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Evaluation of midwifery educated mobile applications for labor guidance and a roadmap for future developers

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ABSTRACT

The objective of the study was to review the midwifery guided mobile apps for labor advice, assessing features, functions, and content relevance. In February to March 2024, midwifery labor-guided applications were reviewed in mobile platforms such as the Google Play Store and Apple iTunes Store. We used multimodal evaluation tools, such as the mobile app rating scale (MARS), specific statements, and IQVIA ratings, to assess the quality of these applications. The study evaluated midwifery-guided applications, resulting in an average objective quality score of 3.96±0.96 out of 5. 'Safe delivery' scored the highest rating of 4.94, followed by 'Pregnancy mentor' (4.89), 'Hypno-birthing' (4.61), 'Obstetrics 6th edition' (4.68), and 'MSD manual guide to obstetrics' (4.56). Functionality received the highest score (4.16±0.865), followed by information (3.99±0.97), engagement (3.88±1.07), and aesthetics (3.82±0.28) areas. Subjective quality score was 3.6±1.18 out of 5 for an overall MARS score of 3.76±1.02. Most applications received favorable reviews, indicating good quality, and it is recommended that future app developers design applications that include comprehensive information on labor management.

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1. INTRODUCTION

Childbirth is a memorable experience in a woman's life". The delivery process is governed by the pregnant mother and the midwife, who provides care throughout the birth. Midwives should provide psychological, emotional support and non-pharmacological pain therapies to parturient women in addition to medical care [1]. Perinatal mothers and relatives possess misconceptions about the birthing process and contractions. However, this is partially dependent on how midwives teach parturient women about labor physiology and how they use coping techniques to cope with labor pains [2]. Midwives possess the roles to encourage pregnant women and family members to participate actively in the delivery process. Strengthening the good relationship between midwives and parturient mothers is critical in achieving positive birthing outcomes for both the mother and newborn. Midwives need to be skilled and capable of managing low-risk to moderate-risk parturient mothers [3]. They are advocates for intranatal mothers throughout delivery, adhering

to their birthing preferences and cultural beliefs. However, if necessary, they must be well prepared to address crises in coordination with obstetricians and neonatologists [4].

Midwives improve favorable maternal and neonatal outcomes by providing efficient care and support for the mother throughout labor process. They need regular, up-to-date training and a holistic strategy to educate mothers and family members in providing emotional and psychological support. Midwives regularly monitor the mother and fetus to assess labor progress and identify any complications at an early stage. They motivate intra-natal mothers to choose natural delivery and empower women to recognize their intrinsic potential to deliver naturally. Non-pharmacological therapies such as Lamaze breathing, hypnosis, Shiatsu massages, hydrotherapy, and others aid in contraction management and contribute to a happy labor result [5].

Mobile apps are becoming extensively used tools for providing and storing information that can be accessed when the user needs them. Midwives monitor the pregnancy and labor advice application to learn how to care for pregnant and postpartum women. Midwifery apps are powerful tools that help provide evidence-based maternity and child care. Despite continued efforts in developing countries to enhance maternal and child health, many countries continue to have high maternal death rates (MMR) [6]. The risk of MMR varies from 1:60 in developing countries to 1:3700 in developed ones. According to the 2018 survey report, mobile applications are important tools that benefit clinical practice and patient delivery care [7]. Labor management knowledge, such as breathing methods and various ways to handle labor, provides many learning opportunities. Midwives working in the labor room can easily access this information through mobiles when caring for a pregnant mother. As per the review, there are only a few midwifery applications accessible in the Indian app store, and they provide limited information and functions [8].

Therefore, this study motivated the current authors to assess the quality, efficacy, and accessibility of mobile apps meant to provide labor care, with a particular emphasis on those that have midwifery-embedded features. It also aims to identify areas for improvement in existing applications, such as gaps and limitations, in order to guarantee alignment with evidence-based practices and the various requirements of pregnant women. Furthermore, the study aims to provide valuable insights and recommendations to app developers, directing the development of novel features, user interfaces, and functions that improve the overall user experience and promote optimum maternal outcomes.

The objectives of the current study are as follows:

- To find and evaluate current midwifery guided Android applications on labor information, including their features, functions, and content relevancy, using a mobile rating scale.
- To provide app developers with advice and guidelines for improving the quality, efficacy, and usability of future midwifery-guided Android labor assistance apps.

The current study examined midwifery-guided mobile labor management applications, focusing on deficiencies in comprehensive, evidence-based content customized to midwives' needs. Previous research focused on the benefits of mobile applications in enhancing maternal health, but did not address labor-specific tools for midwives. This study fills these gaps by providing insights and recommendations for improving app quality and maternal care outcomes. Recent research has highlighted the potential of mobile health (mHealth) applications to improve maternal and neonatal outcomes. Knop *et al*. [9] conducted a systematic assessment of mHealth interventions in low- and middle-income countries, concluding that these tools improved maternal, infant, and child health during the first 1,000 days of life. The study stressed the need of creating context-specific applications to solve distinct healthcare concerns. Similarly, Kiani and Pirzadeh [10] examined a mobile application meant to encourage physical activity among pregnant women during the COVID-19 epidemic. The quasi-experimental study investigated that application-based therapies with motivational multimedia material substantially increased physical activity, promoting healthier pregnancies. Sadeghi *et al*. [11] conducted a systematic assessment of mobile prematurity applications, underlining the need of user-friendly interfaces and reliable material for pregnant women and midwives at risk of preterm birth. The study advocated for standardized evaluation frameworks to assess app quality completely. As per the review of literature, our study will be the first to assess the quality of labor-guided mobile applications designed for midwives. This review will help to identify gaps in existing applications and provide recommendations for future app developers on the necessity to design effective labor-guided apps for midwives working in labor rooms.

2. METHOD

2.1. Design and setting of the study

We conducted a comprehensive review of both iTunes Store (iOS) and Android mobile applications to check the features, functionality, and efficiency of mobile applications that provide information on labor. We also evaluated factors such as user interface design, accessibility, and language options to determine usability among pregnant mothers. The analysis also compared evidence-based content within the

applications to ensure medical accuracy and reliability of labor-related information. Furthermore, the researchers assessed user feedback and ratings to understand overall satisfaction and identify areas for improvement in mobile health tools supporting childbirth education.

2.2. Search strategy

Two researchers used the search bar in the iOS and Google Play Stores to locate applications related to labor guides for midwives. In February to March 2024, one author searched on iOS, and another searched on the Google Play Store. The following keywords were used in the app search: "Nursing and midwifery," "Safe pregnancy and birth," "Birthing guide," "Lamaze breathing," "Shiatsu in labor," "Acupressure in childbirth," "Hypnotherapy," "Labor guide," and "Midwifery guide." The apps discovered by the MeSH keyword search were counted among the mobile applications accessible across all smartphones and tablets.

2.3. Criteria for the selection apps

The applications provided labor-related information and were accessible in Hindi and English, with free or paid use decisions. Apps were rejected if they lacked scientific information, were unrelated to pregnancy, were horoscope apps, or had too many games. The qualifying apps were downloaded from the Google Play Store and iTunes Store for testing. Researchers SD and SB checked the accuracy of approved applications to guarantee their eligibility. Any disagreements between the two reviewers were handled through consensus-building discussions. Figure 1 depicts the selection method.

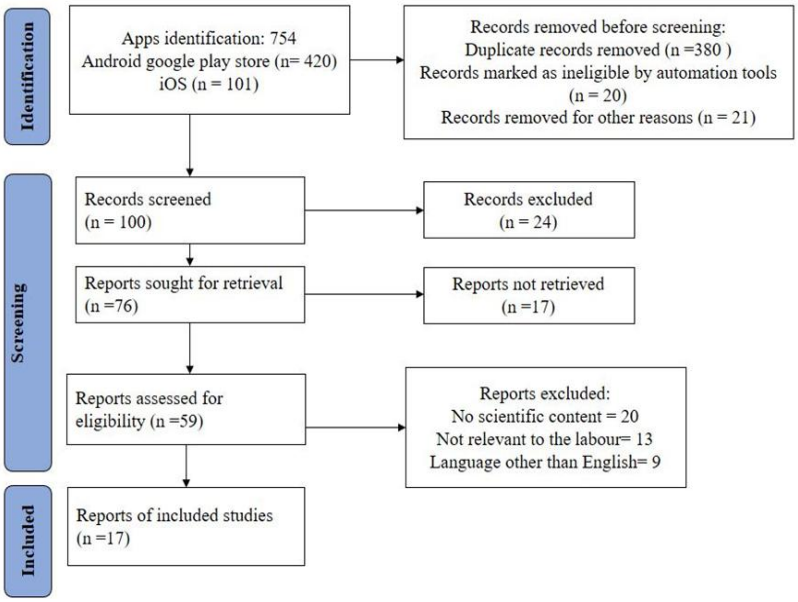

Figure 1. Process of identifying and finalizing the apps for evaluation

2.4. Data collection and app characteristics

Table 1 presents the data on the health application's core characteristics, including the app's name, publishing platform, invention date, updating date, downloads, affiliation, internet requirement, registration, interaction, notification sending, and app membership payment. We stored the data in a Microsoft Excel file for future examination and evaluation. Table 1 presents the data on the core characteristics of labor guided mobile applications. We stored the data in a Microsoft Excel file for future examination and evaluation.

2.5. Apps evaluation

Two authors performed a thorough review of the applications in this study. Each app was tried offline first; if that failed, it was tried online. Payments were made if any apps needed a membership fee, and the apps were evaluated for quality. Both reviewers used and evaluated the applications for a maximum of seven days before beginning the quality evaluation. Mobile rating applications. IQVIA [12] for healthcare informatics to examine functionality, and average rating ratings were used to evaluate app quality. Before the evaluation, the reviewers were trained on mobile app rating scale (MARS) using a YouTube video. Independent app assessments were used to build a shared understanding of mobile rating, specific statements, and app rating scores based on certain criteria [13]. Any differences were settled after communicating with a

third reviewer. The seven IQVIA functioning ratings measured the scope of activities, which included informing, educating, recording, displaying, guiding, reminding, and sending information.

Table 1. Characteristics of labor mobile applications

App	Platform	Invention date	Updating date	Downloads	Internet need	Notification	Payment for use
Safe pregnancy and birth	Android & iOS	Oct 2023	2023	1000+	No	No	No
Midwifery nursing	Android & iOS	July 2020	2023	50000+	Yes	No	No
Midwifery notes	Android & iOS	July 2021	2023	10000+	Yes	Yes	No
Safe delivery	Android & iOS	Sep 2015	2023	1 lakh+	No	No	No
Doula contraction labor coach	Android & iOS	Sep 2015	2023	1 lakh	Yes	Yes	Yes
Nursing and midwifery	Android	Aug 2022	2022	1000	No	No	No
Clinical midwifery	Android & iOS	July 2029	2020	100+	Yes	No	Yes
ESW AOM	Android & iOS	2 years ago	2023	500+	Yes	No	No
Fernandez midwifery app	Android & iOS	Aug 2020	Sep 2022	1000+	No	No	Yes
Pregnancy mentor	iOS	March 2015	Octo 2023	50000	Yes	No	Yes
Birth position	Android & iOS	March 2016	May 2022	100	Yes	No	No
Hypno-birthing	Android & Ios	Jan 2022	Nov 2023	10000+	Yes	yes	Yes
Obstetrics	Android &Ios	Apr 2023	Sep 2023	1000+	No	No	No
Birthpedia	iOs	June 2020	May 2021	100+	Yes	No	Yes
APGO induction of labor	Android & iOs	Feb 2019	April 2023	500+	No	No	No
Obstetrics 6th edition	iOS	-	-	-	Yes	Yes	Yes
MSD manual guide to obstetrics	Android	Nov 2019	Dec @2023	10000	No	No	No

2.6. Mobile application rating score

MARS is a valuable paradigm for conducting in-depth evaluations of mobile apps, particularly those in the health and well-being domains. Roberts *et al*. [14] developed it with six major components. The engagement metric analyses user involvement and interest, whereas the functional metric evaluates app usability and performance. Aesthetics investigates visual design elements, whereas information quality assures data accuracy and dependability. The app-specific dimension focuses on the app's specialized purpose, whereas subjective quality assesses overall user happiness. Each dimension includes a rating scale, which provides a quantitative value for a more in-depth investigation. MARS is an excellent tool for researchers, developers, and users, providing insights into app strengths and areas for development, hence contributing to the growth of mobile app quality and user experience.

2.7. The IQVIA functionality score

The IQVIA functionality score is the only statistic designed to assess the functionality of mobile IQVIA is not an acronym but the merger of two firms, IMS health and quintiles. The apps were evaluated based on seven functions: informing, instructing, recording, presenting, guiding, recalling, and enabling data sharing. The IQVIA functionality score serves as a key metric designed to evaluate the overall functionality and effectiveness of mobile health applications. Unlike traditional measures, IQVIA—formed through the merger of IMS health and quintiles—focuses on practical usability rather than theoretical assessment. The evaluation framework encompasses seven essential functions: informing, instructing, recording, presenting, guiding, recalling, and enabling data sharing, each reflecting a critical component of how effectively an app supports users in managing their health.

2.8. Specific statements on labor information

To provide in-depth review, the authors created fifteen assertions about labor management. If the app content is consistent with a certain assertion, it obtains a score of one; otherwise, it receives a zero. The maximum score for the particular statement rating score was 15.

2.9. Statistical techniques

Descriptive data, including numbers and percentages, identified program attributes such as platform availability (Android or iOS), price (free or paid), user reviews, application collection groupings, and language. The raw and mean scores of the assessment instruments and their standard deviations were computed and reported for each app. All statistical analyses were carried out using Office 365 and Microsoft Excel.

3. RESULTS

This study evaluates midwifery-focused Android applications for labor management guidance, identifying gaps in comprehensive, evidence-based content customized to midwives' requirements. Previous research has focused on the broad benefits of mHealth but has not addressed labor-specific applications for midwives, particularly those with content dedicated solely to labor management. This study addresses these gaps by providing insights and recommendations for future app developers to focus on creating high-quality applications for labor management, aimed at improving maternal and neonatal care outcome.

3.1. Identification of eligible apps

The researchers found 754 applications on Google Play and 101 on iOS during their investigation. Following an initial review, 380 duplicate applications were eliminated, along with 20 invalid ones. In addition, 21 applications were removed for various reasons, including registration and login difficulties. Following an in-depth review, 73 applications were eliminated, while 17 were included in the research and thoroughly analyzed, as shown in Figure 1. A recent study conducted by Habibi *et al*. [15] stated that there is a need for periodical upgrades of mobile applications, emphasizing that they must be updated regularly. However, these findings contradict our study, as most applications (99%) have been routinely updated over the last three years. In the current study, most applications (23.5%) did not offer features for connecting with doctors, healthcare professionals, or consumers. These findings align with those reported by Habibi *et al*. [15], where only one out of ten applications interacted with healthcare professionals with 98% accuracy and precision.

3.2. Assessment of apps quality using mobile app rating scale

Table 2 displays the MARS evaluations of the 17 applications, organized by quality. The average score for objective quality was 3.96±0.96 out of 5. The highest-rated app was "21. Safe delivery" (4.94), followed by pregnancy mentor (4.89), hypno-birthing (4.61), obstetrics 6th edition (4.68), and MSD manual guide to obstetrics (4.56). The total MARS quality score was 3.76±1.02 out of 5. Similar findings were reported in the study conducted by Tucker *et al*. [16], which found that apps containing evidence-based information on peripartum care scored higher on the MARS metrics. However, no correlation was found between the availability of evidence-based content and the number of application users. Overall, the results indicated that existing peripartum applications lack adequate information on maternal health and do not effectively address the needs of the target users. Frid *et al*. [17] also found that only a few applications provide the necessary components for prenatal mother care. A study conducted by Yu *et al*. [18] found that the subjective score of MARS may introduce the risk of biased evaluation. However, our study included all domains of MARS for the evaluation. The subjective quality evaluation was conducted separately before calculating the average MARS score to avoid any potential bias.

Table 2. Assessment of the quality of apps on labor care using MARS

Name of the App	Objective quality section				Objective quality score Mean	Subjective quality score Mean	Overall MARS quality score Mean
	Engagement	Functionality	Aesthetics	Information			
Safe pregnancy and birth	2.6	5	3.33	3.33	3.57	3	3.28
Midwifery nursing	3.2	4	3.00	3.50	3.43	3	3.21
Midwifery notes	4.4	5	4.67	4.17	4.56	3.67	4.12
Safe delivery	5	4.5	5.00	5.00	4.88	5	4.94
Doula contraction labor coach	2	2	2.00	2.00	2.00	2	2.00
Nursing and midwifery	2	3	1.00	2.00	2.00	1	1.50
Clinical midwifery	3.4	3.75	3.00	3.50	3.41	2	2.71
ESW AOM	3.6	4.5	4.00	3.83	3.98	3	3.49
Fernandez midwifery app	2.4	2.75	3.00	3.17	2.83	3	2.92
Pregnancy mentor	4.4	4.75	5.00	5.00	4.79	5	4.89
Birth position	5	5	5.00	4.50	4.88	4	4.44
Hypno-birthing	5	4.5	4.67	4.67	4.71	4.5	4.61
Obstetrics	4	4	3.67	4.40	4.02	4.75	4.38
Birthpedia	4.4	4.5	5.00	5.00	4.73	4	4.36
APGO induction of labor	4.6	4	4.00	4.00	4.15	3.75	3.95
Obstetrics 6th edition	5	5	4.67	4.80	4.87	4.5	4.68
MSD manual guide to obstetrics	5	4.5	4.00	5.00	4.63	4.5	4.56
Mean ± SD	3.88±1.07	4.16±0.865	3.82±0.28	3.99±0.97	3.96+0.96	3.6±1.18	3.76±1.02

3.3. App rating using specific statements

Table 3 shows that the Maternity Foundation's Safe Delivery App received the highest rating of 12 out of 15, followed by obstetrics 6th edition (11 out of 15) and obstetrics (9 out of 15). The average score was 6.24±3.88. Most applications gave information on safe delivery techniques, phases of labor care, and ways to strengthen labor. However, several applications missed information about shiatsu therapy, Lamaze breathing methods, hypnosis, and non-pharmacological labor pain treatments. Similar findings were reported in the study conducted by Asadollahi *et al*. [19], which found that 66% of the applications provided only poor information regarding maternity care. In the present study, no application was found to meet the criteria. However, no similar review study has been conducted previously.

3.4. Apps score on beyond labor-related information

This domain contains topics linked to applications likely to promote knowledge and health behavior, apps likely to modify attitudes, apps likely to raise intent, and apps that aid in seeking help. A Likert scale was employed for evaluation. The entire average score was 3.49±1.39. The Safe Delivery App (4.83) and Pregnancy Mentor (5 out of 5) received the highest ratings, followed by Hypno-birthing (4.6 out of 5) and Obstetrics 6th edition (4.6 out of 5). Table 4 illustrates that most mobile applications extend beyond labor-related content, incorporating information on pregnancy, childbirth, and postpartum care. In the illustration, green represents 'yes,' suggesting that the app has information about pregnancy and the postpartum period. In contrast, pale pink represents 'no,' indicating that the app does not contain pregnancy and postpartum content. A review conducted by Pouriayevali *et al*. [20] reported that existing applications contain insufficient information regarding pregnancy self-care and recommended that future developers include more comprehensive content on pregnancy self-care. Musgrave *et al*. [21] reported that currently available apps require evidence-based information on pregnancy care. Devi *et al*. [22] reported that only 27% of apps tract specific pregnancy issues.

Table 3. Specific statements of labor guide for midwives

Name of the app	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total score
Safe pregnancy and birth	1	0	0	0	0	0	1	1	1	1	1	1	0	1	1	9
Midwifery nursing	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	6
Midwifery 0te	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	8
Safe delivery	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	12
ESWAOM	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	6
Pregnancy mentor	1	1	0	0	0	0	1	1	1	1	1	1	0	0	1	9
Obstetrics	1	1	0	0	0	0	1	1	1	1	1	1	0	1	1	10
Birthpedia	1	1	1	1	0	0	1	1	1	1	1	0	0	0	0	9
APGO induction of labor	1	1	1	0	0	0	1	0	0	1	1	0	0	0	0	6
Obstetrics 6th edition	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	11
MSD manual guide to obstetrics	0	1	0	0	0	0	1	1	1	1	1	1	0	1	1	9

Note:

1. Labor assessment score
2. Physiology of birth
3. Lamaze breathing techniques/breathing techniques
4. Shiatsu therapy
5. Hypnotherapy/positions in labor
6. Acupuncture and pressure
7. Readiness for childbirth
8. Signs of labor
9. Safe delivery information
10. Stage of labor care
11. Strengthening labor
12. Warning signs in birth
13. Partograph
14. Neonatal resuscitation
15. Abnormal labor

Table 4. Content within the apps covers beyond labor-related information

App No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	Total score	%
1																						10	47.62
2																						5	23.81
3																						11	52.38
4																						15	71.43
6																						8	38.10
8																						5	23.81
9																						17	80.95
10																						0	0.00
11																						7	33.33
12																						15	71.43
15																						18	85.71
16																						17	80.95

Note:

A. Physiology of pregnancy
B. Minor ailments
C. Antenatal exercise
D. Antenatal diet
E. Antenatal check-ups
F. Pregnancy calculator
G. Immunization
H. Warning signs
I. Antenatal examination
J. Abnormal pregnancy
K. Labor assessment score
L. Physiology of birth
M. Care in 7 days
N. Uterine massage
O. Warning signs after birth
P. Breast examination
Q. Breastfeeding
R. Immunization
S. Postnatal check-ups
T. Postnatal exercises
U. Abnormal puerperium

3.5. Comparison of results obtained from different scales

The top three applications indicated by each evaluation technique differed, as shown in Table 5. Safe Delivery and Pregnancy Mentor scored well in all three assessment systems. Following closely were "Hypno-birthing" and "Obstetrics 6th edition," rated as high-quality applications by two assessment methods. Figure 2 presents the data of objective and subjective quality assessment performance. The subjective rating ranged from 1 to 5, whereas the objective score went from 2 to 4.88. Interestingly, there is little difference between subjective and objective scores. Figure 3 shows an ROC AUC value of 0.619, which indicates MARS' overall prediction accuracy and the global rating score. A study conducted by Feroz *et al*. [23] reported that most mHealth interventions need to be more effective in improving antenatal, intranatal, and postnatal care, and suggested the need for more clinical trials [23], [24].

Table 5. Multimodal assessment tools comparison labor guidance apps

App name	Total MARS score	Specific scoring system	App information	Average star rating
Safe pregnancy and birth	3.28	9	3.33	3
Midwifery nursing	3.21	6	3.33	3
Midwifery notes	4.12	8	4.00	3
Safe delivery	4.94	12	4.83	3
Doula contraction labor coach	2.00	0	1.00	3
Nursing and midwifery	1.50	3	1.00	3
Clinical midwifery	2.71	0	2.00	3
ESW AOM	3.49	6	4.00	3
Fernandez midwifery app	2.92	0	1.00	3
Pregnancy mentor	4.89	9	5.00	3
Birth position	4.44	4	4.00	3
Hypno-birthing	4.61	4	4.67	3
Obstetrics	4.38	10	4.33	4
Birthpedia	4.36	9	4.00	3
APGO induction of labor	3.95	6	3.50	3
Obstetrics 6th edition	4.68	11	4.60	0
MSD manual guide to obstetrics	4.56	9	4.67	3
Mean ± SD	3.77±1.03	6.06±3.67	3.49±1.39	2.88±0.78

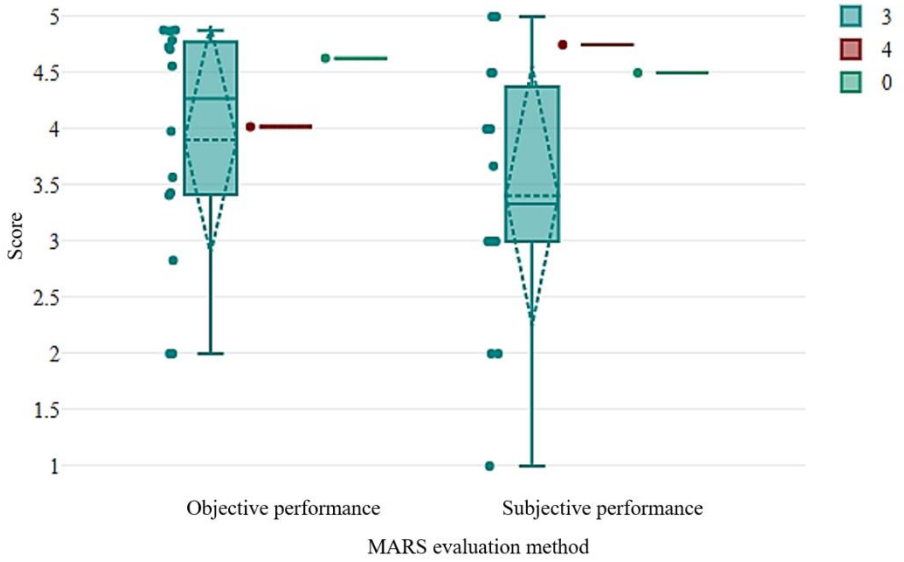

Figure 2. The overall mean values, SD of MARS score subjective and objective performance

3.6. IQVIA functionality

Figure 4 depicts the entire analysis. The "instruct" feature was the most popular across all apps (n= 17, 100%). This tool often advises users on the next steps based on documented symptoms. Only four applications offered the potential to promote contact between patients and healthcare providers—notably, all the applications needed to support all seven capabilities. Devi *et al*. [22] also found the similar results in [25].

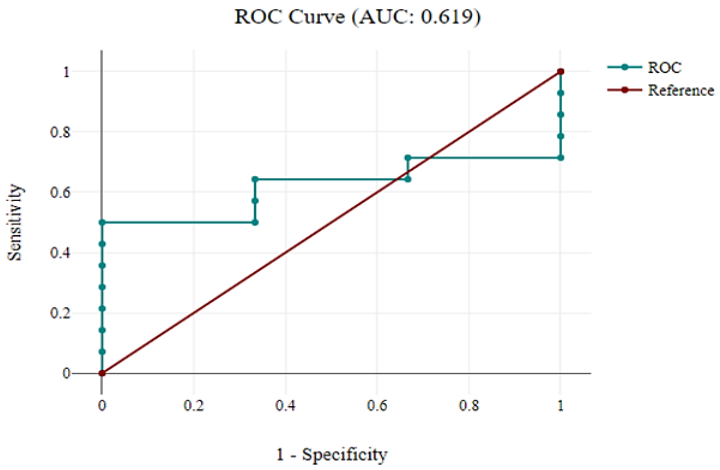

Figure 3. ROC curve for overall MARS and global rating score

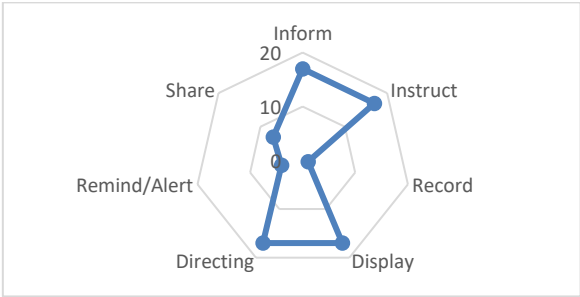

Figure 4. IQVIA functionality scores of healthcare informatics

4. CONCLUSION

Most of the applications in our assessment were created by commercial companies and non-governmental groups, with only a few applications were created by governments and scientific institutions. The quality of the applications may be improved if they were developed with input from scientific organizations, specialists in alternative labor treatments, and midwives who operate in delivery rooms. To our knowledge and based on our analysis, our study is the first to thoroughly examine labor-guided applications employing multimodality assessment tools and compare the results to each assessment scale. In addition, this study analyzed the IQVIA functioning criterion, which had yet to be addressed in earlier investigations. The currently available labor-guided applications have quality ratings ranging from below average to average. However, the information presented by these applications requires improvement and further clinical trials are recommended. Furthermore, evaluation techniques affected app quality rating findings, emphasizing the lack of standardized quality assessment tools for mobile apps. We recommend that future mobile application developers focus on developing evidence-based, user-friendly, and comprehensive tools that provide the education on labor management. Real-time, multilingual support, and non-pharmacological pain control measures, different positions in labor and Lamaze should be among the key aspects. Collaborating with healthcare specialists and providing regular updates would assure relevance. Improved interactivity and connectivity can empower midwives, improve maternal and newborn outcomes, and assist to reduce maternal mortality, especially in resource-constrained environments. This study faced challenges such as the scarcity of midwifery-specific apps in India and with free access, limited evidence-based content, and outdated functionality in existing apps. Evaluation was stalled by application quality variability and language barriers excluding non-English apps. The limitations of this review include the inclusion of only mobile applications in English, which restricts the generalizability of the findings. In today's digital era, mobile applications are continuously developed and updated. Therefore, it is possible that some apps were created and published after the evaluation period of this study and were not included. Additionally, the current study incorporated other sources of healthcare information, such as websites, which are commonly used by midwives.

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Sangeetha X.					✓			✓		✓				
Kumari Dimple		✓			✓					✓				

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Authors state no conflict of interest.

ETHICAL APPROVAL

The study has received approval from the Institutional Research Committee. As this is a review article, no ethical clearance involving human or animal subjects was required. The research complies with all relevant institutional policies and national regulations in accordance with the tenets of the Helsinki Declaration.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author, [LP], upon reasonable request. However, the data are not publicly available as they contain information that could compromise the privacy of research participants.

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