mHealth to enhance oral cancer awareness in older adults in Chile: a preliminary report

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Abstract

This study aims to assess a new mobile application (app)'s efficacy in raising oral cancer awareness among older adults through educational videos and serious games. The app, named TEGO® (Tele-platform of Geriatric and Dental Specialties), with a video about oral cancer prevention, oral-self-examination, and serious gaming elements, like trivia and word search puzzles to reinforce the acquired knowledge was developed. Fifty-six patients, aged 60 to 80 years, were randomly selected from the Dental Clinic of the University of Chile and invited to use the app on their personal smartphones. Knowledge and attitudes were evaluated before two and four weeks after use. Oral self-examination practices were measured with a checkup guideline. The participation rate was 41.1%, mostly male (52.2%). Before using the app, 30.4% of the participants reported awareness of oral cancer, and none had performed oral self-examinations. Following two weeks after use, there was notable engagement, with 100% of participants utilizing it and responding that they had heard about oral cancer, and 56.5% having practiced an oral self-examination. This last outcome increased to 82.6% in the fourth week. The use of mHealth technologies has the potential as an effective educational tool for disseminating knowledge about oral cancer among older adults.

Introduction

mHealth refers to the use of mobile devices, such as smartphones, tablet computers, and personal digital assistants (PDAs), to deliver medical care, public health services, and other health-related services [1]. Information and communication technologies, as well as digital devices like smartphones, offer potentially powerful tools for patient education and reinforcement of behavioral change [2].

Various reviews highlight the use of mobile applications (apps) for education and prevention of conditions such as hypertension [3], prostate cancer [4], and other chronic diseases [5]. However, the use of these apps for oral health prevention in adults, particularly older adults, remains underexplored [6]. Among the oral diseases affecting older adults, prevention and education about oral cancer is crucial, as most cases are diagnosed in this age group [7], and the prognosis is typically worse for older individuals [8]. Although some apps designed for oral cancer education have demonstrated increased knowledge [9] and greater effectiveness compared to conventional health education via PowerPoint presentations [10], to our knowledge, the incorporation of serious games in such apps has not yet been evaluated. In this context, serious games are novel instruments that could allow older adults to practice their skills in a safe and controlled environment. Games can make oral health habits more enjoyable and engaging by turning them into game elements, such as collecting points for brushing teeth twice a day or unlocking new levels for maintaining a healthy diet. Also, it could be used to promote positive behavioral changes, such as quitting smoking and practicing good oral hygiene.

In Chile, oral cancer, particularly squamous cell carcinoma of the oral mucosa, is the most common malignant neoplasm in the mouth, with poor survival rate of approximately 33.9% at 5 years [11]. Survival according to TNM staging system [T describes the size of the tumor and any spread of cancer into nearby tissue; N describes spread of cancer to nearby lymph nodes; and M describes metastasis (spread of cancer to other parts of the body)] has been evaluated, with better survival associated with lower TNM stages: 86% in stage I, 67% in stage II, 52% in stage III, and 51% in stage IV [12]. Given its high mortality rate and the need to improve prognosis, educating the public about oral cancer, especially regarding risk factors control and early diagnosis, is of paramount importance [13]. Tele-assistance for elderly individuals living in rural areas of Chile has reported that approximately 1 in 4 patients require an evaluation by an oral pathologist [14].

This study aims to evaluate the efficacy of a newly developed app, which integrates educational videos and serious gaming elements, in raising oral cancer awareness among older adults in Chile.

Materials and methods

This research is part of the project titled: "Development and implementation of a mobile application to promote prevention and oral health education interventions in older people in an integrated network of Universities of the Council of Rectors of State Universities of Chile". In this project a novel app for mobile devices named TEGO® (in Spanish: Tele-platform of Geriatric and Dental Specialties) was developed to deliver relevant information on oral health care for older people. Increasing awareness about oral cancer and its risk factors, and self-examination to early diagnosis of oral cancer was one of the selected aspects of the research and the focus of this communication.

An educational video previously developed on the TEGO® tele-dentistry tele-platform (COVID Project 0766, ANID) [15] was validated with the Patient Education Materials Assessment Tool (PEMAT) and included in this new app for mobile (Figure 1).

From the video on oral cancer prevention, an instructional design was developed in which serious games were planned, prepared, and designed. A research team made up of engineers, designers, educational experts and dentists specializing in oral pathology and oral medicine defined the learning

Figure 1. Interface of the new TEGO® app with images from the educational video that shows two steps of oral self-examination

objectives. Serious gaming elements such as trivia, word search puzzles, and sort or swipe cards were added to reinforce the knowledge about oral cancer prevention and integrated into the new app (Figure 2). The app is free to use for patients participating in the project. The patients need to be enabled to have access to TEGO® app. It is available in Google® store.

Figure 2. Interface of the new TEGO® app with the link to serious gaming elements: trivia, word search puzzles, and sort or swipe cards

Fifty-six patients, aged 60 to 80 years, were randomly selected from the patients attending the Dental Clinic of the University of Chile. The inclusion criteria were 60 to 80 years old, smartphone users, and users of at least one social network (e.g., WhatsApp, Instagram). The age group of 60 to 80 years was selected for this study because they represent the majority of older adults seeking consultation at the Faculty of Dentistry's dental school. Exclusion criteria included having a medical condition that limits participation (e.g., uncompensated visual problems) and a Mini-Mental State Examination (MMSE) score of 13 or lower.

Questionnaires evaluating knowledge, attitudes, and practice towards oral cancer were administered initially, at 2 weeks and 4 weeks of app use. This instrument was adapted from the questionnaire published in the study by Elango et al. [16] (Table S1). The copyright permission was obtained.

The new app was installed on the participants' personal smartphones. A brief personal training session on the use of the app was conducted at the time of enrollment, lasting approximately 3 to 5 minutes. Participants were recommended to use the educational app at least once a week during the study period, but freedom was left for those who wanted to see them more times per week. Participants were not allowed to ask the enroller questions about the app's content during the 4-week study period. They were only permitted to request support in case of operational issues.

Changes in participants' knowledge and attitudes regarding oral cancer: initial, at 2 weeks, and at 4 weeks after app use were described in absolute numbers and proportions, using STATA/SE 16.0 statistical program. Additionally, in the fourth week, a checklist was used to measure the performance of the oral self-examination based on the 5 steps from the oral cancer prevention video.

The study was approved by a Scientific Ethics Committee of "Universidad de la Frontera" and the reference number is 175-23, November 2023.

Results

A total of 56 older adult patients were invited to participate, of which 23 were accepted. Participation rate was 41.1%. The reasons cited for declining participation in the study included time constraints, work-related obligations, and difficulties attending the additional appointment due to caregiving responsibilities, such as looking after grandchildren or other elderly dependents.

The sample consisted mostly of males (52.2%) with a mean age of 66 years. Additionally, 60.8% had an educational level ranging from completed secondary education to completed higher education. None of them had previously received education about this disease during dental treatment.

Initial assessments indicated a low baseline knowledge of oral cancer with only 30.4% of participants having previously heard of the disease, and none of them aware of the importance of oral self-examination as a preventive method for detecting the disease. Furthermore, none had performed an oral self-examination. In terms of risk awareness, 78.3% recognized the link between tobacco use and oral cancer, while 47.8% were uncertain about the relationship between alcohol consumption and the disease. Although 60.9% associated poor oral hygiene with oral cancer, 34.8% were unsure if such a connection exists. Moreover, 91.3% believed that oral cancer can be detected early. However, 39.1% considered it not curable, and 30.4% were unsure if any cure or treatment was available (Table 1).

Following two weeks of use, there was notable engagement, with 100% of participants actively utilizing the app, and no participants withdrew from the study. Additionally, 100% of participants recognized the existence of oral cancer, while 87% acknowledged that oral self-examination serves as a preventive measure for this disease (Table 1). Furthermore, 56.5% reported having performed an oral self-examination (Figure 3).

At four weeks of use, 100% recognized oral self-examination as a preventive measure, and the percentage of participants who reported having performed the self-examination increased to 82.6% (Figure 3). In the final clinical evaluation of the self-examination steps, 56.5% conducted a complete self-examination for oral cancer following the procedures outlined in the app videos, while 34.8% partially completed the steps, missing one or two (Figure 4).

Regarding risk factors, after 4 weeks of use, 100% of participants recognized tobacco as a risk factor, 87% correctly rejected the statement suggesting that alcohol consumption protects against oral cancer (as alcohol consumption is a recognized risk factor), and 82.6% acknowledged poor oral hygiene as a causal factor. Moreover, 73.9% now believe that oral cancer is not an incurable disease, while 100% indicated that it can be detected early, and 95.7% recognized that early detection improves the chances of successful treatment and recovery (Table 1).

Table 1. Participants' knowledge and attitudes regarding oral cancer: initial, at 2 weeks, and 4 weeks after app use

Question	Initial			2 weeks			4 weeks		
	Yes *n* (%)	No *n* (%)	NS *n* (%)	Yes *n* (%)	No *n* (%)	NS *n* (%)	Yes *n* (%)	No *n* (%)	NS *n* (%)
Have you heard of oral cancer?	7 (30.4)	16 (69.6)	-	23 (100)	-	-	23 (100)	-	-
Can tobacco use cause oral cancer?	18 (78.3)	3 (13.0)	2 (8.7)	23 (100)	-	-	23 (100)	-	-
Does alcohol consumption protect you from developing oral cancer?	1 (4.3)	11 (47.8)	11 (47.8)	-	18 (78.3)	5 (21.7)	-	20 (87.0)	3 (13.0)
Is poor oral hygiene a cause of oral cancer?	14 (60.9)	1 (4.3)	8 (34.8)	18 (78.3)	-	5 (21.7)	19 (82.6)	-	4 (17.4)
Do you believe that oral cancer is an incurable disease?	9 (39.1)	7 (30.4)	7 (30.4)	4 (17.4)	14 (60.9)	5 (21.7)	3 (13.0)	17 (73.9)	3 (13.0)
Do you believe that oral cancer can be detected early?	21 (91.3)	-	2 (8.7)	22 (95.7)	-	1 (4.3)	23 (100)	-	-
Do you think that early detection of oral cancer can improve the chances of a cure?	18 (78.3)	1 (4.3)	4 (17.4)	20 (87.0)	-	3 (13.0)	22 (95.7)	-	1 (4.3)
Do you know what an oral self-examination is?	-	23 (100)	-	20 (87.0)	3 (13.0)	-	23 (100)	-	-

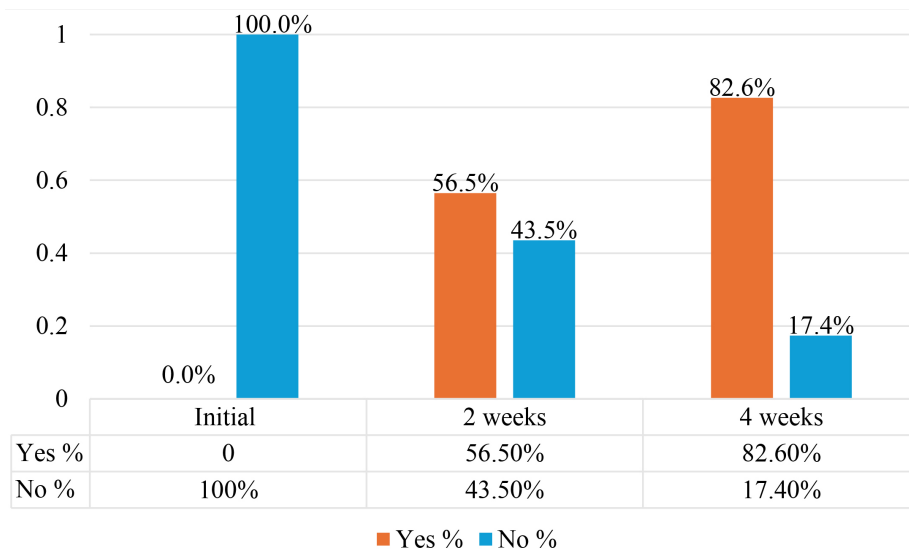NS: I don't know or I'm not sure; -: the value is zero

Figure 3. Practice of oral self-examination: initial, 2 weeks, and 4 weeks after app use. Question: Have you ever performed an oral self-examination

Conclusions

This study highlights the promising potential of the TEGO® app, which combines educational videos and serious gaming elements, in raising oral cancer awareness among older adults in Chile. At the outset, participants demonstrated limited knowledge about oral cancer and the importance of self-examination. However, after using the app, there was a marked improvement in awareness and engagement, with many participants recognizing the signs of oral cancer and adopting self-examination practices. The app also enhanced understanding of oral cancer risk factors and helped shift perceptions regarding the disease's treatability. These results emphasize the value of mobile health technologies in improving health education and promoting preventive behaviors in older adults. Future studies should explore the long-term effects of this intervention on health outcomes, particularly in terms of knowledge retention, attitudes, the sustained ability to perform self-examinations over extended periods, and whether individuals continue performing them consistently over time.
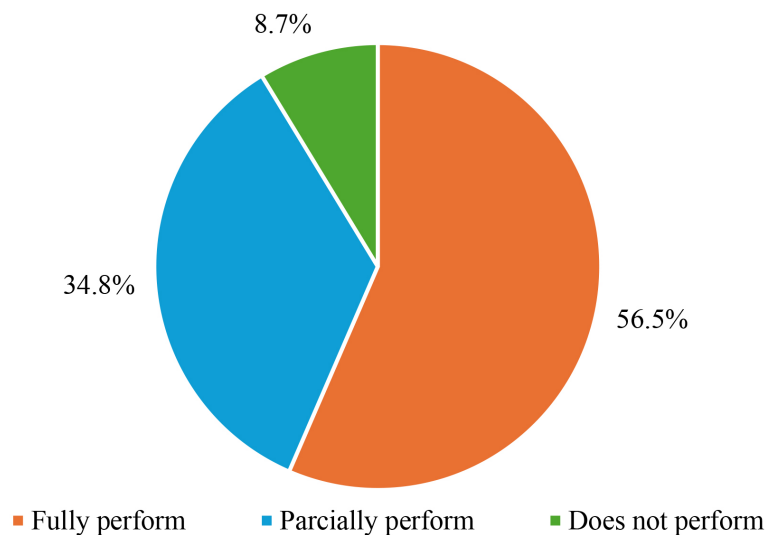
Figure 4. Evaluation of the performance of oral self-examination at 4 weeks of using the application

Abbreviations

app: mobile application

Supplementary materials

The supplementary table for this article is available at: https://www.explorationpub.com/uploads/Article/file/101139_sup_1.pdf.

Declarations

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There is no third-party involvement in the development process of the software except the authors.

Author contributions

CBMG, ILES, LLN, and VB: Conceptualization, Investigation, Writing—original draft, Writing—review & editing. AHvM, MCB, XML, MACO, JAG, ACPL, RAG, and SL: Validation, Writing—review & editing, Supervision. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

This research is part of the project "Development and implementation of a mobile application to promote prevention and oral health education interventions in older people in an integrated network of universities of the Council of Rectors of State Universities of Chile" which was approved by the Scientific Ethics Committee of "Universidad de la Frontera" and the reference number is 175-23, November 2023.

Consent to participate

Informed consent to participate in the study was obtained from all participants.

Consent to publication

Not applicable.

Availability of data and materials

The data cannot be shared due to the protection of private information of the participants of the study, requested by the scientific ethics committee.

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