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Use of gamification strategies and tactics in mobile applications for smoking cessation: a review of the UK mobile app market

Nikita B Rajani,[1] Dominik Weth,[2] Nikolaos Mastellos,[1] Filippos T Filippidis[1]

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[1]Department of Primary Care and Public Health, School of Public Health, Imperial College London, London, UK
[2]Department of Strategy and Innovation, MSU Consulting GmbH, Bad Homburg, Germany

Correspondence to
Nikita B Rajani;
nikita.rajani14@imperial.ac.uk

ABSTRACT

Objective Mobile phone-based interventions have been proven to be effective tools for smoking cessation, at least in the short term. Gamification, that is, the use of game-design elements in a non-game context, has been associated with increased engagement and motivation, critical success factors for long-term success of mobile Health solutions. However, to date, no app review has examined the use of gamification in smoking cessation mobile apps. Our review aims to examine and quantify the use of gamification strategies (broad principles) and tactics (on-screen features) among existing mobile apps for smoking cessation in the UK.

Methods The UK Android and iOS markets were searched in February 2018 to identify smoking cessation apps. 125 Android and 15 iOS apps were tested independently by two reviewers for primary functionalities, adherence to Five A smoking cessation guidelines, and adoption of gamification strategies and tactics. We examined differences between platforms with χ^2 tests. Correlation coefficients were calculated to explore the relationship between adherence to guidelines and gamification.

Results The most common functionality of the 140 mobile apps we reviewed allowed users to track the days since/until the quit date (86.4%). The most popular gamification strategy across both platforms was performance feedback (91.4%). The majority of apps adopted a medium level of gamification strategies (55.0%) and tactics (64.3%). Few adopted high levels of gamification strategies (6.4%) or tactics (5.0%). No statistically significant differences between the two platforms were found regarding level of gamification ($p>0.05$) and weak correlations were found between adherence to Five A's and gamification strategies ($r=0.38$) and tactics ($r=0.26$).

Conclusion The findings of this review show that a high level of gamification is adopted by a small minority of smoking cessation apps in the UK. Further exploration of the use of gamification in smoking cessation apps may provide insights into its role in smoking cessation.

Strengths and limitations of this study

- ► The study had a sample of 140 mobile apps for smoking cessation in the UK iOS and Google Play store.
- ► Since the architecture used to operationalise gamification was developed through review of taxonomies from both academic and non-academic sources, the architecture is representative of existing literature.
- ► The exclusion of apps with less than a 4-star rating or fewer than 5 ratings resulted in the omission of a large number of iOS apps, limiting the generalisability of the findings for the iOS store.
- ► Certain app functionalities and gamification elements that are only visible or activated on long-term use may not have been identified by our review.

INTRODUCTION

Smoking is responsible for 16% of all deaths in the UK and remains one of the major preventable causes of chronic diseases.[1] According to a recent study, smoking is ranked as the number one risk factor driving death and disability within the UK.[2] Although behavioural support along with pharmacological treatments is evidently the most effective method for smoking cessation, not all individuals seeking to quit are able or willing to seek face-to-face support.[3] The number of individuals using smoking cessation services provided by the National Health Service in the UK is continuously falling,[4] a trend observed in multiple European countries.[5] The decline in use of stop smoking services is likely to be attributed to access issues in light of significant public health budget cuts.[6] On the other hand, due to increased digitalisation and diffusion of technologies, internet and mobile-based interventions are becoming more popular. The use of mobile-delivered support can be initiated independently by smokers, and can complement existing face-to-face support services. With their wide reach and low cost of dissemination, mobile health (mHealth) solutions represent a cost-effective method of helping people quit smoking.[7] mHealth interventions have been identified as useful tools for aiding smoking cessation. A Cochrane review found

that mobile phone-based cessation interventions had a beneficial impact on 6-month cessation outcomes.[8] The systematic review concluded that smokers who received support from mobile phone-based interventions were 1.7 times more likely to quit in the short-term compared with those who did not receive the mobile phone-based intervention.[8] Although several mobile apps for smoking cessation exist, many suffer from low engagement and retention levels. According to Singh *et al*, attaining high levels of user engagement is critical for the success of mHealth which is why it is an important focus of mHealth solutions.[9]

The application of gamification, the 'use of game-design elements in a non-game context',[10] in the field of mHealth is rapidly emerging, with mobile app developers increasingly integrating badges and other elements of gamification to motivate and engage users. There is no shortage of gamification advocates, particularly in the context of health behaviour change and mHealth. Some examples of mHealth apps which use gamification and have been empirically studied include *Zombies, Run!* to increase physical activity, *SPARX* for battling depression, *Mango Health* for improving retention of medication use and *FitGame* to increase intake of fruits and vegetables.[11–14] A study on *Zombies, Run!* found the mobile app increases the motivation of participants to run and uplifts their confidence.[11] Likewise, SPARX was found to reduce depression scores and act as a potential alternative to usual treatment in primary care for adolescents suffering from depressive symptoms.[12]

According to a randomised controlled trial, individuals who had access to a gamified version of a web-based intervention to aid arthritis patients, had a higher level of engagement than those offered the intervention without game elements.[15] Similarly, a study found that participants who utilised a gamified smoking cessation intervention had higher levels of motivation and engagement compared with a non-gamified cohort.[16] Gamification has also been associated positively with self-efficacy and psychological empowerment, among other behavioural and psychological outcomes.[15 17–19]

Despite the increased application of gamification in the mHealth industry and the promising findings of its benefits for health behaviour change,[20] little research has examined the use of gamification in the context of mHealth and smoking cessation. Although some reviews on gamification use in health apps have been conducted, they have not explicitly focused on apps for smoking cessation or the UK app market.[20 21] Of the reviews that have focused on mobile apps for smoking cessation,[22–26] none explicitly explored gamification use and only two focused on the UK app market in 2012 and 2014.[27 28] Since the mobile app market is constantly evolving, it is important that a more up-to-date review is conducted to gain insight on the currently available mobile apps for smokers seeking to quit. Our study investigated mobile apps for smoking cessation currently available in the UK to gain insight on the types of apps available and their functionalities. Moreover, we examined the types of gamification elements and the level of gamification implemented in the mobile apps. The findings of our research can have important implications for smokers seeking to quit via mHealth, mobile app developers and tobacco policy makers.

METHODS

Sample and procedure

The methodology of the mobile app review included three stages: identification, screening and testing. To identify mobile apps available on both Android and iOS platforms in the UK, the software 42matters was used.[29] 42matters is an online service that provides app market and audience data to provide insight into the mobile app market to build new products. Data on app market Application Programming Interface were extracted using the software on 19 February 2018 using search terms consistent with prior mobile app reviews: 'stop smoking', 'quit smoking' and 'smoking cessation'.[22–26]

Apps were then screened independently by two researchers. Apps with duplicate identification numbers (assigned by the 42matters software to each unique app) were eliminated. Moreover, apps with no rating, a rating of less than four (out of five) or fewer than five individual ratings were eliminated. The cut-off point of five individual ratings is already set forth by the Apple Store. In order to treat apps from both stores equally, we applied the same cut-off point to Android apps. While the methodology used by Android and Apple stores to rank apps is not transparent, it is accepted that the rating, number of ratings, downloads and reviews can be used to determine an app's popularity. Using popularity as an inclusion or exclusion criterion for mobile app reviews is a common methodology adopted in previous studies as it ensures that the most widely used and most 'liked' apps are evaluated.[30–32]

Once preliminary criteria had been applied, the remaining apps were screened based on the description and screenshots of mobile apps provided on their main page in the store. The information was used to apply the following exclusion criteria: primary aim was not to help smokers quit, app was not in the English language, app was irrelevant (ie, app had nothing to do with smoking cessation but was still captured by the software due to the inputted search terms), app focused on hypnosis and app targeted specific patient groups or healthcare professionals. Further exclusions were conducted on installation of mobile apps. Hypnosis apps were excluded because it is not an evidence-based strategy for smoking cessation.[33] Additional exclusion criteria on installation included: unsuccessful download of the app, software problems on installation and requirement for additional devices such as smartwatches. After screening was complete, a total of 140 mobile apps remained of which 125 were Android apps and 15 were iOS apps. Three mobile apps were found in both platforms but were still

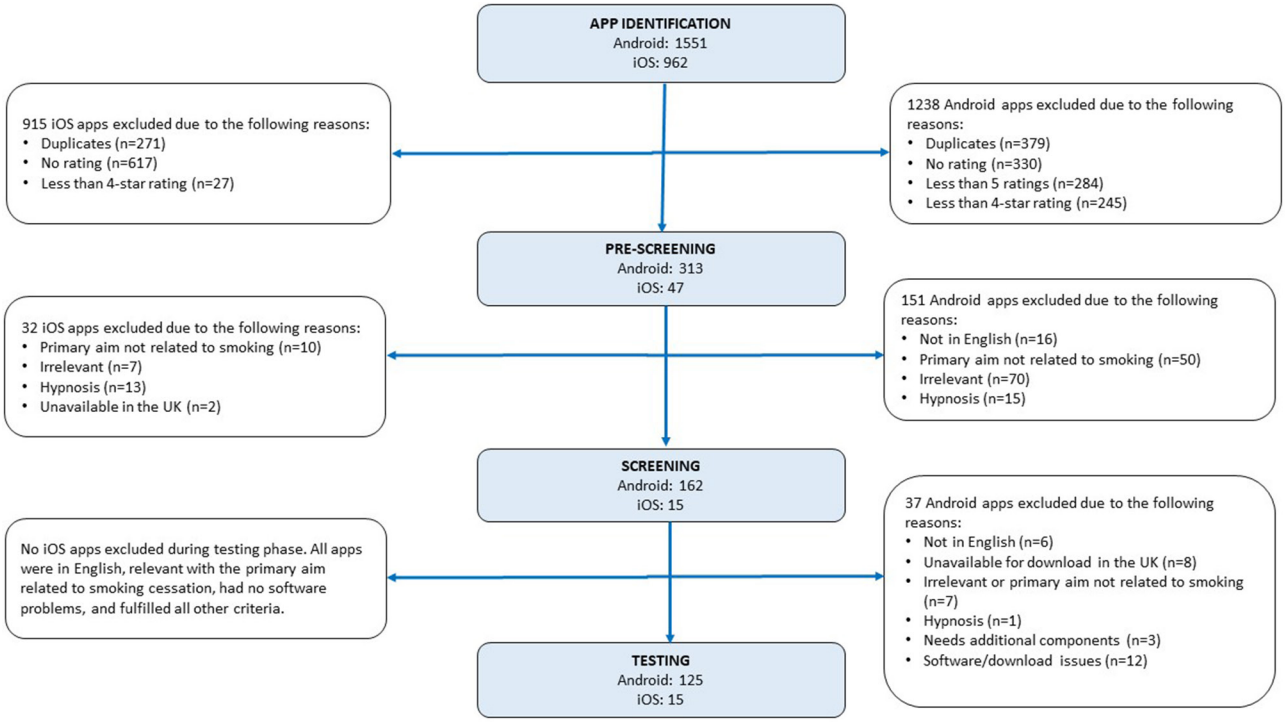

Figure 1 Identification, screening and testing stages of the mobile app review.

assessed independently by both reviewers as slight variations between Android and iOS versions exist. The procedure inclusive of the number of apps excluded in each stage of the methodology can be seen in figure 1.

Coding and classification of mobile apps

After screening procedures, two reviewers independently tested each app. Every app was installed and reviewed for ~30 min on the day of installation. The next day, each mobile app was reviewed for ~5 min for the delivery of any additional notifications. Similar to screening, discrepancies not resolved by the two reviewers, led to a consultation and final decision from a third reviewer.

General functionalities

Functionalities of apps were coded based on categories consistently used by previous mobile app reviews on smoking cessation.[23–25] The categories included: (1) tracker: the app tracked the number of days elapsed since the user quit smoking and/or the number of days until the user's quit date; (2) calculator: the app primarily calculated the amount of money a smoker saved by not smoking and/or the health benefits attained by abstaining; (3) rationing: the app prompted the user to limit the number of cigarettes smoked and/or how often the user can smoke a cigarette (eg, providing time limits); (4) informational: app provided information in the form of text and images to provide the user with knowledge on various aspects of smoking cessation; (5) game: app took the form of a game to help users quit; (6) lung health monitor: app measured and tracks the user's lung function and health; and (7) other: all functionalities that did not fit one of the six other categories.

Five A guidelines

To understand whether apps were developed with scientific input, we assessed them against the Five A's framework (Ask, Assess, Advise, Assist, Arrange) for behaviour change.[34] This framework is globally accepted as a tool to inform and develop health behaviour change interventions (online supplementary table 1). It has been applied to various behaviours including smoking cessation.

Gamification

To assess gamification, an architecture developed by Cugelman[35] was used.[35] It consists of two parts: (1) the persuasive and broad principles of gamification, also known as gamification strategies, and (2) the on-screen features of gamification that users interact with, also known as gamification tactics. Cugelman[35] developed this architecture through a review of a number of other taxonomies presented both in academic and non-academic sources.[35] A large amount of overlap existed when compared with other frameworks; Cugelman[35] captured the active ingredients of gamification as represented in the literature. The architecture used to operationalise gamification can be seen in figure 2.

Data analysis

To examine the price, ratings and features of mobile apps descriptive statistics were calculated. We classified the level of gamification strategies as none, low (1–2 strategies), medium (3–5 strategies) and high (6–7 strategies). Similarly, we classified the level of gamification tactics as none, low (1–3 tactics), medium (4–7 tactics) and high (8–10 tactics). The cut-off points used were arbitrary, as there is no previous research identifying specific

Gamification Principles

1. Goal setting: Committing to achieve a goal
2. Capacity to overcome challenges: Growth, learning and development
3. Provide feedback on performance: Receiving constant feedback through the experience
4. Reinforcement: Gaining rewards, avoid punishments
5. Compare progress: Monitoring progress with self and others
6. Social connectivity: Interacting with other people
7. Fun and playfulness: Playing out an alternative reality

Gamification Tactics

1. Providing clear goals
2. Offering a challenge
3. Using levels or incremental challenges
4. Allocating points
5. Showing progress
6. Providing feedback
7. Giving rewards
8. Providing badges for achievements
9. Showing the game leaders
10. Giving a story or theme

Figure 2 Gamification principles and tactics framework.

thresholds with meaningful implications. In order to investigate any differences between the two mobile platforms, we used Pearson χ^2 tests for independence. For instances, when the frequency count was <5, we used Fisher's exact test of independence. A significance level of p<0.05 was set to determine statistical significance. We also calculated correlation coefficients to explore the association between adherence to Five A guidelines and gamification strategies and tactics. All statistical analyses were conducted using STATA V.12.1.

Patient and public involvement

The study had no patient or public involvement.

RESULTS

App functionalities

Table 1 presents the general characteristics of mobile apps for smoking cessation across both platforms. The most common feature among apps across both platforms was the tracker feature which allows users to track the day until and/or since quitting (86.4%). A large majority of apps included a calculator feature which helps users calculate money saved or health benefits accrued since quitting (80.3%). Only 15.7% of apps across both platforms were informational, and only a small number were games or included games to help smokers quit (11.4%). Across both platforms, the majority of apps tested were free (85.0%) and the average user rating across was 4.4 since apps with less than a 4-star rating were excluded.

Five A guidelines

We found that 92 out of 140 (65.7%) mobile apps across both platforms only adhered to 1–2 out of the Five A's. Only 3 out of 140 mobile apps (2.1%) adhered to all Five A guidelines, indicating a low level of scientific and evidence-based development of the mobile apps. Online supplementary table 2 displays detailed results regarding adherence to Five A guidelines.

Gamification

An overview of the number and percentage of each gamification strategy and tactic adopted by mobile apps is presented in table 2. The most popular gamification strategy across both platforms was feedback on performance (91.4%). A majority of the apps allowed users to track their smoking habits or calculate money and health benefits; hence, this gamification strategy was inherently present. Although almost two thirds of mobile apps across both platforms (64.3%) utilised goal setting to motivate users, only 28.6% of apps provided users with the capacity and support to reach the goals set and the challenges faced. For example, 'smoking log—stop smoking' is an example of an app which was reviewed that enabled the user to set goals with regard to the number of cigarettes the user can smoke that day or the time until the next cigarette can be smoked, but it provides no support or advice to the user on how this goal can be achieved.[36]

Table 1 Overview of mobile apps for smoking cessation

		Platform		
		iOS (n=15)	Android (n=125)	Both platforms (n=140)
Features of apps	Calculator	15 (100%)	99 (79.2%)	114 (80.3%)
	Rationing	1 (6.7%)	24 (19.2%)	25 (17.9%)
	Tracker	15 (100%)	106 (84.8%)	121 (86.4%)
	Informational	4 (26. 7%)	18 (14.4%)	22 (15.7%)
	Game	0 (0%)	16 (12.8%)	16 (11.4%)
	Lung health monitor	0 (0%)	0 (0%)	0 (0%)
	Other	1 (6.7%)	4 (3.2%)	5 (3.6%)
Cost	Free	14 (93.3%)	105 (84.0%)	119 (85.0%)
	Paid	1 (6.7%)	20 (16.0%)	21 (15.0%)
	Mean price (£)	1.0 (0.0–0.99)	2.2 (0.0–8.6)	2.1 (0.0–8.6)
Popularity	Mean user rating	4.6 (4.1–5.0)	4.4 (4.0–5.0)	4.4 (4.0–5.0)
	Mean no of ratings	821 (6–6500)	1726 (6–35 045)	1629 (6–35 045)

Table 2 Number of gamification principles and strategies

		Platform			χ^2
		iOS (n=15)	Android (n=125)	Both (n=140)	P value
Gamification strategies	Goal setting	10 (66.7%)	80 (64.0%)	90 (64.3%)	0.839
	Capacity of overcome challenges	7 (46.7%)	33 (26.4%)	40 (28.6%)	0.101
	Feedback on performance	15 (100.0%)	113 (90.4%)	128 (91.4%)	0.363
	Reinforcement	10 (66.7%)	61 (48.8%)	71 (50.7%)	0.191
	Compare progress	4 (26.7%)	17 (13.6%)	21 (15.0%)	0.242
	Social connectivity	9 (60.0%)	60 (48.0%)	69 (49.3%)	0.380
	Fun and playfulness	1 (6.7%)	10 (8.0%)	11 (7.9 %)	1.000
Gamification tactics	Provides clear goals	10 (66.7%)	80 (64.0%)	90 (64.3%)	0.839
	Offers a challenge	10 (66.7%)	80 (64.0%)	90 (64.3%)	0.839
	Uses levels	3 (20.0%)	25 (20.0%)	28 (20.0%)	1.000
	Allocates points	1 (6.7%)	9 (7.2%)	10 (7.1%)	1.000
	Shows progress	15 (100.0%)	113 (90.4%)	128 (91.4%)	0.363
	Provides feedback	15 (100.0%)	113 (90.4%)	128 (91.4%)	0.363
	Gives rewards	10 (66.7%)	61 (48.8%)	71 (50.7%)	0.191
	Provides badges for achievements	9 (60.0%)	49 (39.2%)	58 (41.4%)	0.122
	Shows game leaders	1 (6.7%)	5 (4.0%)	6 (4.3%)	0.500
	Gives a story/theme	1 (6.7%)	5 (4.0%)	6 (4.3%)	0.500

*P<0.05 (No statistically significant values were found).

Additionally, 69 out of 140 mobile apps across both platforms adopted social connectivity (49.3%). However, most of these achieved this by including share options with popular social media platforms. Only a few of the apps provided users with social communities integrated into the app itself to share thoughts or discuss progress with other smokers trying to quit. Finally, the least common gamification strategy observed in the apps was fun and playfulness (7.9%). This finding is consistent with the low presence of on-screen gamification tactics, such as showing game leaders (4.3%) and including a theme or story within the app (4.3%). No statistically significant differences between the two platforms were found for any of the gamification strategies or tactics (p>0.05).

Table 3 Level of gamification incorporated in mobile apps for smoking cessation

		Platform			χ^2
		iOS (n=15)	Android (n=125)	Both platforms (n=140)	P value
No of gamification strategies adopted	0 (None)	0 (0.0%)	10 (8.0%)	10 (7.1%)	0.600
	1–2 (Low)	4 (26.7%)	40 (32.0%)	44 (31.4%)	0.776
	3–5 (Medium)	9 (60%)	68 (54.4%)	77 (55.0%)	0.700
	6–7 (High)	2 (13.3%)	7 (5.6%)	9 (6.4%)	0.248
No of gamification tactics adopted	0 (None)	0 (0.0%)	10 (8.0%)	10 (7.1%)	0.600
	1–3 (Low)	4 (26.7%)	29 (23.2%)	33 (23.6%)	0.753
	4–7 (Medium)	9 (60.0%)	81 (64.8%)	90 (64.3%)	0.714
	8–10 (High)	2 (13.3%)	5 (4.0%)	7 (5.0%)	0.164

*P<0.05 (No statistically significant values were found).

Table 3 presents the level of gamification adopted by mobile apps, in terms of the number of strategies and the number of on-screen features (also known as gamification tactics). Only 7.1% of apps across platforms did not adopt any gamification strategy or tactic. More than half of mobile apps across both platforms had adopted a medium level of gamification strategies (55.0%) and tactics (64.3%). However, only a minority adopted a high level of gamification strategies (6.4%) or a high level of gamification tactics (5.0%). No statistically significant differences between the two platforms were found with relation to the level of gamification strategies or tactics ($p>0.05$).

Furthermore, we tested whether adherence to Five A guidelines and the number of gamification strategies and tactics incorporated in smoking cessation mobile apps were related by calculating correlation coefficients (online supplementary table 3). We found that across all mobile apps (n=140) the numbers of gamification tactics and strategies were only weakly correlated with adherence to Five A guidelines, an indicator for level of scientific input ($r=0.26$ and $r=0.38$, respectively).

DISCUSSION

We reviewed mobile apps for smoking cessation available in the UK Android and iOS app stores and found that most of them incorporated a limited number of gamification elements and strategies.

We found that a majority of apps tested in our review allowed users to calculate the money saved or health benefits accrued since quitting. The popularity of this feature among mobile apps for smoking cessation is consistent with findings from prior reviews conducted outside of the UK market.[23–26] A large proportion of smoking cessation apps available on the UK market also allow users to track the day until and or since quitting. The integration of tracker and calculator features permits users to self-monitor their progress, a technique which has been associated with increased effectiveness for health behaviour change.[37–41]

Across both platforms the most common gamification strategy adopted was feedback on performance. This finding is consistent with another review which found that 60 out of 64 gamified health apps included feedback and monitoring.[21] The least common gamification strategy was fun and playfulness which requires app developers to include on-screen features such as a story or theme for the entertainment and liking of the user. Most apps do not incorporate such elements likely because they are more difficult to implement in comparison to basic tracker and calculator features which inherently provide feedback on performance. Goal setting was present in >60% of apps. This is promising as previous research suggests that goal setting is a fundamental component for successful health behaviour change interventions.[42] Although several apps allow users to set goals, not many provide advice or information on how to set realistic and appropriate goals, or how to achieve them.

Nearly half of the apps implement social connectivity as a gamification strategy. However, most do so by providing basic and easily implementable options of sharing results and progress to others via popular social media platforms rather than setting up social communities where thoughts and progress can be discussed with other smokers attempting to quit. Online social communities provide a platform for additional support, as well as a channel to interact with others seeking to quit. Two systematic reviews have found that online social networks and features can be effective and have a positive influence on health behaviour change.[43 44] Aside from social support, social connectivity features can drive user engagement via the mechanism of social comparison, which suggests that people compare themselves with others as a method of self-evaluation, which can impact behavioural outcomes.[45]

Regarding the level of gamification, our results indicate that a majority of apps adopt a medium level of gamification strategies and/or tactics, with few adopting no gamification or a high level of gamification. Several gamification elements, such as providing feedback and displaying progress, are inherently present in mobile apps (eg, Instagram, Google Maps) that would not generally be perceived as gamified. As a consequence of this, existing literature and our analysis may overestimate the level of gamification truly present. Refining gamification taxonomies to better measure the true level of gamification would allow researchers to look beyond elements inherently found in mobile apps.

Despite the possible overestimation of the level of gamification in mobile apps, research shows that gamification can positively impact psychological and behavioural outcomes.[12–19] Consequently, gamification can be an important part of persuasive design of mobile apps for smoking cessation which can result in higher user engagement and could thus provide a potentially cost-effective method to improve smoking cessation rates, thereby achieving a substantial public health impact prior research has shown the benefits of mobile and internet-based interventions for individuals of lower socioeconomic status[46 47]; hence, the provision of effective mobile apps for smoking cessation could reduce health inequalities by increasing cessation rates among disadvantaged groups. However, the development of gamified mobile apps for smoking cessation requires collaboration between gaming experts, software developers, behaviour change specialists and smoking cessation experts. Further research needs to continue to investigate gamified mobile apps for smoking cessation in randomised controlled trials to assess effectiveness on quit rates, as well as the potential benefits.

There are several strengths of our review. The focus on the UK mobile app market, which has not been extensively studied in previous literature, helps gain insight on mobile app interventions available in this geographic region. Moreover, we tested apps available in two major

app stores, inclusive of apps with a cost. Previous mobile app reviews focusing on smoking cessation apps available in the UK did not examine apps available on the Android app store nor apps that have to be paid for.[27 28] Our findings are up to date and representative of the entire UK mobile app market.

Our findings are also bound by some limitations. Due to the exclusion criteria, apps with less than a 4-star rating or apps with fewer than 5 ratings were excluded. This particularly led to the exclusion of a large number of iOS apps and therefore could have an effect on the generalisability of the findings. Future research could evaluate apps with lower ratings and explore whether gamification levels are correlated with user ratings as such research can have important implications for app developers and health researchers during the design and development of health apps. Additionally, since all mobile apps were reviewed for ~30 min on the day of installation and a few minutes the next day, it could be that certain app functionalities that are only visible or activated on long-term use would not have been recorded. Future studies could explore app functionalities and gamification features for a longer period of time to ensure that apps that have multiday cessation programmes are accurately assessed. Although our review examined adherence to cessation guidelines as an indicator of scientific input, we did not assess the overall quality of mobile apps and hence were not able to correlate level of gamification to app quality. Such analyses would require rigorous assessment of app quality with evidence-based tools, such as the Mobile App Rating Scale.[48]

CONCLUSION

Our research comprehensively reviewed the UK market for smoking cessation mobile applications in early 2018. Our findings showed that a medium level of gamification was adopted by just over half of the smoking cessation apps and only a minority adopted a high level of gamification or incorporate more complex and difficult to implement gamification features. Since gamification can be used to address critical limitations of mHealth interventions, such as engagement and retention, our research shows that increased effort and collaboration between gaming experts, software developers and smoking cessation specialists is essential for the development of gamified mobile apps for smoking cessation.

Contributors NBR conducted the mobile app review and produced the first draft of the paper. DW acted as a second reviewer and helped consolidate the results of the review. FTF and NM provided guidance on the overall methodology of the review and revised the manuscript for content. All authors contributed to the interpretation of results, read and approved the final manuscript.

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