Evaluation of mobile Apps for health promotion of pregnant women with preeclampsia

Avaliação de aplicativos móveis para promoção da saúde de gestantes com pré-eclâmpsia

Análisis de aplicaciones móviles para la promoción de la salud de mujeres embarazadas con preeclampsia

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Abstract
Objective: Evaluate the available mobile applications (Apps) about preeclampsia (PE) in the main operating systems for the health promotion of pregnant women.
Methods: Evaluative study of available mobile Apps on platforms (iOS and Android). A systematic search was performed in the virtual stores of the main operating systems: Play Store (Android, *Google*) and App Store (iOS, *Apple*), from April to June 2018, delimiting the following steps: establishment of evaluation objectives and the criteria for inclusion and exclusion of Apps (sample selection), definition of the information to be extracted, analysis of the results, discussion and presentation of the evaluation. For this, two devices were used: a Samsung Galaxy S8, compatible with Android, and an Iphone 8, compatible with iOS version 10.2.1. Three searches were conducted in each virtual store, using each of the following keywords individually: preeclampsia; eclampsia; and, health promotion of pregnant women with preeclampsia.
Results: 11 Apps were eligible for the study. All were present on the Android operating system; only one was available on both operating systems, Android and iOS. Of the 11, six Apps addressed PE characteristics; only one addressed the clinical management of PE. The scores for evaluation of the Apps ranged from 14 to 29 points, on a scale that ranged from 6 to 30 points. Only two Apps had Portuguese versions.
Conclusion: It was possible to verify that the Apps have important information that can clarify doubts that pregnant women may have.

Resumo
Objetivo: Avaliar os aplicativos móveis disponíveis sobre pré-eclâmpsia (PE) nos principais sistemas operacionais para a promoção da saúde de gestantes.
Métodos: Estudo avaliativo dos aplicativos móveis disponíveis nas plataformas (iOS e Android). Foi realizada uma busca sistemática nas lojas virtuais dos principais sistemas operacionais: *Play Store* (Android, *Google*) e *App Store* (iOS, *Apple*) de abril a junho de 2018, delimitando-se as seguintes etapas: estabelecimento dos objetivos da avaliação e dos critérios de inclusão e exclusão de aplicativos (seleção da amostra), definição das informações a serem extraídas, análise dos resultados, discussão e apresentação da avaliação. Para tanto, foram utilizados dois dispositivos: um Samsung Galaxy S8, compatível com Android e um Iphone 8, compatível com iOS versão 10.2.1. Três buscas foram realizadas em cada loja virtual, utilizando-se individualmente cada uma das seguintes palavras-chaves: Pré-eclâmpsia; eclâmpsia e promoção da saúde de gestantes com pré-eclâmpsia.
Resultados: 11 aplicativos foram elegíveis para o estudo. Todos estavam presentes no sistema operacional Android e apenas um estava disponível nos dois sistemas operacionais, Android e iOS. Dos 11, seis aplicativos abordavam características da pré-eclâmpsia; apenas um abordava o manejo clínico da PE. A avaliação do aplicativo variou de 14 a 29 pontos em um escore que varia de 6 a 30 pontos. Apenas dois aplicativos possuíam versões em português.
Conclusão: Foi possível verificar que os aplicativos possuem informações importantes que podem esclarecer eventuais dúvidas que as gestantes possam ter.

Resumen
Objetivo: Analizar las aplicaciones móviles disponibles en los principales sistemas operativos sobre preeclampsia para la promoción de la salud de mujeres embarazadas.
Métodos: Estudio evaluativo de las aplicaciones móviles disponibles en las plataformas iOS y Android. Se realizó una búsqueda sistemática en las tiendas virtuales de los principales sistemas operativos: *Play Store* (Android, *Google*) y *App Store* (iOS, *Apple*) de abril a junio de 2018. Se definieron las siguientes etapas: establecimiento de los objetivos de la evaluación y de los criterios de inclusión o exclusión de aplicaciones (selección de muestra), definición de la información que será extraída, análisis de los resultados, debate y presentación del análisis. Para eso, se utilizaron dos dispositivos: un Samsung Galaxy S8, compatible con Android, y un iPhone 8, compatible con iOS versión 10.2.1. En cada tienda virtual, se realizaron tres búsquedas, mediante la utilización de las siguientes palabras clave de forma individual: preeclampsia, eclampsia y promoción de la salud de mujeres embarazadas con preeclampsia.
Resultados: 11 aplicaciones fueron elegidas para el estudio. Todas estaban presentes en el sistema operativo Android y solo una estaba disponible en los dos sistemas operativos Android e iOS. De las 11 aplicaciones, 6 abordaban características de la preeclampsia y solo una trataba el manejo clínico de la preeclampsia. La evaluación de la aplicación estuvo en el rango de 14 a 29 puntos, en una escala de 6 a 30 puntos. Solo dos aplicaciones tenían versión en portugués.
Conclusión: Fue posible verificar que las aplicaciones contienen información importante que puede esclarecer posibles dudas que las mujeres embarazadas puedan tener.

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Introduction

Information and Communication Technologies (ICTs) related to health are being widely used by professionals and patients, and they collaborate with the evolution and improvement of the health professions. There are devices that structure and organize informational data, which enable the storage, processing, sharing and access to real or remote time, and that have as their purpose to resolve health needs, in different regions, with the expansion of health care. These ICTs can also support clinical decision making of professionals, contributing to the guidelines and therapeutic approaches designed for patients.[1-3]

Thus, there are mobile technologies such as computers, tablets, smartphones, among others; with these, comes the use of mobile Apps.[4] In this scenario, currently, it is possible to observe a growth of technologies and mobile Apps that are collaborating in the construction of a new modality of health care, in which the information relating to the health of people becomes pertinent.[4] Studies point out that such Apps, including the information generated by them, can be used to optimize results and reduce risks in health, as well as to understand the determinants that promote health.[5,6]

Currently, the use of smartphones has presented a transforming potential for health care, by placing the power of communication, internet connectivity, and sophisticated settings in the hands of professionals and patients. It is clear that in the last decade, the concept of mobile health (*mHealth*) was increased because most developed *mHealth* Apps enabled health promotion beyond the location of health services, and contributed to self-management and communication.[7]

The *mHealth* Apps are aimed at improving the health of patients through various functionalities and different designs.[8] All these alternatives constituted by technology are important to promote health in individuals with various pathologies, such as PE.

Preeclampsia is among the most serious health problems affecting pregnant women. It is a complication that occurs in approximately 2 to 8% of pregnancies worldwide, and contributes to increased maternal and infant morbidity.[9] This disease is generally characterized by high blood pressure (BP) (systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg) and proteinuria (> 300 mg / 24h), which appear after 20 weeks of gestation in a previously normotensive woman. The disease may also occur in the absence of proteinuria.[10]

Given this scenario, the following guiding research question arose: which mobile Apps are available about PE in the main operating systems, for the lay public, that favor the health promotion of pregnant women? With a growing number of Apps for smartphones available to the lay public, the aim of this research was to evaluate the mobile Apps available about PE in the main operating systems for the health promotion of pregnant women.

The study is relevant because it will enable the verification of the reliability of tools available in the market, if they present consistent information, and promote the health and quality of life of pregnant women.

Methods

This is a descriptive study, designed as an assessment of mobile Apps, in order to know which of the Apps for pregnant women / lay public that address PE are available on the platforms (iOS and Android). The search was conducted from April to June of 2018. In fact, the evaluation objectives, inclusion and exclusion criteria of the Apps (sample selection), definition of the information to be extracted, analysis of the results, discussion and presentation of the evaluation were previously established.

In this evaluation, a systematic search was completed in the virtual stores of the main operating systems: *Play Store* (Android, *Google*) and *App Store* (iOS, *Apple*). For this, two devices were used: a Samsung Galaxy S8, compatible with Android, and an Iphone 8, compatible with iOS version 10.2.1.

Three searches were conducted in each virtual store, using each of the following keywords individually: preeclampsia; eclampsia; and, health promotion of pregnant women with preeclampsia.

The inclusion criterion was mobile Apps that address the health promotion of pregnant women with PE. Exclusion criteria were: Apps available only in languages other than English, Portuguese, or Spanish; and, Apps that required login access or the use of an accessory device.

Based on the criteria of this study, the Apps were evaluated using an adapted synoptic framework, aimed at evaluating Apps related to the management of enuresis, without mentioning any validation process of this instrument.[11] This is composed of ten items, only six of which were used for this research, which evaluate functional characteristics such as: design, usability, language, instructions, security, and transference. The other items were not used because they were specific to enuresis (2 items), and were related to those stories and impressions (2 items). Each of the six aspects has scores ranging from 1 to 5. In this way, the evaluation of the App receives a score that can vary from 6 to 30 points. It is worth mentioning that the evaluation of the Apps performed by consumers, which varies from one to five stars, was also verified.

Based on these criteria, a chart was developed by the authors to allow for the collection and analysis of the data obtained.

Results

From the method described, 11 Apps were obtained for analysis (Figure 1), which were described in table 1.

Applications were downloaded directly to their corresponding devices. Of the 342 results, 331 were excluded for the following reasons: magazines (n=5); login required to access the App (n=31); intended for use by health professionals (n=25); available only in languages other than English, Portuguese, or Spanish (n=194); and, did not address the health promotion needs of pregnant women with PE (n=76).

Eleven Apps were eligible for the study. Of these, all were present on the Android operating system, and only one was available on both operating systems, Android and Apple. Eight Apps received user ratings, and three were not classified. Ratings ranged from one to five stars, highlighting the best ranked five-star, which was also available in both operating systems. The chart below is related to the criteria used to evaluate Apps available for smartphones (Chart 1 and table 1).

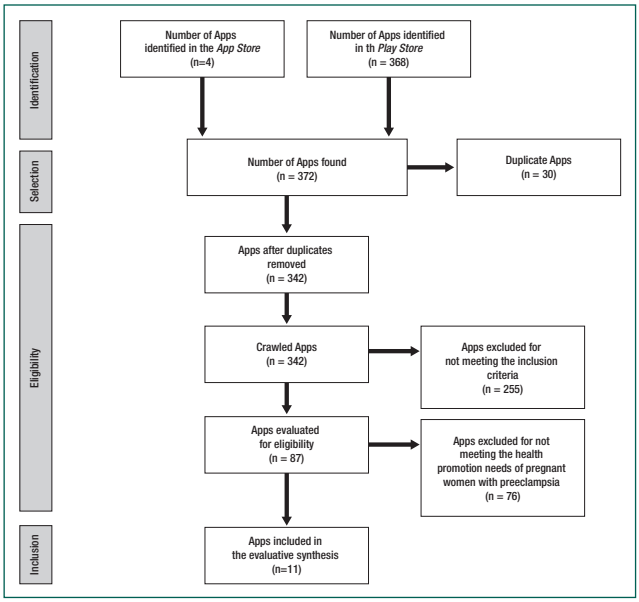

Figure 1. Identification and selection of applications for review

From this chart, the evaluations of each App were conducted, with their respective scores, which are described in table 1.

Chart 1. Criteria used to evaluate available applications for smartphones

Criteria	Question	Evaluation				
		1	2	3	4	5
Design	Is the design attractive?	Very poor	-	Satisfactory	-	Excellent
Usability	Is it easy to use and install the App?	Very difficult	Difficult	Neither easy nor difficult	Easy	Very easy
Language	In which languages is the App available?	Only 1 language	-	2 languages	-	More than 2 languages
Instructions	How would you rate the instructions?	None	Poor	Moderate	Good	Excellent
Security	Evaluate the security and privacy of this App.	None	-	Moderate	-	Excellent
Transference	Capacity and facility of transferring data to another device?	Incapable	Difficult	Neither easy nor difficult	Easy	Very Easy

Source: Adapted from Myint M, Adam A, Herath S, Smith G. Mobile phone applications in management of enuresis: the good, the bad, and the unreliable! J Pediatr Urol. 2016;12(2):112.e1–6.[11]

Table 1. Apps identified after considering the inclusion and exclusion criteria, average score and relevant details

App	Platform	Language	Size	Download	Note / Number of reviews	Category	Update date	Score*
App 1: Enfermidades que pueden afectar el embarazo	Android	Spanish	18MB	> 50	0.0/ 00	Health of pregnant women and Health professionals	Nov 11-2017	17
App 2: Get Pregnant	Android	English	13MB	> 5000	3.7/06	Health of pregnant women	Feb 01-2018	16
App 3: Get Pregnant Fast	Android	English	15MB	> 1000	3.0/01	Health of pregnant women	Feb 14-2018	16
App 4: Lower Your High Blood Pressure	Android	English	12MB	> 50	0.0/00	Health of pregnant women and Health professionals	Jan 24-2018	18
App 5: Minha gestação	Apple Android	Portuguese	26MB	> 100000	4.3/2226	Health of pregnant women	Mar 16-2018	24
App 6: Petograph	Android	English	8.9MB	> 500	4.8/30	Health of pregnant women	Aug 14-2017	16
App 7: Preeclampsia Disease	Android	English	12MB	> 50	0.0/00	Health of pregnant women and Health professionals	Nov 30-2017	13
App 8: Pregnancy and Child Birth	Android	English, French and Portuguese	18MB	> 1000	3.0/02	Health of pregnant women	Jan 26-2018	23
App 9: Pregnancy Health	Android	English	25MB	> 500	5.0/01	Health of pregnant women	Oct 20-2017	23
App 10: Preeclampsia Disease	Android	English	7.9MB	> 500	5.0/04	Health of pregnant women and Health professionals	Sep 29-2015	13
App 11: Happy Pregnancy	Android	Hindi and English	6.6MB	> 10000	4.6/160	Health of pregnant women	Dec 02-2016	19

Source: Myint M, Adam A, Herath S, Smith G. Mobile phone applications in management of enuresis: the good, the bad, and the unreliable! J Pediatr Urol. 2016;12(2):112.e1–6.[11]
* Score of the evaluation criteria proposed by Myint; Adam; Herath; Smith, 2016.

Table 1 shows the Apps that were selected for evaluation, with their respective sizes, download numbers, notes and rating numbers, as well as the categories for which the Apps are intended, the dates of most recent updates, and the scores for the criteria evaluation of the chart, described above. There was no correlation between the user's scores and the score obtained in the evaluation of the Apps ($p = 0.80$). The results were also brought into categories, in order to characterize the Apps more specifically. The categories formed were: Characteristics of PE; Management of PE; and Health Promotion of Pregnant Women, which will be described below.

Characteristics of preeclampsia

Six Apps (App1, App4, App5, App7, App10, and App11) were included in this category. Except for App4, all others specified the characteristics of PE, which included: signs, symptoms, diagnosis, prevention, epidemiology, and complications of PE. These have the purpose of providing guidelines for pregnant women, since reading and handling the App were simple and didactic; but they could also be used by health professionals. It is important to note that although App7 and App10 have the same content, they have different icons, as well as size, download, notes, number of evaluations, and date of most recent update. In this way, it is notable that App10 has more downloads and evaluations, due to its longer availablility. Application sizes across all platforms ranged from 6.6MB to 26MB. The last update date was quite different between the Apps, from older updates (App10 with update on Sep-29-2015) to more recent updates (App5 with update on Mar-16-2018). With regard to design and usability, the Apps were easy to understand, using language that is common in women's daily lives, and society in general. Moreover, when technical terms arose, their meanings were clarified. The Apps were also functional, allowing users to search for information, indicating the steps for using the App, and making the movement through its pages clear.

Management of preeclampsia

The App6 was developed for the management and early detection of PE, from the monitoring of systolic blood pressure (SBP), diastolic blood pressure (DBP), and body mass index (BMI), informing the user when these parameters were high. It shows a graph indicating the levels of SBP and DBP, and the increase or decrease during the days when SBP and DBP were reported in the App. The App6 also provides some information that includes monitoring salt intake, enjoying walking, practicing yoga, and monitoring weight.

Health Promotion of Pregnant Women

Due to fact that this category was an inclusion criterion, all Apps were included in this aspect. The

Apps in this category also provided information about PE, its characteristics, signs, symptoms, diagnosis, prevention, and complications. Among these, some Apps (App2, App5, App8 and App11) not only had information, but also highlighted the modifiable risk factors for the prevention of PE, in which healthy lifestyles are approached through a proper diet, physical activities, and yoga, using educational texts, images, and videos as a way to promote the health of pregnant women.

Discussion

Because the smartphone is an easy Internet access device that has Apps on various subjects and at a relatively low cost, this presents a new alternative for improving people's access to information relating to health, as well as the promotion of knowledge regarding preventive care, for which individuals must be responsible.[12]

The number of *mHealth* Apps available to consumers exceeds 165,000. *mHealth* Apps available for download from the *Apple Store* (Apple) and *Google Play* (Android) show that their current availability and usage is similar to the study conducted in 2013, when most were concentrated in the areas of well-being, diet, and exercise. Nearly a quarter of these focus on disease and treatment management, portraying the growing interest in using chronic disease management Apps. And more than 50% of *mHealth* Apps continue to have limited functionality, simply providing information.[13]

Pregnant women with hypertensive disorders could benefit from *mHealth* Apps. The ICT could be used to aid in diagnosis, monitoring, management, self-care, communication between patients and professionals, education, and patient empowerment.[14] Some of the risk factors for PE are: advanced maternal age (over 40 years), family history, previous pregnancy with PE, chronic hypertension or chronic kidney disease or both, diabetes mellitus type I or II, obesity, in vitro fertilization, and others.[10] Because this is a serious public health problem that is responsible for not only maternal but also fetal morbidity, one can note the growth of Apps related to hypertensive disorders, especially PE, emphasizing its risk factors. In this way, using measures that aid in better control, early detection, and clinical management is fundamental.

Of the eleven Apps involved in this evaluation, ten were informative; in addition to containing information, App5 also had a calculator. Only App6 did not contain information, but the user inputs her SBP, DBP, weight, and height and the App is responsible for tracking these parameters. Only App 6 has, as an alert, the call to action: "Consult the doctor when the SBP and DBP of the pregnant woman is elevated'. Other Apps do not have more specific behaviors. It would be important that these Apps present behaviors, such as: looking for a hospital and / or basic health unit, performing exercises to maintain physical fitness, alcohol withdrawal, and smoking cessation. In previous studies, most Apps (n = 36; 76.6%) had more than one function; 11 (23.4%) had only one function. The most common function was to provide information (80.9%), which is in line with the results presented here. Thus, the use of health Apps, due to their relatively low cost, increases access to health information regarding healthy habits and lifestyle, or pathologies and their respective treatments.[8,15-18]

Therefore, knowledge allows women to detect signs and symptoms, leading to early diagnosis and management, which can prevent complications and reduce morbidity and mortality.[16] It is also important to emphasize that the promotion of a healthy lifestyle through ICTs can be a powerful and useful tool for pregnant women with hypertensive disorders.[14]

The most common health Apps used by women are those related to pregnancy, delivery and child care.[15] One study showed that more primiparous women (53.9%) use Apps compared to multiparous women (46.1%).[15] However, in the case of pregnant women, especially primiparous women, who generally have more doubts about pregnancy, the quality and reliability of the content of the Apps that composed this study should be evaluated, since not all referenced the information contained, and few were developed by professionals or health groups.

Although it is unclear if the Apps are supported by any scientific society, university, or hospital, App 5 had the option of partnerships with health professionals (physicians, obstetricians, gynecologists and pediatricians), and App 11 is provided by an obstetrician and gynecologist. In this way, as these Apps have a considerable impact on the health of women and babies, their content and quality must be monitored and managed by health professional.[15]

It is important to note that when building a technology, the audience must be taken into consideration, as well as geographical location, because there are still areas (remote or rural) without access to technology either due to purchasing power, or lack of access to an internet network. Therefore, it is necessary to ensure that people living in rural areas are effectively using ICTs, the services, and obtain the maximum benefit.[17]

Different Apps and ICT services can be offered to the rural population to augment the economy, quality of life, and reduce inequality. Examples include voice and SMS services based on telephone, internet, eHealth, e-Agriculture, e-Banking, and others. People living in rural areas need relevant content in agriculture, health, education, financing, disaster preparedness, among others, as well as needing content in their local languages. Therefore, it is important that telemedicine education and awareness programs be delivered in rural and remote communities.[17]

In Brazil, a major challenge to be mentioned is the installation of terrestrial networks in remote and difficult access areas, such as areas in the north, related to topography and the presence of large forest areas. Another example is the socioeconomic conditions in which people are unable to afford Internet services, or do not maintain payment plans. Thus, public policies for the development of rural areas should be based on the expansion of terrestrial networks, emphasizing the quality of the services offered, public incentives to reduce the cost of access for the end user, and better conditions for contracting equipment or smartphones.[17] It is worth mentioning that, when considering the sociocultural conditions of our population, it is necessary to develop Apps in Portuguese.

The impact of *mHealth* Apps can be vast and relevant in many health-related settings, including chronic disease management, mental health, education, and patient empowerment. Diabetes mellitus is the disease most commonly addressed by mobile Apps,[8] and the growth of Apps related to gestation and hypertensive disorders is also noted. Therefore, in order to perform digital interventions using the proposed solutions, clinical validation and evaluation of their results is required. This is a necessary step to support the integration of prototypes, as well as protocols reported in health systems, to improve current clinical practice.[14]

It is worth mentioning that the research presented limitations on the searches, in which there are differences of Apps from one smartphone to another, which differs according to the operating system and the update of these systems. Another important limitation is that the questionnaire used to evaluate the Apps, although easy to understand, has not yet been translated and validated into Portuguese. Therefore, for this study, the researchers involved carried out an adaptation of the questionnaire.

Conclusion

It was possible to verify that the Apps have important information, which can clarify doubts that pregnant women may have. Moreover, it is necessary to guide these women about the hypertensive disorders in pregnancy, especially about PE, so that they acquire knowledge about the risk factors and modify those that are possible. It is also essential that pregnant women are able to recognize their symptoms, and are alert to seeking health care as quickly as possible, contributing to early detection and more successful clinical management.

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Collaborations

Gomes MLS, Rodrigues IR, Moura NS, Bezerra KC, Lopes BB, Teixeira JJD, Vasconcelos CTM and Oriá MOB declare that they contributed to the design of the study, analysis and interpretation of data, relevant critical review of intellectual content, and approval of the final version to be published.

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