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ORIGINAL ARTICLE

PREGNANCY AND MOBILE HEALTH TECHNOLOGIES: ANALYSIS OF SMARTPHONE APPS

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ABSTRACT

Objective: analyzing the characteristics of mobile apps available for download in smartphones related to the gestational period. **Method:** a cross-sectional, descriptive study, with quantitative approach conducted between August and September 2020 and updated in November 2023 in the Android and iOS operating system. **Results:** eighteen apps were included and analyzed, in which 72.22% were intended for pregnant women, 66.67% developed in other countries, 83.33% had evaluation above four stars, 66.67% had as main subject information regarding pre-natal pregnancy, 66.67% were updated in the last year, 55.58% did not present the references consulted to elaborate the available content and 83.33% did not indicate the participation of health professionals in their development. **Conclusion:** the needs for greater rigor in the development of apps focused on the health area, especially those related to pregnancy, to ensure that the available information is dependable and based on scientific recommendations and the respective sources accessed.

Keywords: Mobile apps. Telemedicine. Smartphone. Pregnancy.

INTRODUCTION

In the last decade, Information and Communication Technologies (ICTs) through digital technologies have directly influenced the behavior of people with health care. The information began to arrive more quickly and practically to the population. Among the ICTs, the technological tools that propagated faster were smartphones and their apps, which began to be used in addition to the basic features of calls, text messages or even internet browsing[1,2]. These devices have been constituted in a transformative potential of health care, by the improvement of mobile applications (apps) and programs installed in smartphones that have varied functions capable of disseminating information in various contexts. Mobile applications provide the articulation of entertainment solutions and the creation of a vast communication network, as well as enabling independent and autonomous knowledge as they enable the user to navigate according to their own interest[3].

It is estimated that 97% of the world's population has access to a cellular signal and 93% is within the reach of a 3G network[4]. In Brazil, data indicate that 74% of the population have access to the internet, 58% access the network exclusively through a smartphone and 47% usually search for issues related to health or health services[5]. Apps have become an important ally in expanding health care coverage, adherence to treatment, health promotion and disease prevention[6]. The Covid-19 pandemic boosted the use of this technological tool, with a 25% increase in the number of downloads of mobile apps related to health, compared to the number of apps downloaded in previous periods[7].

In the context of reproductive health, several apps are available to assist health professionals,

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pregnant women, and parents/partners, on family planning, prenatal care, prenatal care, childbirth, postpartum, neonatal and infant[8]. Apps specifically for monitoring pregnancy are widely used and have gained popularity, given that women especially have started to look for information about prenatal care on the internet to meet their information needs during the pregnancy period[8, 9].

Thus, for their interactive design and personal nature, these apps can support the autonomy and competence of the user for self-care and present themselves as a viable alternative to promote health in various areas or health programs, such as prenatal care[10, 11, 12]. Scientific evidence shows that the use of apps in pregnancy implies improving the quality of care and has a positive impact on maternal and child health, with the potential to improve health indicators, reduce the number of maternal deaths, assist in the assistance of nurses who work in primary care and reduce costs[13-15].

In this context, users tend to value low-cost and preferably free apps, however, even with the advantages, such as easy access, there is a considerable number of apps available, and the market is constantly growing[16]. Therefore, identifying which are the apps available on pregnancy care that women and parents/partners will access in major online stores, as well as what information and resources are present, becomes important, especially due to the lack of guidelines standard for developing and/or selecting apps[9]. In general, users consider publicly available features to make decisions regarding app usage and satisfaction, such as star rating, number of downloads and reviews[1], but it is considered that this evaluation does not guarantee scientific reliability of the available information.

In this sense, analyzing the existing apps represents an advance in the scientific perspective of this in view of the scarcity of scientific studies that deal with the characteristics of the apps available and that are used daily by society and pregnant women specifically[1]. In addition, this analysis can contribute to identify those that have gaps in the development process, lack of current information and support in scientific evidence, in addition to those that do not specify for which audience the content is aimed. Thus, this study has the potential to fill gaps and support reflections for the development of apps with higher quality and reliability in content, because this conforms to an imminent need.

Thus, in view of the increasing number of smartphone apps available to the lay public, this study aimed to analyze the characteristics of mobile apps available for download on smartphones related to the gestational period.

METHOD

Cross-sectional, descriptive study, with quantitative approach, conducted between August and September 2020 and updated in November 2023, from online searches in the virtual stores of mobile apps for smartphones with Android operating system (Play Store) and iOS (App Store). Thus, the apps made available in these stores constituted the study population, which had as inclusion criterion: to address content about prenatal care, to be available in the Portuguese language and to have free access.

The exclusion criteria were: specific apps on physical exercise and nutritional guidance for pregnant women with technical content, photo album, photo editor, games, advertisements, directed only to health professionals, who presented difficulties to download after three attempts (presenting error), restricted access and specific to records such as: gestational calculators for the calculation of Gestational Age (GA) and Probable Date of Birth (PDB), Fetal Movements (FM), Fetal Heartbeat (FH) and uterine contractions counter.

The searches occurred in both online stores using the terms "prenatal" and "pregnancy" individually. All apps identified as relevant that met the inclusion and exclusion criteria were downloaded. Two independent researchers performed this stage, simultaneously, who followed the selection flowchart (Figure 1) and, after completion of the sample recruitment, compared their findings to verify discrepancies in the sample obtained.

The total number of apps obtained in both online stores was 43. Among these, 25 apps were excluded due to duplication, that is, they were present both in the list of apps from the App Store and the Play Store. For sample selection, preference was given to the maintenance of the apps accessed by the virtual store of the Android operating system (Play Store), as it is the most used operating system in Brazil, according to reports[16]. Thus, the final sample of the research was composed of 18 apps, which were managed by the researchers independently for a minimum of 15 minutes and a maximum of 30 minutes. In order to obtain the data on the characteristics of the apps, an instrument developed

considering the information available in the application itself and/or in the virtual stores, with the following variables: name; country of origin; target audience; evaluation of the application in stars, installations - number of downloads; main subject addressed; last update; type of language used (lay or technical-scientific); resources available; operating system; sponsorship; developer and source of content.

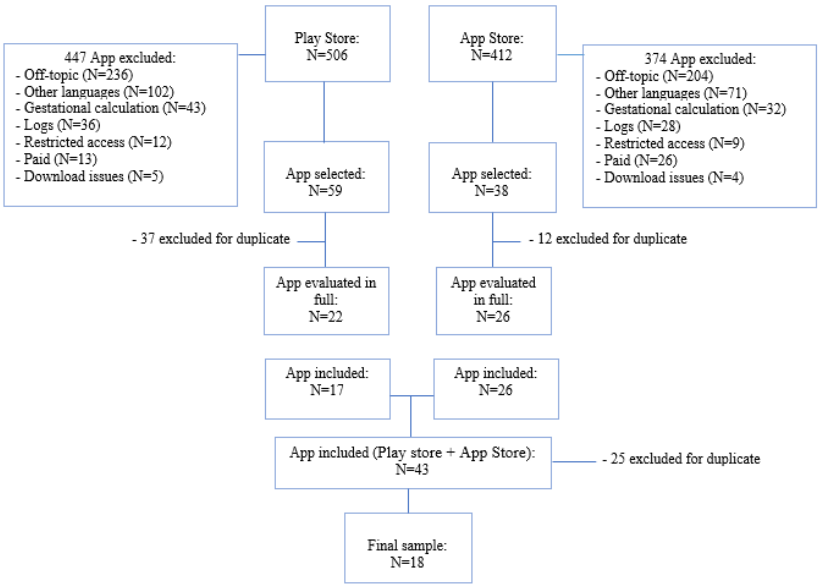

Figure 1. Flowchart of the selection of apps in the Play Store and App Store according to the inclusion and exclusion criteria. Cuiabá, MT, 2023.

The collected data were organized in a Microsoft Excel spreadsheet and subsequently analyzed through the Stata program, version 14. It is noteworthy that there was no need for approval by the Research Ethics Committee (REC), since the contents analyzed were in the public domain and the research did not involve human beings.

RESULTS

This study analyzed the characteristics of eighteen mobile apps focused on gestational care. It was found that, of these, the majority (N=12; 66.67%) was developed in other countries, such as Russia (N=4; 22.22%), the United States of America (N=2; 11.11%), Argentina (N=1; 5.55%), Spain (N=1; 5.55%); Switzerland (N=5.55%) (N=1; 5.55%), which have translation into Brazilian Portuguese. It was identified that few (N=6; 33.33%) were developed in Brazil.

Regarding the target audience, thirteen (72.22%) apps were intended for pregnant women, two (11.11%) included pregnant women and postpartum women, two (11.11%) included the pregnant woman, and only one (5.56%) included the family and called in the app as tempting. As for the evaluation, performed by the star rating ranging from one to five, fifteen (83.33%) had rating above four stars, which means a good rating in the opinion of users.

Regarding the main theme addressed in the apps, twelve (66.67%) presented general information about prenatal care according to the gestational period, such as body changes, healthy eating, physical exercise and emotional care in pregnancy and puerperium. Six other apps (33.33%) exclusively addressed information about the stages of fetal development week by week. Of the eighteen apps analyzed, four (22.22%) addressed the father's and/or partner's participation in their content.

Regarding the update, only nine (50%) were updated in 2023. Among the 18 apps, two (11.11%) did not have any additional features, the other sixteen (88.89%) had several functions, such as gestogram, kick counter, videos, audios, interaction between users, diary for notes and links to access channels and videos on YouTube. Of the apps with resources, five (38.25%) presented the option of Birth Plan (BP).

Regarding sponsorship, only two (11.11%) apps indicated that they were sponsored and, about the source of the content, ten (55.58%) apps did not present the bibliographic references consulted. Most (83.33%) did not contain information about the participation of health professionals in their

development and only three (16.67%) were developed in partnerships with professionals in the area (Chart 1).

Chart 1. Characteristics of the applications available in the "App Store" and "Play Store" virtual stores according to the variables: name, country of origin, rating, number of downloads, main subject, update, type of language, resources, operating system, sponsorship, developer and source of the content. Cuiabá, 2023

Application	Country	Target Audience	User Rating Average	Number of Download	Main Subject	Last Update	Resource	Operational System	Developer	Source of Content
My prenatal	Brazil	Pregnant	4,3	100,000+	Prenatal care and fetal development	Sep/2023	Yes	Android	UFMG Faculty of Medicine	Yes
Pregnancy and week calculator	Switzerland	Pregnant	4,6	500,000+	Prenatal care and fetal development	Aug/2023	No	Android	Smiko	No
Kangaroo	Brazil	Pregnant women and/or mothers	2,6	100,000+	Prenatal care, fetal development and motherhood	Oct/2020	Yes	Android	Qeepme Health Technology	Yes
Sprout Pregnancy	USA	Pregnant	4,5	1,000,000+	Prenatal care and fetal development	Nov/2023	Yes	Android	Med arts Studio	Yes
Pregnancy +	United Kingdom	Pregnant	4,7	10,000,000+	Prenatal care and fetal development	Nov/2023	Yes	Android	Philips consumer Lifestyle B. V.	Yes
Pregnancy week by week	Spain	Pregnant	3,9	10,000+	Stages of the gestational period	May/2021	Yes	Android	PineappleApps	No
My pregnancy	Brazil	Pregnant and/or postpartum women	4,3	500,000+	Prenatal care and fetal development	Aug/2021	Yes	Android	Appz Mobile	No
My pregnancy calendar week by week	Russia	Pregnant	4,6	1,000,000+	Prenatal care and fetal development	Nov/2023	Yes	Android	Wachanga	No
My pregnancy - pregnancy week by week	Poland	Pregnant	4,8	1,000,000+	Prenatal care and fetal development	Jul/2021	Yes	Android	Pregnancy apps contraction timer, due date tracker.	Yes
My pregnancy and my baby today	USA	Pregnant and/or postpartum women	4,8	10,000,000+	Prenatal care and fetal development	Nov/2023	Yes	Android	Babycenter	No
My pregnancy today	Uruguay	Pregnant	4,0	1,000+	Prenatal care and fetal development	Jul/2021	No	Android	Elnono	No
My pregnancy by Paula	Brazil	Pregnant	4,7	500,000+	Prenatal care and fetal development	Mar/2021	Yes	Android	Paula App	Yes
My pregnancy week by week (NEIMAN)	Russia	Pregnant	4,7	500,000+	Prenatal care and fetal development	Sep/2023	Yes	Android	Neiman	No
My pregnancy week by week	Argentina	Pregnant and/or trying	4,6	100,000+	Prenatal care and fetal development	Sep/2023	Yes	Android	My pregnancy	No
Emotional prenatal	Brazil	Pregnant women, mothers and/or family	3,4	1,000+	Prenatal care, fetal development and guidance on emotions	Sep/2017	Yes	Android	Raquel Jandozza	No
Pregnancy calendar + week of pregnancy	Russia	Pregnant	4,7	500,000+	Fetal development and body changes	Oct/2023	Yes	Android	Pregnancy App countdown baby tracker by baby inside	Yes
Parents&Children	Brazil	Pregnant	5,0	Uninformed	Prenatal care and fetal development	Nov/2017	Yes	iOS	Publisher Mancheta	No
My pregnancy - weeks of pregnancy	Russia	Pregnant	4,6	5,000,000+	Prenatal care	Aug./2021	Yes	Android	Mobile Dimension LLC	Yes

DISCUSSION

App development as a resource for accessing health information is a growing perspective in the world. In this study, although all the apps included and analyzed presented translation into Brazilian Portuguese, few were developed in the country. Thus, when considering the specific socioeconomic and cultural conditions of the country, it is necessary to develop Brazilian apps, since apps from other countries may not address the needs and specificities of pregnant women and Brazilian families, in addition to following health guidelines according to the place of origin[14,17,18], usually developed countries such as Russia, the United States of America, Switzerland and the United Kingdom.

As for the content available, most referred to prenatal care with weekly or quarterly information with different approaches, depending on each app. Thus, as found in other studies, most pregnancy-oriented apps presented contents allusive to prenatal care and fetal development according to the woman's gestational age[10]. A study conducted in China with 535 women corroborated this finding, because when investigating the use of apps for pregnancy care, it identified that apps are widely used to monitor fetal development, obtain information about diet, physical exercises, and body changes[19].

Another point highlighted in this study was that few apps (n=4; 22.22%) included father/partner participation in their content. In the Brazilian context, the Stork Network (SN) strategy, the Companion Law and the partner's prenatal care contribute positively to the fulfillment of the inclusion of men in the set of information relating to prenatal care, trying to consolidate the crucial change in the paradigm from the mother-child binomial to the father-mother-child trinomial. It is important to highlight that it is necessary to encourage the involvement of the father/partner in all stages of pregnancy, birth and postpartum, until

the integral development of the child is monitored[20].

Regarding the evaluation, the analyzed apps achieved evaluation above four stars (N=15; 83.33%) according to the users' perception. The popularity of an app in online stores is measured by star rating and this influences its accessibility, as it directly affects the ranking order in the results obtained from the search engine, where the probability of the app that has more stars to be downloaded and used is higher in relation to the others[18]. In this regard, a study conducted by researchers in India on apps for smartphones about Diabetes, showed that apps that received a higher rating of users had a higher number of downloads, thus indicating the popularity and consumer acceptance[21].

Regarding the update, most of them were updated in 2021 (N=12; 66.67%), thus, much information was changed, which may have influenced the positive evaluation of users, since they had current recommendations for maternal health care. The results of this study also highlighted that many apps provided various functions (N = 16; 88.89%), such as gestational calculator, kick counter and diary for notes. Corroborating this finding, research with the objective of identifying and evaluating apps on pregnancy identified that the most common resources available included contraction timers, space for notes/photos, appointment alert and calendar[9].

It was also identified that few apps (N = 5; 38.25%) had on the functionality related to BP, a tool in which pregnant women express the care they want to receive/experience during their labor, Birth and postpartum. The BP is recommended by the World Health Organization (WHO) and the Ministry of Health (MH) in Brazil[23], but there is still ignorance of both pregnant women and health professionals about its use. Thus, to disseminate this tool, it is important that the apps include this document among the available functions[12,13,24].

Regarding the source of information accessed for the elaboration of the content, it was identified that eight (44.44%) apps made this information available. This finding corroborated a study that analyzed pregnancy apps that addressed preeclampsia for pregnant women/lay public, and highlighted that, after analysis of the 11 apps included, only two (18.18%) provided the source consulted for content preparation[14]. For these authors, because they are pregnant women, especially primiparous women, who have more doubts about pregnancy, the quality and reliability of the content of the apps should be evaluated, information contained, and few were developed by health professionals or organizations. Still in this sense, another research highlighted the lack of reliable information provided by a high proportion of apps currently available both in terms of content and functionality[22].

In this scenario, there are still few apps that include the involvement of health professionals in their development. Most app developers are commercial entities or internet portals, and the involvement of health professionals and institutions in the creation or endorsement of digital information sources was still extremely low (N=3; 16.67%) in this study. As in other research on mobile apps focused on maternal and child health, in which it was evidenced that 75.8% of those included in the study were developed by organizations not linked to health, and according to these authors, the low quality of mobile health apps may be related to the lack of participation of specialists in this area in its elaboration[1].

Thus, the literature points to the importance and necessity of the contents of the apps to be monitored and managed by health professionals[1, 25]. So, when we consider that consumers increasingly use mobile apps in everyday life, health professionals, app developers, policy makers and users themselves need to be considered in this process to benefit from a better understanding of the underlying factors that drive user demand, user popularity, and the reliability of available content[1, 25].

The evaluation process stands out as an essential aspect in the development and use of health apps[26]. Therefore, it is necessary the participation of professionals able to contribute to the improvement of the technological solution built. In this research, it was identified that only one application originated from academic production and included the methodological steps of construction and validation of the software. The development in a coherent and appropriate way presupposes the identification of the real needs of the users and, subsequently, the validation process by professionals with expertise in interest is extremely important, since these have a more directional look at scientific technical aspects that can influence and enhance the learning process, empowerment and self-care of the end-user of

technology[13, 27, 28].

It is important to emphasize that nurses play an important role in the qualification process of prenatal care when performing actions of health promotion and prevention of complications of the pregnancy-puerperal period through the use of innovative health technologies[2], which makes the use of mobile apps a useful and current means to disseminate information and contribute to the empowerment and decision-making of women for the course of a healthy pregnancy.

However, this study presents as limitations the inclusion and analysis of apps available only in the Brazilian Portuguese language, since it is interesting in future studies the analysis of apps available in Brazil in foreign languages, to describe its characteristics and verify the accuracy and conformity of the information available.

CONCLUSION

The results of this study present the characteristics of the apps aimed at the gestational period and thus have the potential to provide users with a list of the main apps available in the market and their features. Most of them were developed in other countries and translated into Brazilian Portuguese with diversified information content.

It was also noted the lack of reliable information included in the analyzed app, since few presented the source accessed for the elaboration of the content conveyed, enhanced by the lack of health professionals in the elaboration and stages of the development process.

Thus, we highlight the need for greater rigor in the development of apps for health, especially those related to pregnancy, to ensure that the available information is dependable and based on scientific recommendations and the respective sources accessed.

The use of these technologies contributes to health promotion and the findings reflect on the need to develop apps with recommendations from health professionals and technical and current scientific evidence, in order to function as an instrument of assistance in prenatal care and also for the contents to reflect the real needs of users, considering the cultural particularities of each country.

The apps can also be used by nurses and other health professionals as an educational tool, since the information provided contains important content to foster parents' understanding of the gestational process. The contents offered through the apps can be a means for strengthening prenatal care, representing a breakthrough in nursing practices in assisting pregnant women.

Finally, it should be noted that, as technology and mobile health apps continue in a constant movement of updating and expansion, it becomes necessary to develop new research to analyze the methodological process of developing an app, its effectiveness as well as the improvement of these apps aimed especially at pregnancy care.

GRAVIDEZ E TECNOLOGIAS MÓVEIS DE SAÚDE: ANÁLISE DE APLICATIVOS PARA SMARTPHONES

ABSTRACT

Objetivo: analisar as características dos aplicativos móveis disponíveis para download em smartphones relativos ao período gestacional. **Método:** estudo transversal, descritivo, com abordagem quantitativa realizado entre agosto e setembro de 2020 e atualizado em novembro de 2023 no sistema operacional Android e iOS. **Resultados:** foram incluídos e analisados 18 aplicativos, em que 72,22% eram destinados às mulheres grávidas, 66,67% desenvolvidos em outros países, 83,33% possuíam avaliação acima de quatro estrelas, 66,67% continham como assunto principal informações referentes ao pré-natal, 66,67% foram atualizados no último ano, 55,58% não apresentaram as referências consultadas para elaborar o conteúdo disponível e 83,33% não indicaram a participação de profissionais da saúde no seu desenvolvimento. **Conclusão:** salienta-se a necessidade de maior rigor na elaboração dos aplicativos voltados para a área da saúde, especialmente os relativos à gestação, com o intuito de assegurar que as informações disponíveis sejam confiáveis e tenham como embasamento recomendações científicas e as respectivas fontes acessadas.

Palavras-chave: Aplicativos móveis. Telemedicina. Smartphone. Gravidez.

EMBARAZO Y TECNOLOGÍAS SANITARIAS MÓVILES: ANÁLISIS DE APLICACIONES PARA *SMARTPHONE*

RESUMEN

Objetivo: analizar las características de las aplicaciones móviles disponibles para descargar en *smartphones* relativos al período gestacional. **Método**: estudio transversal, descriptivo, con enfoque cuantitativo realizado entre agosto y septiembre de 2020 y actualizado en noviembre de 2023 en el sistema operativo iOS y Android. **Resultados**: se incluyeron y analizaron 18 aplicaciones, en las que 72,22% estaban destinadas a mujeres embarazadas, 66,67% desarrolladas en otros países, 83,33% poseían una calificación superior a cuatro estrellas, 66,67% contenían como tema principal informaciones referentes al prenatal, 66,67% fueron actualizadas en el último año, 55,58% no presentaron las referencias consultadas para elaborar el contenido disponible y 83,33% no indicaron la participación de profesionales de la salud en su desarrollo. **Conclusión**: se destaca la necesidad de mayor exactitud en la elaboración de las aplicaciones dirigidas al área de la salud, especialmente las relativas a la gestación, con el fin de asegurar que la información disponible sea confiable y tenga como base recomendaciones científicas y las respectivas fuentes accedidas.

Palabras clave: Aplicaciones móviles. Telemedicina. *Smartphone*. Embarazo.

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