

## Comparison of the Effectiveness of a Mobile Phone-based Education Program in Educating Mothers as Oral Health Providers in Two Regions of Saudi Arabia

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### INTRODUCTION

The concept of teledentistry or the provision of care to patients using telephone-based care is not new, and recently, there has been evidence of the success of this form of dentistry in the provision of preventive oral health care to children and their parents.<sup>[1-5]</sup> The advent of the digital age has also seen the creation of web-based programs and interventions to promote oral health care.<sup>[6]</sup> The Kingdom of Saudi Arabia is the largest country in terms of area in the Arab world. Geographic as well as cultural factors make the effective dispersion of auxiliaries for oral health education in remote areas of the Kingdom difficult.<sup>[7,8]</sup> Saudi Arabia has one of

### ABSTRACT

**Aims and Objectives:** The penetration of mobile phone devices is widespread across the Kingdom of Saudi Arabia. Recently, there has been evidence of the success of phone-based applications in the provision of preventive oral health care to children and their parents. The aim of this study was to compare the effectiveness of a mobile phone-based application in educating mothers of children aged below 6 years of age in preventive dental care.

**Materials and Methods:** A mobile phone-based application (iTeethey™) was developed for iPhone and Android and made freely available on Google Play and App Store. The application was then distributed to 3879 mothers of children below 6 years of age (1989 in Riyadh Region and 1890 in Najran region). The mothers were subjected to a standardized knowledge attitude and practice of oral hygiene questionnaire before being asked to download the application. A total of 1055 mothers who downloaded the application completed 3-month recall process.

**Results:** Significant improvement in the knowledge of the mothers was reported after the use of the application from both regions. The mothers from Najran showed significantly greater improvement in knowledge when compared to the mothers from Riyadh region. The application was also more effective in mothers with more than one child when compared to first-time mothers.

**Conclusion:** Within the limitations of this study, we can state that the mobile phone application used in this study significantly improves the knowledge of mothers toward their child's oral health.

**KEYWORDS:** Mobile phone apps, oral health promotion, teledentistry

the fastest growing internet consumption rates in the world,<sup>[9]</sup> which has led some authors to suggest that electronic dental health is not only applicable but also inevitable in Saudi Arabia.<sup>[10]</sup>

The role of the mother in the overall health of the child is well recognized, and over the past two decades, there

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have been several studies examining the extension of this concept to children's oral health.<sup>[11-13]</sup> Research in the field of pediatrics has led to the creation of the concept of "medical home" and later the concept of "dental home" which stress on parental education and early diagnosis and early intervention to provide comprehensive oral health care to children.<sup>[14,15]</sup> The conventional "dental home" concept relied on areas such as schools and community centers where children and their parents could interact first hand with either dentists or trained dental auxiliaries.<sup>[16,17]</sup>

Early childhood caries (ECC) is defined by the American Academic Pediatric Dentistry (AAPD) as the presence of one or more decayed, missing, and filled teeth before 71 months of age (AAPD). The prevalence of ECC in Saudi Arabia is >90% and has remained so for over 20 years,<sup>[18,19]</sup> making early diagnosis and prevention of ECC an important public health need. There have been several papers in the past decade that have shown that the lack of maternal education has been one of the key reasons for the spread of ECC.<sup>[20-23]</sup> This risk when combined with geographic and socioeconomic barriers to health-care results in clearly observable deterioration of oral health and increased rates of ECC.<sup>[24-28]</sup>

Recently, Assery (2015), in a study conducted in Riyadh City demonstrated that the mothers were able to detect dental caries and if given the right education, could serve as effective screeners of oral health-care needs in Saudi Arabia. There is, however, not much research on the effectiveness of mobile phone-based preventive strategies in training mothers in recognizing dental caries early and seeking timely dental intervention. The aim of this study was to compare the effectiveness of a mobile phone-based application in educating mothers of children aged below 6 years of age in preventive dental care.

## MATERIALS AND METHODS

The study was carried out between June 2015 and December 2016. This study was registered, and ethical approval was obtained from the research center of Riyadh Colleges of Dentistry and Pharmacy. The study was assigned the registration number FPGRP//43435005/126. Informed consent was obtained electronically from all users of the application who participated in the study.

## SAMPLE SIZE AND SELECTION

The sample comprised mothers of children aged below 71 months of age reporting to a pediatric primary care center. The sample power required for an alpha of 0.05 with 95% confidence interval was 500 participants. However, no limit was set on the maximum number of responses. To achieve a good response rate, applications were distributed throughout the Department of Pediatrics

and Neonatal Care at primary health centers of the Ministry of Health at Riyadh and Najran.

## DEVELOPMENT OF THE APPLICATION

An account was made on an online web-development platform, and an application was developed which provides information about the oral health care for children from infancy to 6 years of age. The application also provided information for expecting mothers. The application (iTeethey™) was developed using information on early childhood oral health care and based on the guidelines and recommendations of the AAPD (2013).

The application had home pages in English and Arabic and was hosted on both the App Store (<https://itunes.apple.com/us/app/iteethey/id1051796708?mt=8>) for users of iPhones (Apple Inc. Cupertino CA, USA) and the Google Play Store (<https://play.google.com/store/apps/details?id=com.app.p6386GB>) for users of phones running the Android™ platform (Google Corp., San Jose, CA, USA) [Figure 1].

All participants were sent a reminder 3 months after the initial test to reevaluate the knowledge scores to monitor the retention of the knowledge among mothers.

## LOCATION OF SAMPLE

The sample comprised two groups: Group A comprised mothers in Riyadh city, ArRiyadh Region, whereas Group B comprised mothers in Najran city, Najran Region. Although the minimum sample size was 500, there was no limit set on the number of participants. The apps were distributed to a total of 3879 mothers who presented at eight different primary health-care centers



Figure 1: Home page and Arabic page of the application

(three in Riyadh and five in Najran). Responses of those participants who are unable or unwilling to complete the tool were recorded to assess the applicability of the tool in the Saudi Population. All mothers having at least one child >6 years of age who agreed to participate in the study were included in the study. Consent of the parent was established electronically through an online user agreement. Mothers who had a medically compromised child were excluded from the study.

**DATA COLLECTION**

To rule out any potential bias arising from the inability to use electronic devices, the mothers were asked to complete a previously validated Arabic tool designed to test their knowledge of their child’s oral health (Farsi et al., 2013). The mothers were followed up for usage statistics using the online data usage statistics (http://applicius.com/) and reminders were sent after 3 months only to those mothers whose data usage statistics were positive (had used the application at least once in the past 3 months). The mothers who responded were then asked to complete the same validated Arabic language tool.

**STATISTICAL ANALYSES**

The SPSS (IBM Corp, Armonk NY, USA) version 21 data processing software was used for all analyses, and the level of significance for all tests was set at  $P < 0.05$ .

**RESULTS**

A total of 3879 mothers were given the link to the mobile phone application of whom 1055 mothers downloaded the application. Of these, a total of 616 mothers in Riyadh and 439 mothers in Najran completed the follow-up. Although there were more mothers who completed the follow-up in Riyadh when compared to Najran, Chi-square test showed that the differences were not statistically significant ( $P = 0.091$ ). This final set comprised 71 first-time mothers and 545 mothers with more children in the Riyadh region and 96 first-time mothers and 343 mothers with more than one child in Najran region.

The average age of the mothers ranged from 18 to 42 years with a mean age of 28.09 years. The mean monthly income of the sample studied was 13,521 Saudi Riyals (SR) per month and ranged between 3494 SR and 23,000 SR [Table 1]. The sample comprised both working mothers and mothers who stayed at home. When the overall impact of the mobile application was evaluated using the paired sample *t*-test, it was observed that there was a significant improvement in the maternal knowledge 3 months after using the application [Table 2]. Then, the effect of the region was evaluated; it was observed that significant improvements in the knowledge were observed in both Riyadh and Najran regions [Table 3].

It was observed that the mothers in Riyadh had a greater improvement in their knowledge when compared to mothers in Najran. The *t*-test showed that these differences were significant at  $P < 0.05$  [Table 4].

When the impact of the different factors influencing the change in the knowledge score of the mothers was evaluated using a linear regression model, it was observed that only the region and the number of children in the family had a significant impact on the score. The occupation of the mother, age of the mother, or the income of the family did not significantly influence the change in oral knowledge of the mothers [Table 5].

**DISCUSSION**

The internet and mobile phone technology have changed the way we live life in the 21<sup>st</sup> century.<sup>[29]</sup> While the use of

**Table 1: Age and monthly income of the mothers in the study**

	Age of mother		Income	
	Mean	SD	Mean	SD
Region				
Riyadh-Urban	28.18	3.45	14,210.23	3561.09
Najran-Rural	28.05	3.82	13,333.71	3494.73
Total	28.12	3.61	13,845.50	3558.31

SD=Standard deviation

**Table 2: Mean knowledge score of the mother before and after using the application**

	Mean	SD	t	Significant
Pair 1				
Knowledge score before app	7.5839	1.60949	-4.232	<0.001**
Knowledge score after the app	14.6227	1.76618		

\*Calculated using the paired *t*-test, \*\*Differences significant at  $P < 0.001$ . SD=Standard deviation

**Table 3: Improvement in the knowledge of the mothers before and after the application in Riyadh and Najran regions**

	Mean improvement in score	SD	Significant*
Riyadh-Urban	7.19643	2.60120	<0.0001**
Najran-Rural	6.81777	1.97786	<0.0001**

\*Calculated using the paired *t*-test, \*\*Differences significant at  $P < 0.001$ . SD=Standard deviation

**Table 4: Comparison of the improvement of knowledge between the mothers in Riyadh region and those in Najran region**

Region	n	Mean	SD	t	Significant*
Change in score Riyadh-Urban	616	7.1964	2.60120	2.567	0.01**
Change in score Najran-Rural	439	6.8178	1.97786		

\*Calculated using the independent *t*-test, \*\*Differences significant at  $P < 0.05$ . SD=Standard deviation

**Table 5: Linear regression model of factors that can influence the improvement of maternal knowledge after use of the application**

Model	Coefficients <sup>a</sup>			t	Significant
	Unstandardized coefficients		Standardized coefficients		
	B	SE	Beta		
Model 1					
Constant	8.746	0.767		11.406	0.000
Age of mother	-0.047	0.032	-0.072	-1.496	0.135
Number of children	0.173	0.083	0.099	2.084	0.037
Occupation	0.042	0.147	0.009	0.287	0.774
Income	-2.296E-5	0.000	-0.034	-1.089	0.276
Region	-0.450	0.151	-0.094	-2.988	0.003

<sup>a</sup>Dependent variable: Change in score. SE=Standard error

the internet in bringing in new ideas is well recognized, it must be remembered that the internet can also serve as a mean to improve the life of individuals within an existing social structure.<sup>[6]</sup> The difficulty women face in being able to come to the dentist was the reason to develop an application that would allow mothers to interact virtually with their dentist. Saudi Arabia is a technologically advanced society with recent literature documenting an active use of the internet, mobile phones, and social media.<sup>[30]</sup> There is also evidence to suggest that online medical advice and “e-health” are feasible in the social and cultural framework of Saudi society.<sup>[9,30,31]</sup>

Saudi Arabia is the largest country by land area in the Gulf region, and the difficulties in providing health care to such a vast population have been previously documented.<sup>[7]</sup> It has been suggested that the development of an electronic health-care system may help overcome the challenges posed by the vast geographic expanse of the Kingdom.<sup>[10]</sup> One of the objectives of developing a phone-based application was to explore the possibility of using this technology to overcome physical and logistical barriers toward providing preventive dental care. The fact that the application was able to bring about an increase in the knowledge of both first-time mothers and the mothers with more than one child was a positive factor. These results are in keeping with other studies that have documented the success of mobile phone-based applications in the promotion of breastfeeding and maternal health.<sup>[29,32]</sup> Based on these results, the application was distributed in the rural and semi-urban parts of Najran region.

Although the response rates in Riyadh were higher than those seen in Najran, it was interesting to note that no statistically significant difference existed between the two regions. The fact that less than one-third of the mothers who were given the application downloaded it

and completed the study period is one of the limitations of the use of such mobile phone technology. However, this acceptance rate is similar to those observed for other new technologies used in health promotion<sup>[6,29]</sup> and can be considered to be promising.

The baseline oral health knowledge of mothers in Riyadh was significantly higher than the knowledge of those in Najran. This finding is in keeping with studies from across the world that have shown that mothers in cosmopolitan areas with easy access to dental care have significantly better knowledge of their child’s oral health problems.<sup>[18,33]</sup> Interestingly, the use of the application resulted in significant improvements in maternal knowledge of oral health conditions in both regions. The significant improvement in the oral health knowledge in Najran seems to suggest that the use of technology can greatly improve the effective communication of oral health education in areas where there is a documented shortage of trained public health professionals.<sup>[7]</sup>

The decision to base the study in the pediatrics clinics was inspired by several findings in Western countries that have shown the pediatrician to be an effective communicator of oral health goals.<sup>[17,34]</sup> There are significantly greater number of pediatricians and infant health care centers in Saudi Arabia in comparison to dental centers, thus making the provision of preventive dental care through such centers an attractive proposition.<sup>[7]</sup> However, the traditional method of oral health education lectures is time consuming and requires a full-time oral health professional to be stationed in the center.<sup>[35]</sup> This study shows that it is possible to overcome those challenges through the use of technology.

Apart from the region, it was observed that the other significant predictors of the success of the application were the number of children in the family. We found a significant positive association between the number of children in the family and the change in the knowledge score. This suggests that mothers with more than one child in the family are more receptive to the application. These findings are in keeping with studies that have shown that awareness of oral health problems increases in mothers with more than one child.<sup>[13,36]</sup> Furthermore, we found no significant association between the age of the mother and the improvement of the dental knowledge of the mother. This finding is in keeping with a recent study done in Saudi Arabia that has shown that mothers of all ages can be effective screeners for their children’s oral health.<sup>[37]</sup> This seems to suggest that the technology is not age bound. Both these factors are in keeping with evidence from psychological literature that shows that the presence of a “felt need” is the most important factor for influencing a change in a health-related behavior.

The internet revolution has been particularly strong in Saudi Arabia, with data showing that Saudis use one of the highest per capita internet bandwidth in the world.<sup>[10]</sup> The popularity of social media and the vast reach of “smartphones” could explain the effectiveness of the application in promoting oral health. This study goes beyond existing studies on web-based tools<sup>[6,29]</sup> and shows that unlike web-based tools, mobile phone applications are not restricted by the constant availability of internet or the need for a computer.

The sample size achieved in this study though not representative of the entire Kingdom can be thought to adequately represent two distinct cultural domains. The fact that this application had the same acceptability in a cosmopolitan center such as Riyadh as in a semi-urban, largely Saudi region such as Najran emphasizes the potential for mobile phone applications to cross cultural barriers.

## CONCLUSION

Within the limitations of this study, we can state that the mobile phone application used in this study significantly improves the knowledge of mothers toward their child's oral health.

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Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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