Adolescents' opinions on the use of a smartphone application as an oral health education tool: A qualitative study

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Abstract

Developing health-related smartphone applications for oral health education should consider the end-user's perspectives to ensure they will be usable. This study aimed to explore the opinions of secondary school students in Selangor, Malaysia regarding the use of a smartphone application for oral health education and to identify the features for an oral health education smartphone application from the perspectives of adolescents. Focus group discussions were conducted among Form Two (14-year-old) and Form Four (16-year-old) students from selected government secondary schools in Selangor utilising a semi-structured topic guide until data saturation was achieved. Data were analysed using framework analysis. Ten focus group discussions were conducted involving 77 participants. Mixed opinions were recorded on the use of health-related smartphone applications for oral health education. The preferred features in a health-related smartphone application are disease detection, have games and rewards, educational and fun, access to a dentist, reminders, and user-friendliness. Adolescents are aware of the positive aspect of using health-related smartphone applications for oral health education; however, they are wary of the need to install one. Nevertheless, identifying adolescents' preferred features of an oral health education app is the first step in developing an application tailored to their needs. Smartphone application could be a timely strategy to improve oral health education delivery and behaviour improvement for this age group.

Keywords

Smartphone, health education, adolescents, mobile applications, focus groups, Malaysia, schools

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Introduction

It was estimated that almost 90% of the world's population were using smartphones in the year 2020.[1] In Malaysia, smartphone usage showed a tremendous increase from 34.7% in 2013 to 87.6% in 2020.[2,3] Smartphone usage was reported to be higher among younger people.[1,4] In a study among 969 subjects in Malaysia, it was found that almost all subjects aged 12 to 18 years old owned a smartphone, indicating that the majority of adolescents are familiar with it.[5] Children and adolescents are among the most frequent users of smartphones and this trend continues to rise each year.[6]

The worldwide emergence of smartphone applications or mobile apps has encouraged the development of innovative health-related smartphone applications (HRSAs) to help users obtain health information and to improve their behaviours and health. As of 2017, there

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were 325,000 health & fitness and medical apps (HRSAs) available on all major app stores, with 78,000 new apps added in the same year.[7] Fox and Duggan reported that half of smartphone owners use it to find health information, and about one fifth of them have HRSA on their devices.[8] The huge proliferation of HRSAs indicate the increasing trend among consumers in taking care of their health.

A series of systematic reviews have reported that using HRSA to promote health was feasible and it could be an efficacious strategy to improve health-promoting behaviours.[9–12] There were also studies that showed evidence on the use of HRSAs to promote tooth brushing, fluoride mouth rinsing and reduction in gingival bleeding among adolescents.[13–15] As smartphones can be used almost anytime and anywhere, it is potentially effective in reaching out to a wider number of people which can be useful in targeting adolescents and students.[4] Developing HRSAs could be the next approach in promoting health and encouraging behaviour change in this age group. This is important as healthy habits built during adolescence may last into adulthood.[16]

The majority of HRSAs available were mainly developed for adults and very few were tailored to the younger, tech-savvy generation.[17] In a review by Dute et al.,[4] of the 12 HRSAs identified, only four were developed for adolescents. In addition, it was also reported that many HRSAs were developed with minimal input from the target users during its developmental stages.[18] For example, studies on HRSAs designed to address adolescents' mental health did not involve adolescents' viewpoints during the development of the apps.[19,20] This may resulted in the lack of uptake among adolescents as the applications were considered not appealing and did not fulfil their needs.[21] Furthermore, HRSAs that were developed without considering the target users' perspectives in its development would result in the app not having features considered important to adolescents which subsequently undermines its potential effectiveness.[22]

Commonly, oral health education (OHE) targeting adolescents is carried out via verbal, written and audio-visual modes mostly at their respective schools.[23,24] In Malaysia, this traditional method for imparting OHE to the target group has been practiced for many years by the school dental team as part of the annual health promotion programmes at government primary and secondary schools. However, despite the efforts in the typical intervention programmes, it was a challenge to achieve the desired levels of adolescents' adherence to the programmes.[25] As adolescents prefer engaging interventions, the usual OHE approaches at schools were deemed by the students as uninteresting and not interactive enough.[26,27]

Unlike the traditional approaches in OHE, HRSAs provide greater accessibility, which allows frequent and sustained contact to health information.[28] HRSAs may be more preferable to adolescents as they offer a fun, interactive, and personalised platform to improve their health.[17] Another advantage of HRSA particularly for adolescents is its anonymity, which allows them to seek help privately and independently especially when dealing with sensitive health issues.[28,29] Thus, HRSA could be a promising tool to improving oral health among adolescents.[30] Based on the emerging evidence from the use of HRSA, it would be interesting to explore the use of HRSA in conducting OHE by investigating the viewpoints of the adolescents themselves.

Therefore, this qualitative study was undertaken to explore the secondary school students' opinions and perspectives regarding the use of HRSA for OHE. In Malaysia, secondary school students are those aged between 13 and 17 years. The findings from this study will be useful to guide the development of an HRSA for OHE among urban adolescents in this country. The findings may also benefit neighbouring countries with a similar socio-cultural background.

Methods

Study design

In this study, a qualitative approach was used to explore adolescents' perspectives on the use of smartphone applications for OHE. The qualitative study design is most suitable when the researchers wish to get a richer description of opinions or experience on a topic of interest. Focus group discussions (FGDs) were used as the method for data collection.

Selection and recruitment of research participants

The study population was secondary school students in the state of Selangor, Malaysia. Three government secondary schools in the Petaling district were purposely sampled. Selangor was chosen as the study location because it is the most populous state with the highest number of government secondary schools in the country. The inclusion criteria for the schools were: 1) urban schools, 2) public schools, and 3) co-educational schools. Urban schools were included as almost all students owned a smartphone. The three schools selected were from different towns in the Petaling district to encourage wider and more varied responses from the participants.

After the schools had been selected, the students from the schools were recruited using purposive sampling. The inclusion criteria were students aged 14 and 16 years old and owned a smartphone. The two age groups were chosen as they were not involved in the national level examinations. The participants were grouped by age and academic performance, i.e. high and low academic achievements at school. This encouraged better participation in the discussion when the students were grouped among their classmates who were at a similar academic performance.

Development of focus group discussion questions

The FGD questions which formed the topic guide were developed in both English and Malay languages and validated by dental public health specialists to address the study objectives. The questions were: (a) What are your opinions about using a smartphone application for OHE? and (b) What are the features of a smartphone application for OHE that you wish to see? Some probing questions to seek further clarification and encourage responses from the participants were also prepared.

A trial FGD was conducted with a group of eight participants from a school before the actual data collection began. The trial FGD enabled the topic guide to be tested and improved and to determine whether conducting the FGD was feasible.

Data collection and analysis

The FGDs were conducted in a closed room at the participants' own schools. Before the session began, the participants were asked to fill up a questionnaire on demographic background and light refreshments were served. The session began with the moderator (NAM) introducing herself to the participants and vice versa, followed by a short ice-breaking activity. The moderator explained to the participants the objectives of the study and ground rules. The participants were given opportunities to ask questions. They were also informed that an audio recorder would be used to record the session after they were given assurance that the recordings will only be used for research and would not be disclosed to third parties.

To begin the discussion, the moderator asked the first question to the participants, and they were allowed ample time to discuss and share their opinions on the topic. The discussion continued until no further points were raised by the participants. Next, the moderator asked the second question, and the participants again discussed the given topic until no further points were raised. Each FGD took approximately 40–60 min. A note-taker was also present to note important points from the discussion. Before each session ended, the moderator summarised the key points and asked the participants if any points were missed from the discussion. The moderator then concluded the discussion by thanking the participants. The FGDs continued with other students from the subsequent schools until no new information was obtained from the FGDs, indicating that data saturation had been reached. At this stage, the FGDs were stopped. Data collection took place between January 2019 and May 2019.

Data analyses were performed using framework method analysis.[31] First, the audio-recordings from the FGDs were transcribed verbatim. Next, the researcher (NAM) familiarised herself with the transcription. This was done by reading the transcripts several times and listening to the audio-recordings. Open coding on the transcripts was performed manually to find and highlight possible initial themes. Once the initial codes had been established, the transcripts were transferred into NVivo software 12.0 (NVivo qualitative data analysis software; QSR International Pty Ltd Version 12, 1999–2021) where more detailed coding was carried out. Subsequently, the codes were converted into themes. Next, a working framework was developed where the themes and the coded data were indexed into it. The data were then charted in a table using a Microsoft Excel spreadsheet according to the themes. The summarised themes were finalised and the findings interpreted.

Reliability and validity of research

Reliability and validity of the study was ensured by recruiting adolescents who have experience in using mobile apps and were able to discuss about it.[32] Persistent observations and prolonged engagements during the data collection have allowed the researcher to establish rapport with the participants that led to sufficient data being obtained.[33] Data triangulation was conducted by collecting data at three different secondary schools located in different towns in Selangor using the same methods and investigator.[34] Investigator triangulation was done with a researcher in the same field (ZYMY) and a researcher from a different specialty (UO) where the themes and the coded data were assessed independently to ensure the themes correctly depicted what the participants had said.[34] Differences in opinions regarding the final themes were discussed and the final consensus was reached through agreement among all researchers.

Research ethics

Ethical approval for the study was obtained from the Medical Ethics Committee, Faculty of Dentistry, Universiti Malaya [Ethics No: DF CO1812/0081(P)] and the study was registered with the National Medical Research Register (NMRR-18-3880-45396). Permission to conduct the study was obtained from the Ministry of Education and the Selangor State Education Department. Written consent from the students and their parents was also obtained prior to data collection. Participants were paid honorarium at the end of the session as a token of appreciation for their involvement in the study. All participants were assured that their personal information was protected against disclosure.

Results

A total of 77 students participated in ten FGDs. Six groups consisted of participants from upper academic classes while four groups involved participants from lower academic classes. The participants' demographics are shown in Table 1.

There were two domains explored: (a) adolescents' opinions on using smartphone applications for OHE, and (b) features of a smartphone application for OHE that they wish to see. The themes under each domain are elaborated below and summarised in Figures 1 and 2.

Adolescents' opinions on using smartphone applications for OHE

Under the first domain, five themes emerged:

Convenient. Most of the participants opined that having an app specifically for OHE would be a convenient way to get information on oral health. They said it would make life a lot easier for them as all the information needed will be on one platform such as a smartphone application.

> Before this, if we do not know something about our oral health, we have to go out (see a dentist) to find the answers. Now that everything is in our phone, it can save our time greatly… (Participant 11).

> It makes it easy for us to find information that we want to know (about our teeth). (Participant 31).

Table 1. Demographic profile of the participants (*N* = 77).

Variable	*n* (%)
Gender	
Male	46 (59.7)
Female	31 (40.3)
Age	
14 years (Form 2)	37 (48.1)
16 years (Form 4)	40 (51.9)
Ethnicity	
Malay	37 (48.1)
Chinese	24 (31.2)
Indian	15 (19.5)
Other	1 (1.3)
Academic performance	
Upper academic class	46 (59.7)
Lower academic class	31 (40.3)

Facilitate oral health learning. Some participants said that having a smartphone application dedicated for oral health would make it easier to learn skills and obtain knowledge pertaining to their oral health. The idea of having all the information they wanted to know in one application was very appealing to them. One of the participants said:

> In my opinion, we can use the app to search how to brush our teeth, how to floss, which food that is good for oral health, and other information on how to take care of our teeth. I can learn a lot of things, I can click search in the application, read tutorials, say, how to floss our teeth, how many times we should brush, what are the consequences, the bad thing that can happen to our teeth if we don't brush… (Participant 49)

Trustable source of information. A smartphone application is viewed as a credible source of information on oral health. When asked to provide reasons for why the idea of having an app for OHE is favourable, one participant explained:

> When people want to search about oral health and there is no application for it, they will search in Google. However, in Google, anyone can post about anything, it makes people unsure if the information is right or wrong. But if it is in a dedicated application specific for oral health, the information is verified, right? So, it is more trustable. (Participant 9)

The response above showed that the participants were aware of the possibility of finding false information on the internet via a Google search.

Limited phone storage. Despite the positive feedback, a few participants showed a lack of enthusiasm and gave less-
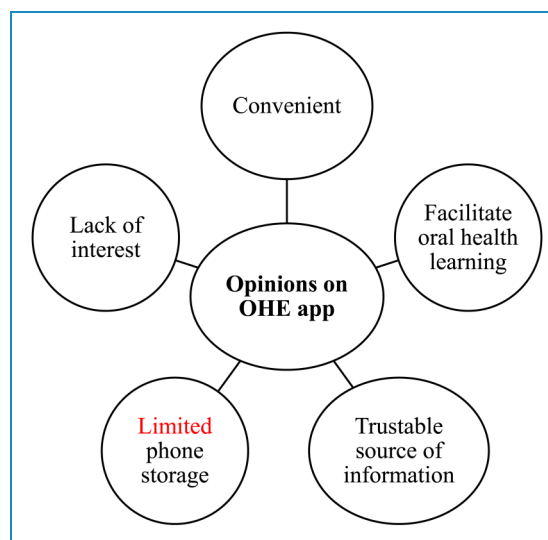

Figure 1. Summary of themes for adolescents' opinions on OHE apps (OHE = oral health education).
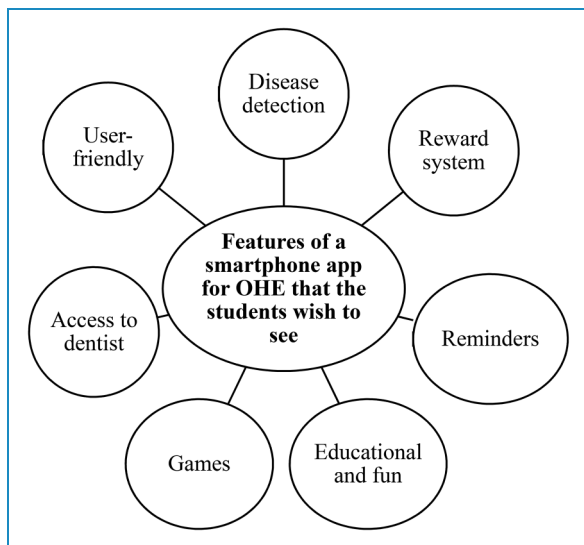
Figure 2. Summary of themes for features of a smartphone app for OHE that the students wish to see (OHE = oral health education).

favourable opinions about using a smartphone application as a tool to learn oral health. Their major concern is the phone's internal storage. When asked to elaborate further, some of the participants replied:

> Such app will consume a lot of phone storage and for a phone with low storage capacity, installing such an app will leave less storage in my phone for other apps. (Participant 75)

> It will waste the phone's memory. (Participant 21)

> No, I don't want to install such application, because it will take up the phone storage. (Participant 44)

Lack of interest. A few participants admitted that they were not interested to have an OHE application in their phone. In fact, none of them had heard about oral health-related applications before. When asked to elaborate further, most of them said they would only install and keep applications that they have interest in.

> If a person is not interested, they would not find (look for and install) that app. (Participant 57)

> "I don't think I will install the application. There is a lot more interesting applications than an application for oral health. We can educate ourselves to brush teeth or floss from the internet or something. (Participant 5)

This showed that interest plays a big role on whether such an application will be installed and used by adolescents.

Features of a smartphone application for OHE that the students wish to see

The second domain was directed at exploring the participants' preferred features of a smartphone application for OHE. Seven themes emerged as described below:

Disease detection. The majority of the participants said that having an application that could detect oral diseases would be important and appealing to them. One male participant animatedly described the features with hand gestures, indicating his excitement with the idea. The participants' words were as quoted below,

> I would like to have an app that could scan the mouth and detect any disease. (Participant 8).

> If we have an oral health application, and it incorporates some sort of a scanner where we can scan our mouth and it will tell us what problems we have in our mouth, it will be good. Now people are quite lazy, and many don't want to see a dentist, we would love to have an app that scan and detect the problem. (Participant 16)

Reward system. Many of the participants opined that the application for OHE should provide rewards to users. The rewards can be in the form of collecting points which later can be translated into vouchers. Having a reward system was described by the participants as making them want to keep using the app to collect more points. One female participant said,

> Every time you brush your teeth, the app will give you points. After a month, you can get something from the points collected. Like you reward yourself for brushing teeth. (Participant 14)

Some participants suggested that having mini games in the application that award points to users who play the games would be appealing. The feature can apply the same reward system.

> Like those mini games, where you will win points then you can buy or use the points to win prizes for something that can be used to take care of your teeth. For example, when you have scored certain points by doing good behaviours suggested in the app, you are entitled for a toothbrush or toothpaste. (Participant 20)

Reminders. This was a preferred feature that emerged in almost all FGDs. The participants voiced their preferences to have reminders sent to them via the application. An application that has a feature which alerts them to brush their teeth was highly favourable to all of them.

It would be nice to have a reminder to brush our teeth. Everyone is always watching their phone, so they can get a notification before sleep, or after waking up to remind them to brush their teeth. (Participant 32)

I think the application should have a reminder when to brush our teeth. Like, there is this voice telling and reminding us to brush our teeth. (Participant 64)

Educational and fun. Another preferred feature mentioned by the participants was that the application should provide oral health information in an interesting way. The application must not only be informative, but it should also be fun to users and not dull or boring.

For the oral health education application, please make it interesting, have some cartoon characters that teenagers usually like. For example, an anime character, because I like anime, and make it good looking too! (Participant 31)

If we have some problems with our teeth, we can search in the app and there will be answers and solutions in it. (Participant 38)

Games. When asked about the features they would prefer to see in the OHE application, most of the male participants suggested that the application should include games. Having games that contain oral health information had been suggested by some of them.

You can put some games in the application, but not the brushing teeth game as that is too childish. Maybe a game that can provide education about oral health. (Participant 4)

One male participant said that games have elements of competitiveness which was appealing to him. An application which contains games that challenge users to compete with other users to get high scores would be something worth considering.

Create a game like Kahoot. It is like quiz but has elements of challenge and competition. It is like competing who gets the right answer to all the questions, and who gets the highest score. (Participant 26)

Access to a dentist. Getting access to a dentist is another commonly recurring theme during the FGDs. Access to a dentist was described by them as being able to ask questions and get answers from a dentist in the application.

It would be nice to be able to directly send a message to a dentist and ask them questions. Right now, we have things like online teacher, why not an online dentist? So, we can ask questions and get answers from them. (Participant 64)

People experience different kinds of oral condition. Let say it is not mentioned in the application, it would be a good idea to have a small section where we can actually ask a professional dentist about a specific problem that we have. (Participant 50)

Another description under access to a dentist was being able to bring the user to a dentist when they need it. Some participants said an application that can locate a nearby dentist in the area and can facilitate access for treatment at the dental clinic would be great. Quite a few participants suggested a feature which allows the application to find the nearest dentist to their location.

If I have oral problem, I want to go to see a dentist, maybe the application can provide or suggest the location. The application helps to find the nearest dental clinic around my area. (Participant 6)

It would be nice if the app can offer information of a nearby dental clinic to us. (Participant 49)

User-friendly. The final theme under the second domain is having a user-friendly application. Some participants, especially females voiced out their concern if the application was not easy to use. An application that is not user-friendly would be off-putting to them. One female participant said,

I hope that it will be easy to use and access the applications. Some apps are difficult to browse, and they ask so many details from us. (Participant 13)

As for the oral health application, I hope it's not too difficult for us to understand it. As for the language used in the app, please make it easy for people to understand. Once you open and use the app, you should understand it instantly without many difficulties. (Participant 14)

Discussion

This study aimed to explore two domains regarding the use of a smartphone application for OHE among adolescents. The first domain was on the adolescents' opinions about having a smartphone app for OHE and the second domain was the features in an OHE app preferred by the students. Five themes emerged under the first domain while seven themes emerged under the second domain.

The findings revealed mixed opinions among the participants regarding the use of HRSA for OHE. The participants showed willingness to use an OHE app as it is convenient and can facilitate learning. At the same time, their concern over the phone's storage consumption and the lack of interest to own an OHE app were also noted. When enquired about the type of applications they

frequently used, none mentioned about oral health-related applications. The lukewarm response could be due to their lack of awareness about HRSAs and their uses.[17,35] Studies have reported that most HRSAs are designed and developed for adults, which could explain why most participants were not aware of them and showed less enthusiasm.[17]

The majority of the participants agreed that having an application will make it easy for them to get information about oral health, similar to what was reported by Dennison.[36] Google-searching for oral health information usually yields too much information leading to confusion and information overload. Deciphering which websites provide accurate and evidence-based information is a skill not many possess, especially among children and adolescents.[37] An OHE app developed by experts would be a better option for a trustable source of information.[36] The app will be a go-to platform when they face any oral health issues without having to search among the list of websites on Google. Although some viewed having an OHE app could facilitate oral health learning, they also admitted they might not have such apps installed on their phones due to substantial internal storage consumption, as found by Warnick et al.[38] The concern about limited internal storage on their phones is likely due to the type of smartphones used by adolescents that are usually more low-to-mid range. Most adolescents still rely on their parents, and they do not have the buying power to select higher-end smartphones with larger storage capacity. In one study, phone's storage consumption is one of the reasons why adolescents may discontinue using a smartphone app.[28]

Some participants opined that they would not install an OHE app as oral health does not interest them. According to the participants, they will only install applications that pique their interest. Not having an interest in oral health will not make them use the application often, hence would be a waste of their phone's internal storage as found by Krebs.[39] Studies reported that adolescents mostly used smartphone applications for social networking and to get updates from friends and family via social media accounts such as Instagram, Facebook and Twitter.[5,38] Interest plays a major role in whether adolescents would install and use a particular app.[28]

According to Chan et al.,[17] one of the ways to promote the use of HRSAs among adolescents is by incorporating features that appeal to them. In this study, one of the two domains explored is the features preferred by participants in an OHE app. One of the features mentioned by participants is an app that provides rewards to its user, in line with findings from Peng et al.[35] Creating a reward system where a user will rank up to a higher level or gain points will keep them motivated to continue using the app.[40] It is also a part of gamification which is defined as applying elements from a gaming domain to improve behaviours in non-gaming situations.[41] It is a method to encourage better performance and continued use among app users by utilising gaming features such as badges, leader boards, competition, incentives and avatars.[42]

Besides that, being adolescents who are used to getting information at their fingertips, they prefer an OHE app that can provide quick solutions to their needs and problems. Some of the participants said an app that could scan their teeth and detect diseases would be a very desirable app. They would want to know the status of their oral condition; however, they want it done in a hassle-free manner. This is a typical criterion of Generation Z who are used to instant gratification and getting answers immediately.[37] Another preferred feature is access to a real dentist where they can personally ask oral health questions and locate a nearby dental clinic whenever they need it. One study reported that applications which offer personalisation, including apps that provide tailored information and real-time feedback are highly valued and preferred.[43]

Such preferences can be well understood. According to Shatto and Erwin,[37] adolescents which belong to Generation Z are mostly self-directed learners who flourish in a technological environment. They are used to obtaining information via a swipe of their smartphone. The world they are living in now enables them to learn anything by only sitting at home. Services such as online shopping, requesting for a driver, and ordering food are all done via mobile apps and adolescents are accustomed to getting things this way.

Besides that, almost all groups mentioned that they preferred an OHE app that gives them reminders to brush their teeth. Some gave examples from apps they are using, showing the usefulness of having such a feature as it can alert them when they are too engrossed with their phones or TV which is a similar finding to Peng et al.[35] However, this was in contrast to what was found by Frontini et al.[28] who reported that receiving messages or alert notifications from apps was among the least favourite features among the adolescents in their study.

Another feature raised by the participants is an app that has games. This is a gamification technique that encourages user retention as it will keep them engaged and interested to continue using the app.[42] Some of the participants, especially males admitted that they spend a lot of time playing games on their smartphones. When asked to elaborate, they mentioned that they find games very satisfying. They feel challenged and keep wanting to play more to defeat their online opponents. Such a situation can be created in an OHE app by creating a leader board, where users can see their scores and feels motivated to keep getting higher points to outdo other users.[44] However, it was also mentioned specifically that the games must not be childish, citing examples like games of brushing teeth to chase germs away.

Besides that, the majority of participants mentioned that they want the OHE app to be informative in a fun way. Learning should not only be one-way; it should also be

fun especially when it is done interactively. As much as educators wish to provide oral health information, perhaps a different approach can be done which makes learning more relevant to the current generation of adolescents. One of the examples to impart knowledge and provide information in an interactive way is like Kahoot, where the users compete to be the first to get the right answer and strive for the highest score.[37] This pedagogy is similar to the gamification approach, where rewards and recognition spur the motivation to do more.

In addition to the above, participants also opined that the app must be easy to use, without requiring much effort to understand, as suggested by Chan et al.[17] The application developed must be user-friendly, or in other words easy to be used by the user without much configuration needed. User-friendliness of the application is one of the features recommended in review studies of apps and rendered as highly preferred by users.[36,45]

Implications of the study

The findings of this study revealed mixed opinions among the participants on the use of a smartphone app as an OHE tool. As much as they see the positive side of using a potential app, they also showed scepticism on whether an OHE app is something they would want to have in their phone. Acknowledging the ambivalence in their opinions, perhaps the first step that needs to be addressed is to expose the adolescents to the vast possibilities that can be achieved with HRSAs, thus creating more interest among them.

Developing a HRSA should begin by understanding the users whom the application is built for. Exploring the opinions and features preferred by adolescents for an OHE app was intended as part of a user-centred approach in developing a smartphone application for them. A user-centred approach involves consideration of the user throughout the design and development process[22] which may lead to greater product acceptability and success.[46] It was also reported that involving users to determine what they require may enhance the usability of the product.[18] Involving the adolescents in the early stages of development may yield results that can be utilised to help build interventions that are focused on the areas where they need assistance.[47] Identifying the adolescents' preferred features in an OHE app will hopefully increase the chances of them installing and using the app.

As most of HRSAs were developed for adults, the apps may not be relevant to adolescents as these apps would be considered uninteresting to address adolescents who possess a distinct technology usage and behaviour.[17] Generalising the users may lead to the app having features and design that does not appeal to adolescents. As cited by Chan et al.,[17] one of the fundamental reasons for poor uptake in health-related app is due to the design process which may not be up to the preferences and need of users.

The current generation of adolescents is known as the 'Generation Z' or Gen Z who were born after 1995 until 2012.[37] This group of adolescents created the most global youth culture in history with the majority of them have access to digital technology.[25] Studies have shown that adolescents are among the highest users of technology.[48] Due to the pervasiveness of technology in the adolescents' lives, digital technology is potentially used as a feasible and acceptable platform for health promotion and education in this population. This is an opportunity to introduce the OHE app to assist behaviour change and improve their oral health. In addition, digital health interventions such as smartphone applications appear to be a viable and practical option for health behaviour interventions aimed at improving health among adolescents.

Besides that, engaging adolescents in the traditional health education activities is not an easy task as adolescents' daily schedules are quite hectic. They are often involved in extracurricular activities, part-time work and social engagements in addition to schoolwork, all of which make health education and promotion initiatives more difficult. Thus, having an engaging and personalised health intervention incorporated in their daily activities such as the OHE app is a smarter approach to reach out to them.[25]

According to Dute et al.,[4] adolescents are already able to handle and use smartphone applications by the age of 10. An OHE app can be an alternative option to the conventional method of oral health education that consists of dental talks in halls/classrooms and poster exhibitions at schools. Having an OHE app would allow adolescents the opportunity to learn and improve their oral health while providing them with more autonomy and responsibility to take care of their own health.[17] For the younger, techno-savvy adolescents, HRSAs may be more preferable compared to the traditional approaches.[17] A different method such as a smartphone application that is more interactive, fun, and tailored to the needs and preferences of the adolescents could be a new approach in promoting oral health.

On another matter, for studies that aim to explore and understand adolescents' opinions and preferences regarding an OHE app, FGDs may be the most suitable data collection method. FGDs are primarily used for marketing research and remains as one of the most common methods applied in consumer research.[49] On the other hand, framework method analysis is commonly used to analyse data in qualitative studies and is the appropriate tool to use in studies that seek to find answers to a certain issue and studies with a focused objective.[50,51]

Limitations of the study

Due to the lack of external validity, the findings from this study may not be generalised to the whole population of Malaysia, especially adolescents who live in rural areas.

However, the total number of participants who took part in this study was quite significant and the findings may be applicable to adolescents in urban areas. Data were collected from each of the ten groups until comparable points were cited repeatedly, suggesting data saturation. The groups were made up of a balanced mix of genders, ethnicities and academic performances so fuller and more diverse perspectives may be obtained.[52]

Grouping the students by academic performance can help to ease interactions. However, one issue that occurred was that some of them became too relaxed and kept teasing their friends during the sessions. This happened during FGDs involving students from lower academic classes. Besides that, it is possible that mixing male and female students in one group resulted in some restraints owing to shyness or fear of being mocked when they spoke.

In this study, the participants were recruited from government secondary schools. Those who attended private or international schools were not included. However, the number of students who attend non-government schools is relatively small. Future studies should consider adopting a community-based approach that would include adolescents from all types of schools.

Conclusion

Adolescents acknowledge the positive aspects of using HRSA for OHE; however, they are uncertain of the need to install one. Nevertheless, having identified the adolescents' preferred features in an OHE app is one of the ways to create a smartphone application that is relevant, appealing and able to address adolescents' OHE needs, thus would be most beneficial to the adolescents who use the application. Such initiatives should be the first step in a user-centred approach for developing smartphone applications. As adolescents are among the most frequent users of smartphones, such relevant application would be a timely strategy to improve OHE delivery and health behaviour in this age group.

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