. preventive measures of CC f. screening procedures g. Eligibility test, h. Frequency of test i. Mode of transmission, j. HPV infection, k. The HPV vaccine,

Based on the MARS Analysis of the above mentioned apps, apps have been scored and their respective ratings have been determined using linear regression. Linear Regression is a method to model relationship between dependent variable here it is 'app rating' and one or more independent variables, here - 'Predicted ratings'. This relationship between the predictors and target variable has been evaluated using the R2 value. The App 'Rise Against Cancer' emerged with the highest rating followed by 'Cervical Cancer Forum' and 'FightHPV' [5].

Table 2. APPLICATION Scores of Cervical Cancer Apps

Name of the APP	Awareness	Attitudes	Intention to change	Help Seeking	Behavior change	Total Score
Rise Against Cancer	4	4	4	4	3	19
Belong	3	4	3	4	3	17
Hope 4 all	3	4	4	4	4	19
CervicalCancer Symptoms	4	3	3	3	3	16
MFHP Cancer	1	3	2	4	2	12
Cervical Cancer News	2	2	3	1	2	10
Cervical Cancer Tips	3	3	2	1	3	12
OCI Cervi Breast	4	3	3	4	2	16
CDC STI TX guidelines	4	4	3	4	3	18
BSCCP Colposcopy Guide	3	3	3	4	2	15
Cervical cancer Forum	1	2	1	3	2	9
HPV vaccine	4	3	4	4	3	18
FightHPV	3	2	3	2	3	13
FIGO Gyn Cancer Management	3	3	3	2	2	13

Table 4. Evaluation of CC Applications Using Specific Statements

Name of the App	a	b	c	d	e	f	g	h	i	j	K	Total score
Rise Against Cancer	1	1	0	1	1	0	0	0	0	0	0	4
Belong	1	1	1	0	1	0	0	0	0	1	1	6
Hope 4 all	0	1	1	1	0	0	0	0	0	0	0	3
OCI Cervi Breast	1	1	0	0	1	0	1	1	1	0	0	6
CDC STI Tx guidelines	1	0	1	1	0	0	0	0	0	0	0	3
Cervical Cancer Symptoms	0	0	0	1	0	0	0	0	0	0	0	1
MFHP Cancer	1	1	1	0	1	0	0	0	0	0	0	4
Cervical Cancer Tips	0	0	0	1	0	0	0	0	0	0	0	1
Cervical Cancer News	0	0	0	1	0	0	0	0	0	0	0	1
BSCCP Colposcopy Guide	0	0	0	1	1	0	0	0	0	0	0	2
Cervical cancer Forum	0	0	0	0	1	0	0	0	0	0	0	1
HPV vaccine	0	0	0	0	1	0	0	0	0	0	0	1
Fight HPV	0	1	0	1	-	0	0	0	0	0	0	2
FIGO Gyn Cancer Management	0	0	0	0	-	0	0	0	0	0	0	0

Table 3. Characteristics of Cervical Cancer applications

Application	Platform	Invention date	Updating date	Rating	Downloads	Affiliation	Requires Web access	Login/password	Sends Notification	Paid
Rise Against Cancer	ANDROID	17-Sep-23	26-Dec-23	3+	100+	Indian Cancer Society	Yes	Yes	Yes	No
Belong	ANDROID	19-Jan-16	4-Dec-23	12+	1L+	Yes	Yes	Yes	Yes	Yes
Hope 4 all	ANDROID	15-Sep-23	26-Oct-23	3+	1+	No	No	Yes	Yes	No
Cervical Cancer Symptoms	ANDROID	7-Mar-15	29-Sep-23	3+	1000+	No	No	No	Yes	No
MFHP Cancer	ANDROID	24-Jun-21	18-Sep-23	3+	1000+	No	No	No	Yes	No
Cervical Cancer Tips	ANDROID	22-Oct-17	14-Jun-23	3+	1000+	No	No	No	Yes	No
Cervical Cancer	ANDROID	25-Nov-16	23-Jan-23	3+	1000+	No	No	Yes	No	No
OCI CerviBreast	ANDROID	10-Sep-19	17-Jul-23	3+	10k+	No	No	Yes	No	No
CDC STI Tx Guidelines	ANDROID	15-Jan-16	29-Dec-23	3+	100k+	Yes	Yes	Yes	No	No
BSCCP Colposcopy Guide	IOS & Android	3-Apr-17	20-Jul-20	12+	500+	-	No	No	Yes	No
Cervical cancer Forum	IOS	17-Jan-21	27-Jan-21	17+	500+	Yes	Yes	Yes	Yes	No
HPV vaccine	IOS	8-Mar-18	19-Mar-18	4+	1000+	Yes	Yes	Yes	No	No
FightHPV	IOS	15-Dec-16	14-Jun-17	17+	1000+	Yes	Yes	No	No	No
FIGO Gyn Cancer Management	IOS	15-Sep-16	18-Apr-19	All	1000+	Yes	Yes	No	No	No

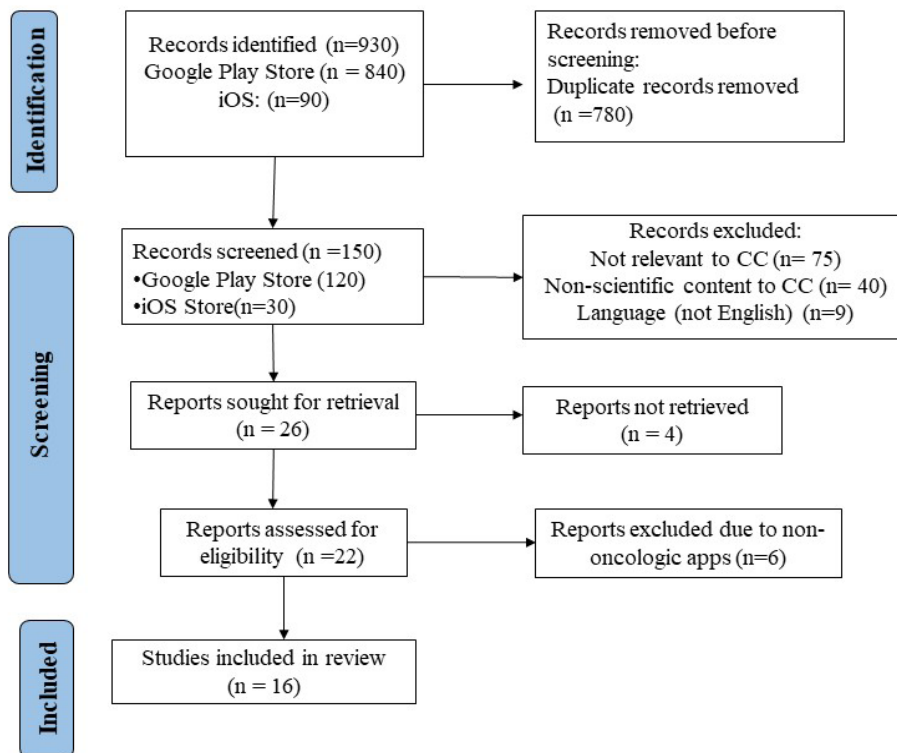


Figure 1. PRISMA Flowchart to Describe the Screening Mechanism for Selection of Mobile Applications

### Discussion

The assessment of mobile health (mHealth) apps related to cervical cancer in India, employing the Mobile Application Rating Scale (MARS) and apps scoring system, offers significant perspectives on the array of resources accessible for cervical cancer education and support. Accessible and trustworthy information is critical since a significant proportion of India’s female population is at risk for cervical cancer [1]. In order to support ongoing efforts addressing the public health issues related to cervical cancer in the nation, our study set out to evaluate the quality of these applications. Our assessment’s conclusions showed a wide variety of app

features and quality indicators.

Apps such as “OCI Cervibreast” and “Rise Against Cancer” stood out for their excellent performance in the areas of engagement, functionality, aesthetics, and information categories. This suggests that these platforms are strong and easy to use for raising awareness and providing advice on cervical cancer [13]. The cluster of applications assessed in this think about reflect a concerted exertion to adjust with particular client needs and communicated concerns, as point by point within the one of a kind portrayals and targets of each app. They endeavor to furnish clients with the foremost up-to-date data, consolidate locks in intuitively components, and maintain a solid commitment to client security. All

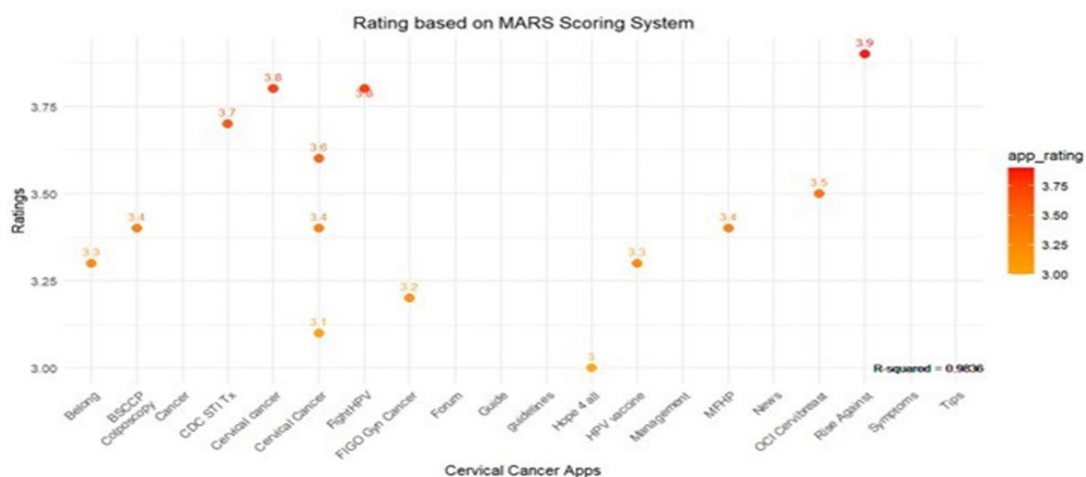


Figure 2. MARS Rating of Application

Table 5. Evaluation of Cervical Cancer Apps Performance Using Multimodal Tools

Name of the App	MARS	Application	App specific statements	Total Mean
Rise Against Cancer	3.9	4.83	0.54	3.09
Belong	3.5	4.33	0.62	2.82
Hope 4 all	2.6	4.67	0.46	2.58
OCI Cervi Breast	3.5	3.17	0.62	2.43
CDC STI TX guidelines	3.5	3	0.54	2.35
Cervical Cancer Symptoms	3.5	3.5	0.15	2.38
MFHP Cancer	3.5	3.83	0.38	2.57
Cervical Cancer Tips	3.4	4.33	0.15	2.63
Cervical Cancer News	2.4	4.5	0.15	2.35
BSCCP Colposcopy Guide	3.5	4.17	0.31	2.66
Cervical cancer Forum	3.7	3	0.15	2.28
HPV vaccine	3.5	4.5	0.08	2.69
FightHPV	3.8	3.83	0.15	2.59
FIGO Gyn Cancer Management	3.2	4	0.08	2.43

things considered, whereas these characteristics are commendable, certain applications, such as “Hope 4 all” and “Cervical Cancer News,” did not admission as well in our evaluation, especially in terms of usefulness and client engagement. These specific viewpoints appeared stamped room for change, proposing a require for improvement in how these apps encourage client interaction and convey related information.

Despite their potential, they don't give the complete range of highlights, current substance, or the level of interaction that's basic for conveying comprehensive bolster and instructive assets for people concerned with cervical cancer [14]. Besides, the examination of these apps divulged a noteworthy setback within the profundity and breadth of substance relating to the Human Papillomavirus, which is generally recognized as the foremost causative operator of cervical cancer. By implanting a more comprehensive and point by point account of HPV into these apps, their down to earth utility and pertinence to clients might be considerably expanded [15]. This incorporation gets to be basic against the backdrop of the urgent part that HPV immunization and preventive measures play within the overarching technique to check the rate of cervical cancer. Upgrading these apps to incorporate thorough data on HPV may hence not as it were teach clients but moreover possibly drive more noteworthy selection of preventive activities, counting immunization, which might have an enduring effect on the control of cervical cancer universally [16]. mHealth apps focusing on cervical cancer could benefit greatly from expanding their consultation services. The inclusion of more robust consultation features as well as essential functionality for tracking test results and managing screening appointments could significantly enhance the value these applications bring to users [17]. Incorporating consultation session reminders will help improve user engagement in their healthcare process, ensuring they receive timely support and guidance throughout their healthcare journey.

Going further, creating opportunities for users to

interact directly with healthcare providers through apps can personalize and enhance the care experience [18]. This can manifest in the form of personalized advice or specific interventions, developed to meet the user's individual requirements or health concerns. This high level of personalization ensures that the care provided is not only appropriate but also empathetic and tailored to each individual situation. By expanding the range of available services and fostering stronger communication channels between users and healthcare professionals, mHealth applications can make a more significant contribution to health management women's cervix [19].

These innovations can facilitate a comprehensive, patient-centered care model that will not only improve the usability and functionality of applications but is also essential to improving patient engagement and ultimately health outcomes. Overall, such innovations could transform these apps into more comprehensive wellness tools, empowering women to take more responsibility for proactively managing their cervical health [20].

To maximize the value of mHealth apps designed for cervical cancer, developers should prioritize regular content updates to ensure accuracy and timeliness, thereby maintaining application relevance and reliability. Critical to this effort is a continued focus on providing current, evidence-based information relevant to the evolving medical landscape and user expectations. Additionally, by integrating interactive features such as decision-making tools and AI-based support, applications not only become more engaging but also empower users, especially women, by how to provide them with powerful resources to make informed health care decisions. User engagement is further enhanced by the integration of interactive elements that respond to user preferences to actively participate in managing their health [21]. Artificial intelligence capabilities can personalize user experiences, provide tailored advice, and improve decision-making. This level of personalized engagement is necessary to drive deeper connections with the app and encourage sustained usage over time [22]. Additionally, strengthening privacy

policies is essential to increase users' trust and willingness to participate in mHealth applications [23]. Providing users with clear and accessible explanations on how to protect their data will help alleviate privacy concerns [24]. Along with this, it is essential to provide comprehensive educational content about HPV and the importance of testing methods. This information will demystify medical procedures and highlight the importance of proactive medical measures, including the HPV vaccine, which serves as a valuable preventive education tool [25]. By implementing these enhancements, developers can fill existing gaps and significantly improve the quality and effectiveness of mHealth apps targeting cervical cancer [26]. With these improvements, these applications can be more than just information resources; they can be transformed into essential, trusted tools that help women access relevant health information and give them the skills to proactively manage their cervical health [27]. This comprehensive enhancement strategy not only benefits individual users, but also has the potential to positively impact women's healthcare outcomes globally.

In, Conclusion, in concluding this study on the evaluation of cervical cancer apps using mobile application scoring systems, we have observed a substantive engagement in the use of mobile health (mHealth) technologies for the support and education of cervical cancer. The evaluation revealed that while there are several applications available, particularly in the Indian context, with "Rise Against Cancer" attaining the highest scores in overall mean rating, there exists a variance in quality, functionality, and user engagement among the different apps.

The applications display strengths in several areas, as evidenced by their performance on the Mobile Application Rating Scale, with commendable attributes in engagement, functionality, aesthetics, and information that are crucial for user retention and effectiveness. This indicates potential for mHealth apps as tools for raising awareness, aiding early detection, and possibly even in the prevention of cervical cancer through educational outreach and resource availability

Nevertheless, the study highlights crucial gaps, particularly in knowledge concerning the HPV virus—the primary cause of cervical cancer. The incorporation of comprehensive and up-to-date information on HPV as well as features that facilitate interaction with healthcare professionals could greatly supplement these applications. Essential functions like test result monitoring and appointment scheduling are present in several apps, yet, the expansion of counseling services and the inclusion of reminders could significantly enhance user experience and provide more personalized care

This review highlights a significant chance to improve the calibre and efficiency of apps for cervical cancer. To guarantee that the content is current and accurate, developers are asked to give frequent updates top priority. Furthermore, incorporating interactive elements and utilising AI-backed resources may improve user involvement and provide women the confidence to make knowledgeable healthcare decisions. Building user confidence and encouraging wider app use also

requires improving privacy policies to protect user data and offering thorough information on HPV and screening procedures. Through the consideration of these factors, app developers can produce more comprehensive and intuitive cervical cancer applications that facilitate women's journeys towards disease prevention, early detection, and management. In the end, these initiatives help to enhance health outcomes and lessen access gaps.

In summary, our research shows how important it is for mHealth apps to improve the way information is shared, offer assistance, and encourage cervical cancer prevention. The results highlight how critical it is to acknowledge these digital technologies as vital resources in the fight against cervical cancer. It is crucial that app developers and medical professionals recognise the importance of these apps and keep coming up with new ones in order to make sure that these resources advance and become more easily available, educational, and encouraging for people who are at risk of or currently battling cervical cancer. We can successfully close the knowledge gap and promote preventive actions by utilising mobile technologies, which will ultimately improve health outcomes and lessen the incidence of cervical cancer.

Future app developers should prioritize user-friendly interfaces, data privacy, evidence-based content, and seamless connection with current healthcare systems. Personalized teaching, regular updates, and user feedback will improve the effectiveness of mHealth applications in cervical cancer prevention and management, ultimately leading to better health outcomes.

## Author Contribution Statement

Conceptualization, S.D.; methodology, J.P.; software, J.P.; validation, S.D.; formal analysis, S.D.; investigation, S.D.; resources, S.D.; data curation, S.D.; writing, S.D.; writing, review and editing, S.D.; supervision, S.D.; project administration, S.D.

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### Approval

The current study was approved by institutional research committee (IRC)

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### Data Availability

The data presented in this research may be found in the UCI Machine Learning Repository, which can be found at <https://archive.ics.uci.edu/dataset/17/breast+cancer+w isconsin+diagnostic>.

### Conflict of Interest

Authors declare that there is no conflict of interest.



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