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QUALITY AND USE OF FREE SMOKING CESSATION APPS FOR SMARTPHONES

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Objectives: Smartphone Apps are one of the tools available to support patients who wish to quit smoking. Content analysis studies have indicated multiple deficiencies within these Apps including minimal use of evidence-based research and Nicotine Dependence Treatment Provider (NDTP) in App development. The aim of this study was to determine quality and features of smoking cessation Apps available on Android® and iOS® platforms.
Methods: The first fifty free smoking cessation Apps available for download using the search term *smoking cessation* on Google Play Store and Apple App Store were chosen. Each of these Apps was analyzed and categorized based on ratings, target audience age, language, and a variety of tracking functionalities noted on the Apps. Indications and suggestions regarding either the use of NDTP or evidence-based behavior change protocols were noted.
Results: There were no significant differences in the features of smoking cessation Apps on Android and iOS. Only 15 percent of all Apps analyzed on both platforms indicated some involvement of NDTP and there was no difference between the two platforms. More than 50 percent of Apps studied were downloaded over half a million times and the average user rating was 3.89/5.00 for Android and 3.72/5.00 for iOS with no significant difference.
Conclusions: Most smoking cessation Apps in both platforms offer basic tracking functionalities with limited motivational tips. Only a handful of Apps have moved beyond this role and while their development is applaudable much innovation remains.

Keywords: Smoking cessation, Mobile applications, Android, iOS, mHealth

More than five million deaths occur worldwide due to direct cigarette smoking (1). With more than 2 billion smartphone users worldwide (2), using smoking cessation smartphone applications (Apps) can be an effective low-cost population-based behavior change intervention in theory. Currently, the global market share of operating systems that run on smartphones is dominated by Android and iOS (3). The former dominates the non-Apple products and the latter is used exclusively by Apple products. Both operating systems allow users to download Apps, which are often created by third parties, using the Google Play© Store for Android© and Apple iTunes© App Store for iOS©.

To date, there have not been any publications of large randomized trials of App-based smoking cessation interventions. Some studies have demonstrated their usefulness in smoking cessation (4;5). However, content analyses to assess the quality of a few iOS, Android, and Facebook© based smoking cessation Apps have found that adherence to established guidelines on smoking cessation, provision for feedback, tailored communication with the user and user community was lacking (6–8).

Ascertaining the quality and effectiveness of smoking cessation Apps has been challenging. It would be naive to assume that user ratings such as those given to hotels and restaurants, could be used as a metric of App quality. As of January 2015, there were at least 400 Apps for smoking cessation (9) and the market is dynamic, large and growing. Therefore, the requirement for standardized quality measures to perform an external quality review has never been more important. Researchers have used multiple techniques to search for high-quality Apps. Some have attempted to use feedback from smokers and treatment providers to determine important features necessary in an App (10), and others have looked at interrater reliability as a measure to evaluate Apps (11). The right App continues to be elusive.

Nevertheless, clinicians and patients frequently look at Apple iTunes or Google Play stores in search for high-quality Apps that may assist them in smoking cessation. During a search in these e-commerce stores, consumers encounter ratings and screenshots followed by descriptions of features within an App. Based on this information, consumers decide on whether to proceed with the App download.

This study used these screenshots of free smoking cessations Apps in Google Play Store and Apple iTunes Store to determine their key features, rating, and use rates. The results of this study would help consumers and clinicians in recognizing essential common elements while highlighting important deficiencies in Apps for the developers that are deemed to be important while addressing them in future App development.

METHODS

App Selection

The Apps analyzed in this study were searched in the Apple iTunes Store (iOS platform) and the Google Play Store

(Android platform) between February 1, 2016, and March 31, 2016. A query using the term *smoking cessation* resulted in multiple Apps of which the top fifty free Apps were selected (available in Appendix 1). Generally, the ranking of Apps in stores depends on external factors (user ratings, search keywords, number of downloads, etc.) and internal factors which often are not disclosed. The display order of Apps in the iTunes store is generally a reflection of the App's popularity, however, Apple states that other undisclosed factors are used in determining an App's popularity. The representative sample size of the first fifty free Apps reflects those that are most visible to smokers who wish to quit. These smokers, who have no idea about which App to choose, are likely to pick one of the fifty they see first.

Data Material

Screenshots of the Apps were the major source of data in this study. Although limited, this is the same amount of data a consumer or a clinician can obtain regarding an App before making a decision to download. Furthermore, developers would likely ensure that the screenshots provide comprehensive information highlight key features of the App making it appealing to the consumer.

Selection of Features, Functionalities and Quality Measures

A review of existing literature on smoking cessation Apps quality and evaluation was undertaken to identify measures of quality. Unfortunately, a gold standard that was valid and reliable for rating and evaluating Apps was not found. The list of quality measures and features used in this study were derived from three different recent studies that performed content analyses of smoking cessation Apps in iOS (7), Android (8), and Facebook Apps (6). These three studies used the Treating Tobacco Use and Dependence: 2008 Update, Clinical Practice Guideline as a framework for the content analyses of their Apps (12). The resulting features and functionalities of the smoking cessation Apps were used to perform a content analysis of the Apps. Google Play and Apple iTunes both allow consumers who have downloaded the App to rate it on a 5-point scale (1 lowest to 5 highest). The average user ratings were noted for each App. App features and functionalities derived from the combination of the three studies that used the United States Public Health Services's (USPHS's) 2008 Clinical Practice Guidelines for Treating Tobacco Use and Dependence are listed in Table 1.

Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version twenty-two using frequencies, cross-tabulations, chi-square test for nominal data, and Students *t*-test for ordinal data.

RESULTS

Our findings regarding the characteristics of the first fifty free smoking cessation Apps in the two platforms are noted in Table 2.

Table 1. List of App Features and Functions Derived from the Combination of the Three Studies That Used the USPHS's 2008 Clinical Practice Guidelines for Treating Tobacco Use and Dependence

App Features:
- Name
- Producer
- Subcategory
- Age of target audience
- Number of downloads
- Languages
- Option for In-App purchases
- Number of ratings
- Average customer satisfaction rating
- Utilization of a valid smoking cessation guideline
- Involvement of nicotine dependence treatment provider in its development

App Functions:
- Tracks quit time
- Tracks number of cigarettes
- Tracks financial savings
- Tracks cravings
- Tracks triggers
- Presence of motivational tips

USPHS, United States Public Health Service.

Although all evaluated Apps were free to download, a total of twenty-eight Apps from both platforms had In-App purchases which requires users to pay to use all the functionalities the App offers. Most Apps from both platforms tracked quit time ($n = 76$), number of cigarettes ($n = 76$), cravings ($n = 73$), savings ($n = 73$), and provided motivational tips ($n = 80$). Only thirteen Apps tracked triggers for smoking. Most Apps on both platforms were available in English only ($n = 90$). Statistical tests did not show significant differences in each of these features between the two platforms.

Apple iOS smoking cessation Apps were categorized into Medical (27 Apps) or Health & Fitness (23 Apps) when compared with the Android Apps, all of which were categorized into Medical (50 Apps).

Only fifteen of ninety-four (16 percent) Apps analyzed in both platforms indicated some involvement of an NDTP (seven for Android and eight for iOS). Most Apps did not have any involvement of an NDTP (thirty-six for Android and forty-three for iOS, six had no indication). Apple iOS had one more App with health professional involvement than Android, however, the differences were not significant. Only one App called Smart Quit on Android incorporated evidence-based technique for behavior change.

Most of the Apps were designed for individuals 12 years and older, including adults (everyone category) (Missing data

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Table 2. App Characteristics Analyzed in This Study

App feature[a]	iOS© [a]	Android©	Total (%)	Statistical test (χ^2)
In-App purchases	14	14	28 (30%)	$p = .89$, n = 94
Unknown	6	–		
Tracks quit time	36	40	76 (80%)	$p = .34$, n = 95
Unknown	5	–		
Tracks number of cigarettes	38	38	76 (76%)	$p = 1.00$, n = 100
Tracks cravings	34	39	73 (78%)	$p = .56$, n = 94
Unknown	6	–		
Tracks savings	32	38	70 (73%)	$p = .32$, n = 96
Unknown	4	–		
Motivational tips	38	42	80 (80%)	$p = .23$, n = 100
Tracks triggers	6	7	13 (14%)	$p = .93$, n = 91
Unknown	9	–		
Languages				
English only	44	46	90 (92%)	$p = .89$, n = 98
English plus one	2	2	4 (4%)	
English plus two or more	2	2	4 (4%)	
Unknown	2	–		

[a]Categories of App features were included if reported in the App's description.

$n = 4$ from iOS) χ^2, $p = .71$, $n = 96$. thirteen Android and fifteen iOS Apps were unrated, only three were rated for teens on both platforms, and thirty-five Android and thirty iOS were given a rating of "everyone."

The average customer rating score of the Apps on a scale from one to five was 3.89 ± 1.07 for Android and 3.72 ± 1.31 for iOS ($n = 50$ apps analyzed on each platform). There is no significant difference in the scores (t-test; $p = .96$; $n = 100$). Twelve Android and sixteen iOS smoking cessation Apps of the fifty Apps analyzed in each platform were downloaded more than 100,000 times (Figure 1). Difference between platforms with respect to these most downloaded Apps were not significant (χ^2; $p = .92$; $n = 100$).

DISCUSSION

Our study used screenshots of free smoking cessations Apps in Google Play Store and Apple iTunes Store to determine their rating, the frequency of downloads and features according to the categories defined by the (USPHS) 2008 Clinical Practice Guidelines for Treating Tobacco Use and Dependence. Majority of smoking cessation Apps in both platforms functioned as trackers for cravings, quit time, number of cigarettes, and the amount of money saved. Although there were not many significant differences in the features of the Apps between the platforms, there were few Apps from both platforms that surprisingly were very innovative.

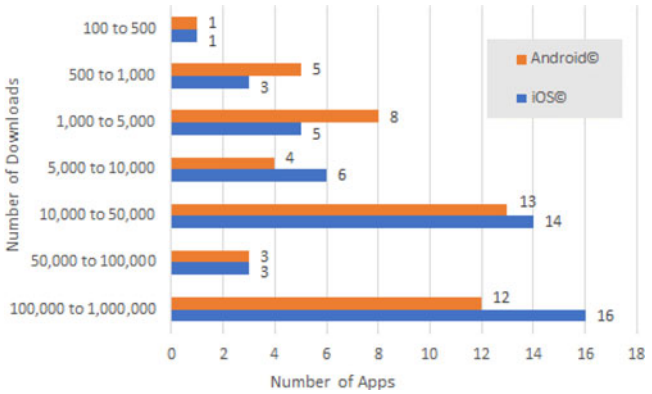

Fig. 1. Number of App downloads by platform as of March 31, 2016.

Innovation

Four of the studied smoking cessation Apps hosted on the Android platform were hypnosis based. Others offered motivational tips e based commonly on "rewards" like those given by mobile games. Some Apps used pictures of cancerous lungs and others had a button if pressed during a craving, would lead to a coughing noise from the phone. These findings suggest that developers are being creative in the manner through which consumers can be actively engaged in the program. Developers are also using visual and motivational tools to make their Apps more effective.

A few Apps on both platforms allowed for the possibility of linking to Facebook© and Twitter©. This marks a major step toward the development of a progressively complex App that has the ability for bi-directional interaction between the user and the healthcare provider while addressing the privacy issues. Of interest, a survey of NDTPs and smokers recognized the cost of tobacco products, nicotine withdrawal symptoms, and support methods of those attempting to stop smoking as important elements compared with games, communication with friends, family, personal doctor, or social media connectivity that was not considered important in a smoking cessation App (10).

NDTP Use

Like all medications, the treatment prescribed for nicotine dependence has to be effective and evidence-based. One of the major components of a high-quality comprehensive smoking cessation program is pharmacotherapy (13;14) and our study found only a handful of Apps on both platforms that discuss medications used for smoking cessation.

App developers must be knowledgeable regarding treatment complexities and they must understand the elements necessary within a cessation program. Although assessing the App's adherence to any specific evidence-based guideline was beyond the scope of this study, we noted a lack of NDTP involvement in the development of most Apps. Only 15 Apps out of the 100 studied in both platforms had evidence of use

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of NDTP. Despite multitudes of studies done over the past 3 years recommending the integration of clinical practice guidelines and evidence-based behavior change techniques into the Apps (9;15), only one App among the ones we studied had evidence of this. The App called "Smart Quit" on the Android platform used Acceptance and Commitment Therapy (ACT) which has been associated with successful quitting (16). Another App on Android claimed to have been developed by the Colorado Department of Public Health and Environment; however, it did not indicate if NDTPs were involved in the process, or that it followed a guideline.

Ratings and Number of Downloads

Smoking cessation App users generally don't check the quality and the producer of the App before downloading (10;17), and unfortunately, NDTPs are unable to guide or recommend a suitable high-quality App. Results from our study show that more than half of the Apps we studied were downloaded more than half a million times. Average ratings of Apps in both platforms in this study were high but similar between platforms. Such high ratings provided by users may explain the ease of use of a particular App but may not correlate with its quality or effectiveness. Studies have recommended caution when interpreting App ratings because it is not clear whether the measurements are valid and reliable (11). A better approach to evaluating Apps with high ratings is to read the reviews and decide whether the App is worth selecting to be assessed by an NDTP who can provide further recommendations.

Smoking cessation Apps are being developed at a rapid pace (18) and with so many on the market, it is difficult to ascertain whether they are all basic trackers or much more. Interpreting parameters like the number of downloads and rating can also be challenging when trying to find an App that would suit a smoker. Until a reliable coding methodology to help classify all App features are tested and validated, one needs to rely on screenshot descriptions, the number of downloads, ratings, and reviews.

SWOT Analysis

We embarked on a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis to gain a better understanding of the study results. SWOT analysis allows us to match the resources and capabilities of the Apps to the current need within the domain of smoking cessation. This simple, analytic tool is instrumental in categorizing goals and formulating strategies (19) to create better Apps that fulfill the requirements.

SWOT analysis has shown that the strengths of the Apps studied lies in their ability to support those who wish to quit tobacco smoking by tracking when they quit, the number of cigarettes smoked, cravings, how much is being saved financially, and have motivational tips for quitting and staying smoke-free. The main weakness is the lack of evidence-based guidelines and NDTP use in the development of most Apps. Another weakness is the absence of information regarding pharmacological interventions for smoking cessation in most of the studied Apps. The opportunities are there for developers to link the triggers of craving to motivational tips, and to link smokers with NDTP providers.

Also, developing smartphone apps for tobacco cessation in other languages such as Arabic, and individualizing App functionalities with bidirectional communication. The main threats are that developers choose not to evaluate their Apps in any research capacity which leads to lack of validation, continued unwillingness of developers to incorporate research evidence during App conceptualization, and loss of trust from users due to incongruency of perceived App abilities and actual functionalities. A summary of the SWOT analysis is shown in Table 3.

Strengths and Limitations

To our knowledge, this is the first study that has reviewed screenshot descriptors, ratings and use rates of free smoking cessation Apps in the two most common smartphone platforms. By doing so, we provide some insight for developers into how users and treatment providers may interpret and use the data while attempting to choose the right App in Google Play Store or Apple iTunes Store.

Results of this study should be viewed with a few key limitations. First, the sample size was limited, and it is not clear

Table 3. SWOT Analysis of Smoking Cessation Apps

Strengths: • Tracking quit time • Tracking number of cigarettes smoked • Tracking cravings • Tracking financial savings • Providing motivational tips for quitting and staying smoke-free	Weaknesses: • Lack of evidence-based guidelines • Poor NDTP utilization in App development • The absence of information regarding pharmacological interventions for smoking cessation
Opportunities: • Link triggers of craving to motivational tips • Connect smokers with NDTP providers • Enhancing existing Apps by adding multiple languages such as Arabic • Bidirectional communication with NDTP providers and within the group of App users	Threats: • Continued unwillingness of developers to incorporate research evidence during App conceptualization • Developers choose not to evaluate their Apps in any research capacity which leads to lack of validation • Loss of trust from users due to incongruency of perceived App abilities and actual functionalities

NDTP, nicotine dependence treatment provider; SWOT, Strengths, Weaknesses, Opportunities, and Threats.

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whether the findings will generalize to all smoking cessation Apps in both platforms. However, if the relative cost and the popularity of Apps are considered then certainly the first 50 free Apps are probably a good representative sample of smoking cessation Apps. Second, the Apps analyzed were not downloaded, used and evaluated, but rather the data gathered is based on what the producer has stated or what the screenshots have displayed in the App stores. Finally, the App market is dynamic with continual additions and deletions and our sample is a snapshot of availability at one period.

Implications for Development and Future Research

Following these findings, App developers may want to focus on developing complex mobile smoking cessation tools that use behavior change theories, evidence-based research NDTP guidelines and treatment options while conforming to region-specific privacy guidelines. NDTP should also collaborate with App developers, health policy, public health, addiction, and information technology experts to use features that would increase user engagement and lead to successful outcomes. These features should be highlighted in the screenshots to help guide the user to an appropriate high-quality App.

Future research should focus on validation studies to determine usability, functionality, and effectiveness of smoking cessation App features. Efforts in improving App effectiveness will require studies that can assess improvements in smoking cessation outcomes rather than focusing on user-friendliness, appearances, and number of downloads. App developers can analyze their use log to assist in understanding the extent of use of specific functionalities thereby leading to research in behaviors of smokers during smoking cessation.

In conclusion, the majority of the free smoking cessation Apps that are available on the two largest platforms function as basic trackers and thus have limited usefulness. Only a handful of Apps have moved beyond this role and while their development is applaudable much innovation remains.

SUPPLEMENTARY MATERIAL

The supplementary material for this article can be found at https://doi.org/10.1017/S0266462318000521.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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