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Requirement Analysis of mHealth app for Pregnancy Care and a Framework Suggestion for Evaluating Pregnancy Mobile Apps

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ABSTRACT

Background & Objective: There are a lot of apps for pregnancy care using mHealth technologies. However, it has not been studied which criteria in these apps are essential for increasing the quality of these mHealth programs in pregnant women. Thus this study aimed to review the desirable features of mobile-based pregnancy care applications and provide a model to evaluate existing applications.

Materials & Methods: Features of a mobile-based pregnancy app were designed using a qualitative approach. In this research, an open questionnaire was developed. Obstetricians and gynecologists filled out this questionnaire. After thematic analysis of the questionnaires, the obtained items are embedded into a general framework for evaluation mHealth.

Results: Fifteen gynecology and obstetrics experts participated in this study. Eight themes were obtained from 34 items mentioned by the experts. Finally, a specialized framework for evaluating mHealth apps for pregnancy care is proposed.

Conclusion: To design mobile-based pregnancy care app and evaluate the existing apps in the field of pregnancy, the provided indicators can be used. This framework and other similar specialized frameworks could be developed to improve the quality of the mHealth apps.

Keywords: Application, Evaluation, Framework, mHealth, Pregnancy care

Introduction

Due to the high demand of patients for being visited by medical experts and place or time barriers, they cannot regularly use face-to-face consultation. Therefore, patients may face challenges in identifying priorities to address their clinical concerns. In this regard, the Internet and smartphones have received much attention for accessing health care information as a tool for managing health care. Mobile health (mHealth) technologies, as one of the healthcare approaches, could reduce the pressure on the healthcare system and improve the quality of care for patients (1-4). The World Health Organization (WHO) has defined mHealth as mobile devices, including mobile phones, patient monitoring devices, and personal digital assistants to achieve health purposes (5). mHealth, as a self-management tool, could be used to support patients via monitoring and managing health, resulting in an improved healthy life (6).

Among mHealth platforms, besides mHealth apps in women's health (7), numerous studies have been conducted worldwide to confirm the effectiveness of mHealth in promoting the health of the mother and fetus during pregnancy (8, 9). For example, several studies have reported the advantages of mHealth monitoring apps for controlling diabetes during pregnancy (10). mHealth also provides a platform for obstetricians and midwives to overcome their time and place limitations and enhance the health of pregnant women during pregnancy (11).

Systematic monitoring, including examination and consultation about pregnancy issues, education and support of the pregnant woman, and preparation of a

continuous clinical screening program, are essential to prevent possible complications during pregnancy **(12)**. Studies in different world areas consider the amount of inadequate prenatal care **(13)**. Due to the importance of continuous care for pregnant women, the benefits of mHealth can be increasingly understood **(10)**.

Women need information during their pregnancy. According to the literature, many pregnant women worldwide use the Internet as a source of information **(14)**. Instead of using paper and face-to-face techniques to obtain information, they have used mHealth technology **(15)**. Studies have shown that more than 50% of pregnant women download pregnancy-based apps, and these women have fewer pregnancy visits **(16)**. For example, Chan *et al.* demonstrated that social media and mHealth apps could be widely used for improving the quality of life during pregnancy **(17)**. In recent years, mHealth technology has grown quickly, and mobile phones are used in various aspects such as healthcare services **(18)**. In developing countries, mHealth is highly used among women to get healthcare services, especially prenatal care **(19)**.

Furthermore, the necessity of mHealth apps during the COVID-19 pandemic has also been observed more than ever for reducing the need for visits due to the adverse effects of COVID-19 on pregnant women **(20)**. For example, it was reported that 21% of prenatal visits in March 2020 and 26% of prenatal visits in April 2020 were canceled, postponed, or performed remotely **(21)**.

In addition to all of the above, exposure to incorrect information and nonevidence-based mobile apps causes problems for pregnant women due to the high sensitivity of maternal to external impacts; therefore, these issues should be carefully considered **(22)**. Also, it requires to be considered that many medical Web sites and smartphone mHealth apps are not transparent in providing accurate health information **(23)**. Wallwiener *et al.* reported that despite the great importance of mHealth apps, many smartphone applications are not reliable sources **(10)**. Henriksson *et al.* evaluated the effectiveness of a smartphone app for reducing excess weight gain, dietary habits, physical activity, and glycemia during pregnancy **(24)**.

All in all, there are a lot of apps for pregnancy care using mHealth technologies. However, it has not been studied which criteria in these apps are essential for increasing the quality of these mHealth programs in pregnant women. Thus, this study aimed to determine a model to identify the desirable features of mobile-based pregnancy care apps for improving maternal well-being.

Methods

Data Collection

In this research, a qualitative study has been conducted. A questionnaire with one general open question from experts was asked. The question was, "what features should a good mobile-based app contain?". The questionaries were designed in Google Forms. Next, a gynecology and obstetrics expert shared the link in specialized Telegram groups with her colleagues.

Data Analysis

The codes were extracted from the answers manually. In the next step, the themes were identified based on the codes and regarding items in the general framework for mHealth apps developed by Nouri *et al.* (25) (Figure1).

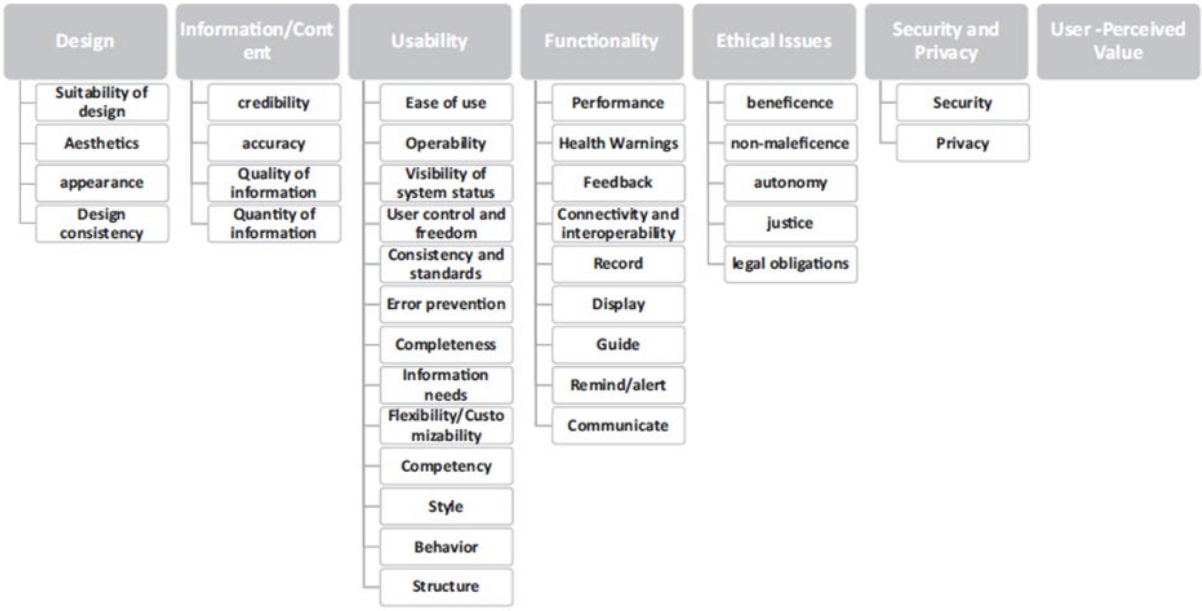

Figure 1. Criteria for evaluating the quality of mHealth programs

Results

Data Collection

Fifteen experts filled out the questionnaire. The specialist and the experts were all gynecologists and obstetrics. The work history of the experts is listed in Table 1.

Data Analysis

The new codes are listed in Table 2. The themes extracted from the codes using Nouri's framework are shown in Table 3.

Table 1. Years of working in the field of the experts

Work history (year)	Number of experts
2	1
3	3
4	6
5	2
7	1
10	1

Table 2. Codes extracted from the answers

Code extracted
Updated with the science of the day
Contains pregnancy care training tips
Ease to understand
Access to patient information via simplified code
Ability to work offline
Easy and permanent access
Ability to install on various devices and operating systems
Data transmission speed
Connect to the patient file
special diseases
Medications
Record the patient's main complaint
Registration of symptoms
Registration of Vital Signs
Registration of Feeling the movement of the fetus
Registration of Vaginal bleeding
Registration of Feeling of a ruptured bladder and wet underwear
Registration of Pain in the lower abdomen or back
Registration of Headache
Registration of Heartburn
Registration of Blurred vision
Registration of Ultrasound report image
Save patient records for physician

Code extracted
Reminders of the necessary screening references and tests in each term
Recall supplements every trimester of pregnancy
Ability to message the doctor
Perform calculations
Calculate gestational age based on test results
Calculate BMI
Calculate the date of screening
It should not cause you not to see a doctor
Ease of use
Comprehensive
Reminder

Table 3. Themes extracted from the codes

Code extracted
Ease to understand
Simplicity
Comprehensive
Accessibility
Cross-platform
Reminder
Performing calculations
It should not cause you not to see a doctor

The specialized framework for evaluating pregnancy care mHealth apps framework is represented in Table 4. New items extracted from the codes are shown in green color. Also, the items already existed in the framework and mentioned in the answers are colored blue.

Table 4. The specialized framework for evaluating pregnancy care mHealth apps

Category	Items	Subitems	Subitems child
Design	Suitability of design		
	Aesthetic		
	Appearance		
	Data consistency		
Information/Content	Creditability		
	Accuracy		
	Quality of information	Updated with the science of the day	
	Quantity of information	Contains pregnancy care training tips	
	Understandable		
Usability	Ease of use	Access to patient information via simplified code	

Category	Items	Subitems	Subitems child
		Ability to work offline	
	Operability		
	Visibility of system status		
	User control and freedom		
	Consistency and standards		
	Error prevention		
	Completeness		
	Information needs		
	Flexibility / customizability		
	Competence		
	Style		
	Behavior		
	Structure		
	Easy and permanent access		
	Ability to install on various devices and operating systems		
	Performance	Data transmission speed	
	Health warnings		
	Feedback		
	Connectivity and interoperability		
		Connect to the patient file	
		special diseases	
		Medications	
		Record the patient's main complaint	
Functionality	Record	Registration of symptoms	Registration of Vital Signs
			Registration of Feeling the movement of the fetus
			Registration of Vaginal bleeding
			Registration of Feeling of a ruptured bladder and wet underwear
			Registration of Pain in the lower abdomen or back
			Registration of Headache
			Registration of Heartburn
			Registration of Blurred vision
			Registration of Ultrasound report image
		Save patient records for physician	
	Display		
	Guide		
	Remind/alert	Reminders of the necessary screening references and tests in each term	

Category	Items	Subitems	Subitems child
		Recall supplements every trimester of pregnancy	
	Communicate	Ability to message to the doctor	
	Perform calculations	Calculate gestational age based on test results	
		Calculate BMI	
		Calculate the date of screening	
	Beneficence		
	Non-maleficence		
Ethical Issues	Autonomy		
	Justice		
	Legal obligations		
Security and Privacy	Security		
	privacy		
User-Perceived Values Designing	It should not cause you not to see a doctor		

As a result, by integrating the general framework model for mHealth apps and the new specialized features obtained using experts' opinions, the developed model was redesigned, as shown in Figure 2.

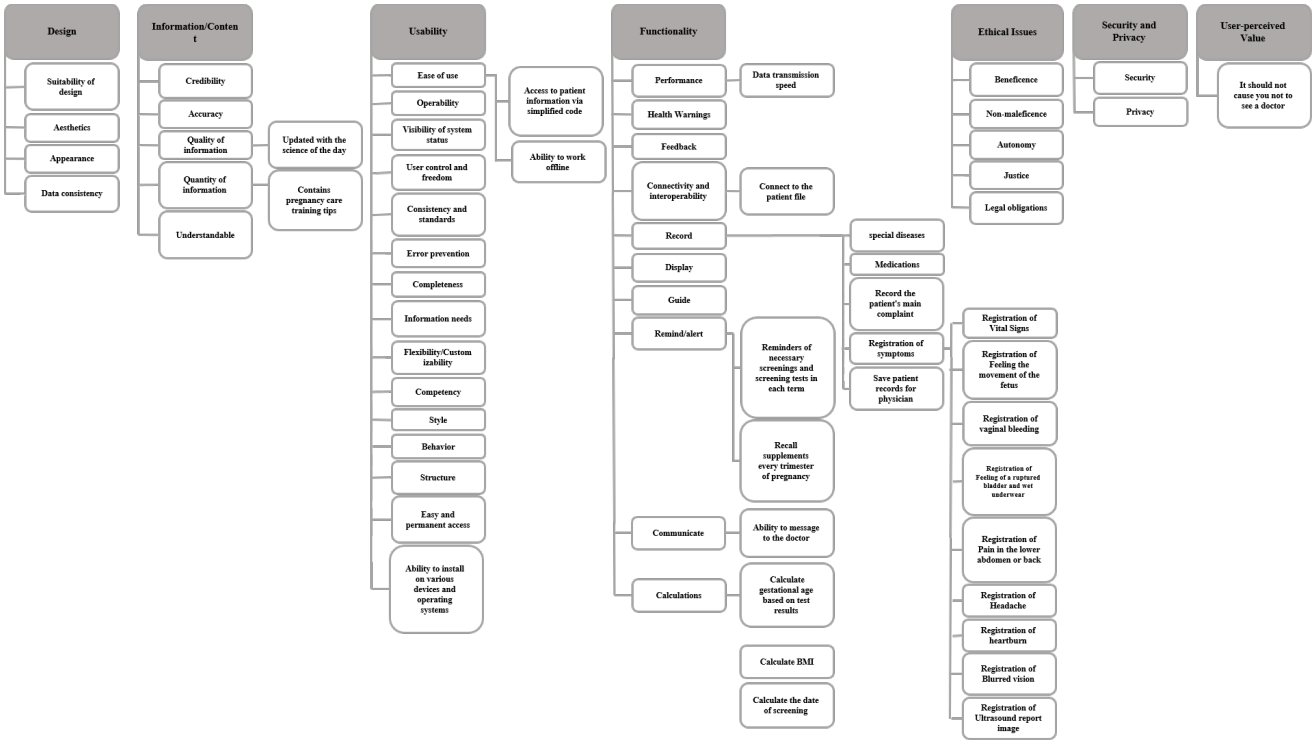

Figure 2. Criteria for evaluating the quality of mHealth programs for pregnancy care applications

Discussion

In this study, a mHealth evaluation framework for pregnancy care was designed based on a previous general framework for evaluating mHealth apps. The specific domain features required by obstetrician experts had been embedded into the previous general model, resulting in a mHealth pregnancy-specific evaluation framework. The main categories of the original framework were not changed; however,

specialized features required for pregnancy apps were added to subcategories of the original framework. The survey results showed that this mHealth evaluation framework could be used in pregnancy care.

A previous study by Hussain *et al.* **(26)** uses Jakob Nielsen's usability principle as the evaluation framework for a mHelath pregnancy app. The principles contain a subset of the usability category in the proposed framework. Some criteria such as abling to install on multiple devices and the ability to work offline are in the proposed framework that could be used in the evaluation of similar apps.

In another study by Lee *et al.* **(27)**, the authors used general website confidence and satisfaction evaluation tools to evaluate mHealth pregnancy-related tools **(28)**. This tool contains four categories and 19 items, including content components, information clarity and protection, content management, and information source. These categories could be mapped to Information/Content and security and privacy categories of the proposed framework.

In the mentioned studies, like most research in the literature, the authors used a general framework for evaluating the pregnancy apps. The authors believe that the suggested framework could be used to evaluate the mHealth apps from a general and a specific point of view, and this framework could help the experts to have a clear image of the status of their apps. Also, this framework could help authors to prevent mistakes in the development of the pregnancy-related app. For example study by Halili *et al.* **(29)**, the authors derived multiple themes using two focus groups for the evaluation of a pregnancy app. The items they categorized in the "Critique of the SmartMoms app" include design and aesthetic, Interactivity, Feedback, Emphasis on weight gain, and Developmental and technical issues. Some of these shortcomings could be prevented if the developers considered the suggested framework for the app development.

Conclusion

As a qualitative study, this study investigated essential criteria for pregnancy care mHealth apps. To this end, a general framework for evaluating mHealth app was adopted, and specialized features related to pregnancy were added to the model based on expert opinions. The findings provide an innovative perspective on the evaluation of pregnancy apps that enable the maternal to monitor and manage their health and reduce complications. Future works could focus on creating a quantitative tool derived from the current framework. Future work can also incorporate the findings of this study into the design and implementation of a comprehensive mobile app for pregnancy care.

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Conflict of Interest

The authors declare no conflict of interest.

References

1. Kreps GL, Neuhauser L. New directions in eHealth communication: opportunities and challenges. Patient Educ Couns. 2010;78(3):329-36. [DOI:10.1016/j.pec.2010.01.013] [PMID]
2. Tate DF, Finkelstein EA, Khavjou O, Gustafson A. Cost effectiveness of internet interventions: review and recommendations. Ann Behav Med. 2009;38(1):40-5. [DOI:10.1007/s12160-009-9131-6] [PMID] [PMCID]
3. Goldzweig CL, Towfigh A, Maglione M, Shekelle PG. Costs And Benefits Of Health Information Technology: New Trends From The Literature: Since 2005, patient-focused applications have proliferated, but data on their costs and benefits remain sparse. Health Aff. 2009;28(Suppl2):w282-w93. [DOI:10.1377/hlthaff.28.2.w282] [PMID]
4. Mosa AS, Yoo I, Sheets L. A systematic review of healthcare applications for smartphones. BMC Med Inform Decis Mak. 2012;12(1):67. [PMCID] [DOI:10.1186/1472-6947-12-67] [PMID]
5. Organization WH. mHealth: new horizons for health through mobile technologies: World Health Organization; 2011.
6. Dansharif AR, Iyawa GE, Owoseni A, Iyawa R. mHealth for Self-Management in Pregnancy: Perceptions of Women in Low-Resource Settings. Procedia Comput Sci. 2021;181:738-45. [DOI:10.1016/j.procs.2021.01.226]
7. Dantas LO, Carvalho C, Pena C, Breda CC, Driusso P, Ferreira CHJ, et al. Mobile health technologies for the monitoring of menstrual cycle: A systematic review of online stores in Brazil. J Obstet Gynaecol Res. 2022;48(1):5-14. [DOI:10.1111/jog.15082] [PMID]
8. Espinosa MCS, Lauzurique ME, Alcazar VRH, Pacheco BLC, Lubian MdCM, Cala DC, et al. Maternal and child health care in Cuba: achievements and challenges. Rev Panam Salud Publica. 2018;42:1.

9. Blakeney EL, Herting JR, Bekemeier B, Zierler BK. Social determinants of health and disparities in prenatal care utilization during the Great Recession period 2005-2010. BMC Pregnancy Childbirth. 2019;19(1):390. [PMCID] [DOI:10.1186/s12884-019-2486-1] [PMID]

10. Wallwiener S, Müller M, Doster A, Laserer W, Reck C, Pauluschke-Fröhlich J, et al. Pregnancy eHealth and mHealth: user proportions and characteristics of pregnant women using Web-based information sources-a cross-sectional study. Arch Gynecol Obstet. 2016;294(5):937-44. [DOI:10.1007/s00404-016-4093-y] [PMID]

11. Tamrat T, Kachnowski S. Special delivery: an analysis of mHealth in maternal and newborn health programs and their outcomes around the world. Matern Child Health J. 2012;16(5):1092-101. [DOI:10.1007/s10995-011-0836-3] [PMID]

12. Shin D, Song WO. Influence of the Adequacy of the Prenatal Care Utilization Index on Small-For-Gestational-Age Infants and Preterm Births in the United States. J Clin Med. 2019;8(6):838. [DOI:10.3390/jcm8060838] [PMID] [PMCID]

13. Osterman MJ, Martin JA. SystemTiming and adequacy of prenatal care in the United States, 2016. Natl Vital Stat Rep. 2018;67(3):1-14.

14. Fonseca F, Peixoto H, Braga J, Machado JM, Abelha A. Smart mobile computing in pregnancy care. 2019.

15. Musgrave LM, Kizirian NV, Homer CSE, Gordon A. Mobile Phone Apps in Australia for Improving Pregnancy Outcomes: Systematic Search on App Stores. JMIR Mhealth Uhealth. 2020;8(11): e22340. [DOI:10.2196/22340] [PMID] [PMCID]

16. Frid G, Bogaert K, Chen KT. Mobile Health Apps for Pregnant Women: Systematic Search, Evaluation, and Analysis of Features. J Med Internet Res. 2021;23(10):e25667. [DOI:10.2196/25667] [PMID] [PMCID]

17. Chan KL, Chen M. Effects of Social Media and Mobile Health Apps on Pregnancy Care: Meta-Analysis. BMC Pregnancy Childbirth. 2019;7(1): e11836. [DOI:10.2196/11836] [PMID] [PMCID]

18. Aker JC, Mbiti IM. Mobile phones and economic development in Africa. J Econ Perspect. 2010;24 (3):207-32. [DOI:10.1257/jep.24.3.207]

19. Ezenwa C, Brooks L. Understanding the Introduction and Use of a Mobile Device-Supported Health Information System in Nigeria. Electron J Inf Syst Dev Ctries. 2014;62(1):1-20. [DOI:10.1002/j.1681-4835.2014.tb00445.x]

20. Ahmadi M, Ayyoubzadeh SM, Abbasi S. Digital health tools for prenatal care in COVID-19 pandemic. J Obstet Gynecol Cancer Res. 2022;7 (3):12. [DOI:10.30699/jogcr.7.3.254]

21. Burgess A, Breman RB, Bradley D, Dada S, Burcher P. Pregnant Women's Reports of the Impact of COVID-19 on Pregnancy, Prenatal Care, and Infant Feeding Plans. MCN Am J Matern Child Nurs. 2021;46(1):21-9. [PMID] [DOI:10.1097/NMC.0000000000000673]

22. Scott KM, Gome GA, Richards D, Caldwell PHY. How trustworthy are apps for maternal and child health? Health Technol. 2015;4(4):329-36. [DOI:10.1007/s12553-015-0099-x]

23. Bert F, Giacometti M, Gualano MR, Siliquini R. Smartphones and health promotion: a review of the evidence. J Med Syst. 2014;38(1):9995. [DOI:10.1007/s10916-013-9995-7] [PMID]

24. Henriksson P, Sandborg J, Blomberg M, Alexandrou C, Maddison R, Silfvernagel K, et al. A Smartphone App to Promote Healthy Weight Gain, Diet, and Physical Activity During Pregnancy (HealthyMoms): Protocol for a Randomized Controlled Trial. JMIR Res Protoc. 2019;8(3):e13011. [DOI:10.2196/13011] [PMID] [PMCID]

25. Nouri R, S RNK, Ghazisaeedi M, Marchand G, Yasini M. Criteria for assessing the quality of mHealth apps: a systematic review. J Am Med Inform Assoc. 2018;25(8):1089-98. [DOI:10.1093/jamia/ocy050] [PMID] [PMCID]

26. Hussain A, Mkpojiogu EO, Fadzil N, Hassan N, Zaaba ZF. A mobile usability evaluation of a pregnancy app. J Telecommun Electron Comput Eng. 2018;10(1-11):13-8.

27. Lee Y, Moon M. Utilization and Content Evaluation of Mobile Applications for Pregnancy, Birth, and Child Care. Healthc Inform Res. 2016; 22(2):73-80. [PMCID] [DOI:10.4258/hir.2016.22.2.73] [PMID]

28. Woo Y-W, Cho K-W. A model for evaluating confidence and satisfaction of health information web-sites. J Korea Contents Assoc. 2006;6(9):42-9.

29. Halili L, Liu R, Hutchinson KA, Semeniuk K, Redman LM, Adamo KB. Development and pilot evaluation of a pregnancy-specific mobile health tool: a qualitative investigation of SmartMoms Canada. BMC Med Inform Decis Mak. 2018;18 (1):95. [DOI:10.1186/s12911-018-0705-8] [PMID] [PMCID]

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