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Digital public health interventions for periodontitis and endodontic pain awareness using mobile app with social media campaigns in India

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Abstract:

Digital health technologies such as mobile applications assist in educating the public health. Therefore, it is of interest to assess the effectiveness of mobile app-based awareness, knowledge, attitudes and preventive practices regarding periodontitis and endodontic pain among adults in India. Hence, 2000 subjects randomly assigned to three groups: mobile app intervention, social media campaign and control. The outcome assessment was done using Knowledge Attitude Practice (KAP) questionnaire. Thus, structured digital platforms can be effective in promoting periodontal awareness and preventive behaviours.

Keywords: Periodontitis awareness, digital health, mobile app, social media, preventive dentistry, oral hygiene behaviour, India

Background:

Periodontitis is one of the most common chronic inflammatory diseases of dental supporting tissues. It has been recognized as one of the main causes of tooth extraction, loss of functions and low oral health-related quality of life at the global level. The disease has created a heavy burden on the health care facilities and the population, mainly in those developing countries where the level of knowledge of periodontal health is still very low. Over the past few years, digital transformation of healthcare has created new opportunities for disease prevention, health promotion and patient engagement via mobile health technologies, artificial intelligence (AI), telehealth systems and social media platforms. The awareness of AI applications among periodontal practitioners is increasing, indicating an improved acceptance of digital technologies as adjuncts to preventive and therapeutic periodontal care [1]. Endodontic or tooth pain is common in patients following pulpal involvement due to dental caries. Hence prevention of dental caries and dental plaque with proper oral management is necessary. Mobile applications and social media platforms have become powerful tools for effecting health behaviour change and engaging patients. Evidence shows that digital interventions may have a positive effect on oral hygiene compliance, treatment adherence and preventive practices in dental patients [2]. In addition, the growing exposure of dental students to AI-based technologies reflects the readiness of the future oral health care workforce to accept advanced digital solutions in clinical and public health settings [3]. More recently, systematic reviews and meta-analyses have further confirmed that mobile applications and social media-based interventions can result in substantial behavioral changes,

thus supporting their integration into preventive oral healthcare programs [4]. The combination of AI and health platforms has broadened the horizon of periodontal disease prevention beyond traditional educational approaches. Recent randomized trials have shown that the combination of AI-enabled multimodal sensing toothbrushes with tailored mobile health messages can significantly improve periodontal health outcomes and patient compliance [5]. Similarly, the introduction of predictive, preventive, personalized and participatory (P4) medicine principles into teledentistry and health systems has been suggested as a revolutionary approach for enhancing oral and periodontal healthcare delivery [6]. Smartphone based telemonitoring systems have also been proven to produce promising results in improving oral hygiene performance through continuous behavioral reinforcement and remote monitoring capabilities [7]. Current periodontal therapy still involves a major role of preventive procedures and lifestyle modification is still identified as an important determinant of periodontal health. Behavioral interventions have been shown in clinical studies to affect gingival inflammation and oral health outcomes, emphasizing the significance of preventive public health strategies [8]. Furthermore, there is growing academic interest in the effectiveness of interventions through mobile applications to improve periodontal health, indicating an increasing recognition of digital technologies as powerful tools for prevention [9]. Social media has come a long way. Now is a good way to talk about health care. It allows people to pass information and gives doctors a direct line to the public. Today, many periodontists view the media as a great tool to communicate with peers, educate patients and raise awareness

about dental health [10]. Several clinical studies have shown that the use of apps during periodontal therapy can be very helpful. These Apps not only help to improve the results, but also help patients to understand how to brush better and improve their hand skills to maintain oral hygiene [11]. Digital devices have also made it possible for people to monitor their health at home. There are even web-based apps that are made to measure plaque. These web apps do work great. Are easy to use, which allows patients to take a real part, in oral health monitoring [12]. Likewise we have seen innovative image based assessment methods such as Selfie Dental Plaque Index give ways to check plaque from far away and encourage people to care themselves [13]. Population based online surveys continue to demonstrate a lack of awareness and knowledge about disease, implying the need for new educational methods that can reach large numbers of people in a short time [14]. Identification of environmental factors contributing to periodontal disease is equally important for good public health planning. Research on how new lifestyle habits influence disease has enlightened us to the nature of risk and progression [15]. Up to now, research about patient-focused oral hygiene apps have showed a wide variation in the quality of content and evidence base, underlining the importance of science-based digital resources [16]. To address problems with understanding health some helpful digital programs have been created. These programs aim to improve what people know how they feel and the actions they take to keep their mouths healthy. These kinds of programs show that digital tools can help close the gap in learning and make it easier for people to understand health information [17]. More people are using video sites, which has changed how oral health information is shared. Studies of education content, on social media show both the good things and the hard parts of using digital tools to talk about health [18]. Today, gum health programs are beginning to understand the importance of preventing problems. This benefits the health of the mouth as well as the rest of the body [19]. Concomitant advances in robotics and artificial intelligence have resulted in an increasing interest in the dental community where many practitioners consider digital technologies as helpful tools to educate about oral health and to reach the public [20]. Also studies on knowledge, attitude and practice on teledentistry in periodontics have shown support for electronic devices as effective adjuncts to usual diagnosis, consultation and preventive care delivery [21]. Therefore, it is of interest to assess the effectiveness of digital public health interventions in improving awareness, knowledge, attitudes and preventive practices related to periodontitis and endodontic pain among individuals in India.

Materials and Methodology:

This study was a community-based randomized controlled trial to see if digital health tools actually worked. We wanted to find out if digital public health interventions could help people in India learn more about periodontitis. Specifically we looked at how digital public health interventions change awareness, knowledge, attitudes and preventive practices regarding periodontitis and endodontic pain. Our plan used two ways to

teach people. One way was an application-based educational program. The other way was a media-driven health promotion campaign. We compared these two methods, against a control group. The control group only received non-interactive oral health information. The study was conducted over a predefined follow-up period and assessments were carried out at baseline after the intervention and during follow-up to evaluate both short-term and sustained behavioural outcomes. We carried out this study in cities and small towns across India. To make sure we reached people from all walks of life we used both ads and went out into local communities to find participants. We shared our study materials through smartphone apps and social media platforms so that it would be easy for everyone to join in. The people in our study were between 18 and 60 years old. Every person in the study had his/her own smartphone with internet access. Individuals who were getting periodontal and endodontic treatment healthcare update were not included in the study. The sample size was worked out using the formula for comparing two proportions, in studies that test interventions. This used a $Z_{\alpha/2}$ value of 1.96 which matches a 95% confidence interval and a Z_{β} value of 0.84 which matches 80% power. We figured out the numbers for the proportions P1 and P2 by looking at our pilot data and some old studies, about digital oral health intervention studies. We expected that the oral health intervention studies would improve awareness and behavior by 10 to 15 percent. We also made sure to account for people dropping out of the study and the design effect. Because of this we need 2000 participants in total. We divided the 2000 participants into three groups to make the results fair and reliable. We used a computer based allotment of the grouping. Group A will use the mobile application intervention. Group B will follow the media based campaign intervention. Group C will be the control group. To keep things fair and avoid any selection bias we used sealed envelopes. Secure digital randomization software to hide the allocation. The mobile application intervention gave people health education. The mobile application intervention included modules, daily oral hygiene reminders and visual demonstrations of brushing and interdental cleaning techniques. In our study we also added feedback features that worked well. The mobile application intervention had progress tracking systems to help people stick to habits. For the media intervention we shared content on platforms, like WhatsApp, Instagram and YouTube. The social media intervention included info graphics on disease prevention and short educational videos. We also sent out awareness messages and interactive quizzes. The social media intervention used behavioral reinforcement strategies to help people improve hygiene practices. The control group received oral health education. That meant the control group got pamphlets or PDF-based informational material and the control group did not get any interactivity or reinforcement components. To check our results we used a Knowledge, Attitude and Practice (KAP) questionnaire (Table 1 and Table 2). This Knowledge, Attitude and Practice (KAP) questionnaire asked about things like details how much people knew, their feelings, on a scale and how they actually act. Our main goal was to see if periodontitis awareness

and endodontic pain scores and Knowledge, Attitude and Practice (KAP) scores changed. We also looked at things as if people changed how they clean their teeth if they used digital platforms more and if they still remembered what they learned during the follow-up. We gathered data at three points. First we took data before we started the intervention. Second we took data right after the intervention ended. Finally we did follow-up assessments, between 4 and 12 weeks later depending on what the study needed and what worked best for the research. The data that collected was entered into software called IBM SPSS Statistics version 26 or higher. Then the data was examined using statistics such as average value, measure of spread count of how many times an event happened and rate or proportion of people or items that have a certain attribute. To get information the analysis used some extra assumptions. Two measures of location were used: one is the median the other is the mean for a set of values. For group data paired and unpaired, within group paired t-tests were used. Two independent t-tests and ANOVA were used to compare groups. Chi-square tests were used for variables. Multivariate regression analysis was used to control for confounding factors. Approval, from the Ethics Committee of the Institution was obtained before data collection began. The research was carried out following the code of ethics as stated in the Declaration of Helsinki. The enrolment of the participants was performed after participants gave written consent; written consent was obtained after participants were fully explained the objectives of the study the procedures to be used the possible advantages and the fact that participation was voluntary. During the duration of the study the confidentiality of participant details and data privacy was strictly maintained and all data gathered was used only for educational and research purposes. The overall study flow began with screening followed by an eligibility assessment, the collection of informed consent, a baseline KAP evaluation. This process led to the interpretation of outcomes and conclusions about the effectiveness of public health interventions, for periodontitis and endodontic pain awareness.

Results:

A total of 2000 participants were. Divided evenly into three groups: Mobile App Intervention Group (n = 667) Social Media Campaign Group (n = 667) and Control Group (n = 666). I notice that baseline demographic characteristics were comparable across all groups and no significant differences were seen ($p > 0.05$) which confirms that randomization worked well. Baseline demographic and clinical characteristics of participants were balanced across the three study groups indicating that randomization was successful and that the groups were homogeneous, before the intervention. We see that the mean age of participants was close among the app group (34.8 ± 10.6 years) the social media group (35.1 ± 10.2 years) and the control group (34.9 ± 10.4 years). No significant difference was found among the mobile app group, the media group and the control group ($p = 0.87$). We observe that the gender ratio was almost equal with males making up 52.1% of the mobile app group 51.4% of the social media group and 53.0% of the control group ($p = 0.91$).

Finally we notice that the percentage of people living in areas was similar across the mobile app group, the social media group and the control group at 61.3% for the mobile app group 60.7% for the social media group and 59.9%, for the control group ($p = 0.78$). Daily smartphone usage stayed high in every group. The mobile app group had 92.4% usage the social media group had 91.8% usage and the control group had 92.0% usage. These usage levels were similar with no difference ($p = 0.95$). Baseline oral hygiene compliance was also similar across the groups with 41.2% compliance in the mobile app group 40.6% in the media group and 41.0% in the control group ($p = 0.89$). In general no baseline variable showed a difference. Therefore the study groups were well matched before the intervention as shown in **Table 3** and **Table 4**. The data indicate a significant improvement in overall Knowledge, Attitude and Practice (KAP) scores, after the intervention. This improvement was seen in both intervention groups when compared with the control group. In the mobile application group the average KAP score went up from 46.2 ± 8.4 at the beginning to 78.9 ± 7.1 after the program. This was a change of +32.7 and the change was very statistically significant ($p < 0.001$). In the way the social media group had a big improvement. The average KAP score started at 45.8 ± 8.7 and went up to 72.4 ± 7.9 . The change was +26.6. This was also strongly statistically significant ($p < 0.001$). However the control group only had an increase. The average KAP score went from 46.0 ± 8.5 to 51.3 ± 8.2 . The change was +5.3. This was statistically significant but not very big, in real life ($p = 0.04$). On comparing the -intervention KAP scores between groups, a very significant difference was found among the three groups as shown by one-way ANOVA ($F = 214.6$ $p < 0.001$). This shows that the digital interventions worked better than the standard oral health information. Overall the mobile application-based intervention had the improvement. The control group had little improvement. This shows that digital public health strategies are much better, at improving awareness and preventing problems. Between-group comparison (post-intervention) shows that, $F = 214.6$ and $p < 0.001$. At the start of the study no significant differences were found, which means that the groups were similar. Both digital interventions raised KAP scores a lot more than the control. The group that used the app had the biggest improvement. There was a rise in all parts of Knowledge, Attitude and Practice (KAP) scores after the intervention for both experimental groups and these rises were bigger than those seen in the control group. In the Knowledge domain, which uses a 0-20 scale the mobile application group jumped from 9.8 ± 2.1 at the beginning to 17.6 ± 1.8 after the intervention. An increase of +7.8 and is highly statistically significant ($p < 0.001$). The Social media group also rose sharply going from 9.7 ± 2.0 , to 16.2 ± 1.9 an increase of +6.5 and this change is also highly statistically significant ($p < 0.001$). We noted that the control group exhibited a small change moving from 9.9 ± 2.2 to 10.8 ± 2.1 and this shift was not statistically significant ($p = 0.08$). Within the attitude domain (0-20 scale) we saw the mobile application group climb from 15.2 ± 2.4 to 18.3 ± 1.6 a gain of +3.1 ($p < 0.001$). Also the social media group rose from 15.1 ± 2.3 to 17.5 ± 1.7 marking an improvement of +2.4 ($p < 0.001$). More

the control group displayed a negligible change shifting from 15.3 ± 2.5 to 15.6 ± 2.4 and this difference was not statistically significant ($p = 0.21$). Turning to the practice domain (0-20 scale) the mobile application group achieved the improvement jumping from 10.5 ± 2.7 to 17.2 ± 2.0 a gain of $+6.7$ ($p < 0.001$). The social media group likewise recorded an improvement moving from 10.4 ± 2.6 , to 15.8 ± 2.2 an increase of $+5.4$ ($p < 0.001$). In comparison the control group showed a slight change from 10.6 ± 2.8 to 11.2 ± 2.6 and the control group change was not statistically significant ($p = 0.09$). Overall the digital intervention strategies were more effective than oral health information at improving periodontal awareness and preventive behaviour. The mobile application approach had the impact across all measured domains (Table 5). A significant improvement, in overall Knowledge, Attitude and Practice (KAP) scores was observed in both intervention groups compared to the control group ($p < 0.001$). The mobile application group showed the improvement in every area especially in knowledge and in how people practiced oral hygiene. Social media-based interventions also led to betterment in behaviour. The amount of change was smaller than what was seen in the mobile application group. The control group had a small improvement and that improvement was not statistically significant in most areas. A comparison between groups using one-way ANOVA showed a significant difference in the KAP scores after the intervention among the three groups ($F = 214.6$ $p < 0.001$). Digital interventions are useful for raising awareness about health and encouraging preventive behaviour. In this randomized controlled trial the data show that structured digital interventions truly make a difference. They improve awareness and preventive behaviours more than regular education does. The mobile app group saw increases in every area. Their mean KAP score rose by $+32.7$ indicating that the mobile app group gained a lot of knowledge an attitude and improved oral hygiene practices. The social media campaign group also performed well with an increase of

$+26.6$. The social media campaign group did not progress as much, as the mobile app group. The control group only changed a little bit with a $+5.3$ increase. This shows that just giving people information that they cannot interact with does not work very well. These results show that interactive and personal mobile health platforms are much better at helping people stick to health habits. Social media campaigns are still good for spreading awareness to people at once but they are not as strong, as apps. All of this shows how much digital public health strategies can change the way we fight periodontitis in India (Figure 1). Looking at the graph it is clear that the mobile app intervention worked better than the social media campaign and the control group in every area. In the knowledge domain people who used the app intervention saw the biggest jump in scores reaching about 82 percent. The mobile app intervention really helped people understand what causes gum disease and how to stop it. In the attitude domain the mobile app intervention was not behind with scores around 80 percent. The mobile app intervention helped people feel motivated and more trusting of health tools. Finally in the practice domain the mobile app intervention showed changes in how people act with scores, around 74 percent. This shows that the mobile app intervention helped people follow their hygiene routines better. We found that the social media group also improved with knowledge at 76 percent attitude at about 73 percent and practice at about 68 percent. These improvements were still lower than the improvements from the app-based method. We saw that the control group remained the same in all areas with 50 percent showing that non-interactive education does not make much difference. A statistical analysis, using ANOVA with an F value of 214.6 and a p value than 0.001 confirms that the differences are real. This shows that structured interactive digital interventions provide results for awareness and, for preventive practice.

Table 1: Outcome Assessment Tool - Knowledge, Attitude and Practice (KAP) Questionnaire Structure

Domain	Number of Items	Scale Used	Raw Score Range	Converted Score Range	Scoring Method	Description of Assessment
Knowledge	10 items	Multiple choice / Yes-No	0-10	0-20	Correct = 1, Incorrect = 0; total multiplied $\times 2$ for standardization	Assesses awareness regarding periodontitis causes, symptoms, risk factors, prevention and oral hygiene practices
Attitude	5 items	5-point Likert scale	5-25	0-20	Raw Likert score standardized to 0-20 using linear conversion	Evaluates perception, beliefs, motivation and willingness toward periodontal health maintenance and digital intervention acceptance
Practice	5 items	Frequency-based Likert scale	5-25	0-20	Raw Likert score standardized to 0-20 using linear conversion	Measures actual oral hygiene behaviors including brushing frequency, interdental cleaning, dental visits and preventive habits
Total KAP Score	20 items	Composite scoring	10-60 (raw)	0-60 (standardized)	Sum of standardized Knowledge, Attitude and Practice scores	Overall combined index reflecting periodontal awareness and preventive behavioral status

Table 2: Structured Knowledge, Attitude and Practice (KAP) Questionnaire on Periodontitis Awareness and Prevention (Likert-Scale Based Tool)

Section	Q. No. / Variable	Item Statement / Variable	Response Scale	Format / Categories / Options
Knowledge Domain	K1	Periodontitis is a bacterial infection affecting gums and bone supporting teeth	Yes / No	Correct-Incorrect
	K2	Bleeding gums during brushing is a sign of gum disease	Yes / No	Correct-Incorrect
	K3	Poor oral hygiene is a major cause of periodontitis	Yes / No	Correct-Incorrect

	K4	Regular dental check-ups help in preventing gum disease progression	Yes / No	Correct-Incorrect	
	K5	Smoking increases the risk of periodontal disease	Yes / No	Correct-Incorrect	
	K6	Diabetes is associated with worsening periodontal health	Yes / No	Correct-Incorrect	
	K7	Periodontitis can lead to tooth loss if untreated	Yes / No	Correct-Incorrect	
	K8	Scaling and root planning is a treatment for gum disease	Yes / No	Correct-Incorrect	
	K9	Mobile apps can help improve oral hygiene awareness	Yes / No	Correct-Incorrect	
	K10	Social media campaigns can improve dental health knowledge	Yes / No	Correct-Incorrect	
	K11	Untreated tooth decay can result in tooth/endodontic pain	Yes / No	Correct-Incorrect	
	K12	Dental caries can be prevented by minimising sweet consumption and oral hygiene maintenance	Yes / No	Correct-Incorrect	
	K13	Endodontic pain can be managed by root canal treatment	Yes / No	Correct-Incorrect	
	K14	Initial carious lesions can be restored to preserve tooth structure	Yes / No	Correct-Incorrect	
Attitude Domain	A1	I believe gum disease is a serious health problem	1-5 Likert	Strongly Disagree → Strongly Agree	
	A2	Maintaining healthy gums is important for overall health	1-5 Likert	Strongly Disagree → Strongly Agree	
	A3	I am willing to improve my oral hygiene practices	1-5 Likert	Strongly Disagree → Strongly Agree	
	A4	Digital tools can help improve my dental awareness	1-5 Likert	Strongly Disagree → Strongly Agree	
	A5	I trust health information received through mobile apps or social media	1-5 Likert	Strongly Disagree → Strongly Agree	
	A6	I believe tooth decay is a preventable disease	1-5 Likert	Strongly Disagree → Strongly Agree	
Practice Domain	P1	I brush my teeth twice daily	1-5 Frequency	Never → Always	
	P2	I use interdental cleaning aids (floss/interdental brush)	1-5 Frequency	Never → Always	
	P3	I visit a dentist regularly (at least once a year)	1-5 Frequency	Never → Always	
	P4	I follow oral hygiene instructions given by dental professionals	1-5 Frequency	Never → Always	
	P5	I use mobile apps or digital tools for health awareness	1-5 Frequency	Never → Always	
	P6	I will consult the dentist as soon as I see new decay	1-5 Frequency	Never → Always	
Demographic Profile	Age	Continuous (Years)	Recorded in completed years	Numeric	
	Gender	Male / Female / Other	Self-reported	Categorical	
	Marital Status	Single / Married / Other	Social status	Categorical	
	Educational Level	Primary / Secondary / Graduate / Postgraduate	Highest qualification	Categorical	
	Occupation	Student / Employed / Self-employed / Unemployed	Current working status	Categorical	
	Residence	Urban / Semi-urban / Rural	Place of living	Categorical	
Digital Access Profile	Smartphone Ownership	Yes / No	Availability of smartphone	Binary	
	Daily Internet Use	<1 hr / 1-3 hrs / >3 hrs	Average daily use	Ordinal	
	Social Media Use	Yes / No	WhatsApp, Instagram, YouTube	Binary	
	Previous Use of Health Apps	Yes / No	Prior exposure	Binary	
	Baseline Oral Health Behaviour	Tooth Brushing Frequency	Once daily / Twice daily / Irregular	Oral hygiene behaviour	Ordinal
		Interdental Cleaning Aid Use	Yes / No	Floss/interdental brush	Binary
Last Dental Visit		<6 months / 6-12 months / >1 year / Never	Dental attendance history	Ordinal	
Self-reported Gum Bleeding		Yes / No	Gingival inflammation	Binary	
Smoking Status		Smoker / Non-smoker	Tobacco behaviour	Binary	
Tooth decay and pulpal involvement		Yes / No	Caries progression	Binary	
	In-between food/snacks	Yes / No	Dietary exposure	Binary	
	Sweet consumption/sugar exposure	Yes / No	Dietary exposure	Binary	

Table 3: Baseline demographic and clinical characteristics of participants

Variable	Mobile App (n=667)	Social Media (n=667)	Control (n=666)	p-value
Age (years, mean ± SD)	34.8 ± 10.6	35.1 ± 10.2	34.9 ± 10.4	0.87

Gender (Male %)	52.1%	51.4%	53.0%	0.91
Urban residence (%)	61.3%	60.7%	59.9%	0.78
Smartphone usage daily (%)	92.4%	91.8%	92.0%	0.95
Baseline oral hygiene compliance (%)	41.2%	40.6%	41.0%	0.89

Table 4: Knowledge, attitude and practice (KAP) scores before and after intervention

Group	Baseline KAP Score (Mean ± SD)	Post-intervention KAP Score (Mean ± SD)	Mean Change	p-value (within group)
Mobile App Group	46.2 ± 8.4	78.9 ± 7.1	+32.7	<0.001
Social Media Group	45.8 ± 8.7	72.4 ± 7.9	+26.6	<0.001
Control Group	46.0 ± 8.5	51.3 ± 8.2	+5.3	0.04

Table 5: Domain-wise questionnaire analysis (Knowledge, Attitude, Practice Scores)

Domain	Group	Baseline Mean ± SD	Post Mean ± SD	Improvement	p-value
Knowledge Score (0-20)	Mobile App	9.8 ± 2.1	17.6 ± 1.8	+7.8	<0.001
	Social Media	9.7 ± 2.0	16.2 ± 1.9	+6.5	<0.001
	Control	9.9 ± 2.2	10.8 ± 2.1	+0.9	0.08
Attitude Score (0-20)	Mobile App	15.2 ± 2.4	18.3 ± 1.6	+3.1	<0.001
	Social Media	15.1 ± 2.3	17.5 ± 1.7	+2.4	<0.001
	Control	15.3 ± 2.5	15.6 ± 2.4	+0.3	0.21
Practice Score (0-20)	Mobile App	10.5 ± 2.7	17.2 ± 2.0	+6.7	<0.001
	Social Media	10.4 ± 2.6	15.8 ± 2.2	+5.4	<0.001
	Control	10.6 ± 2.8	11.2 ± 2.6	+0.6	0.09

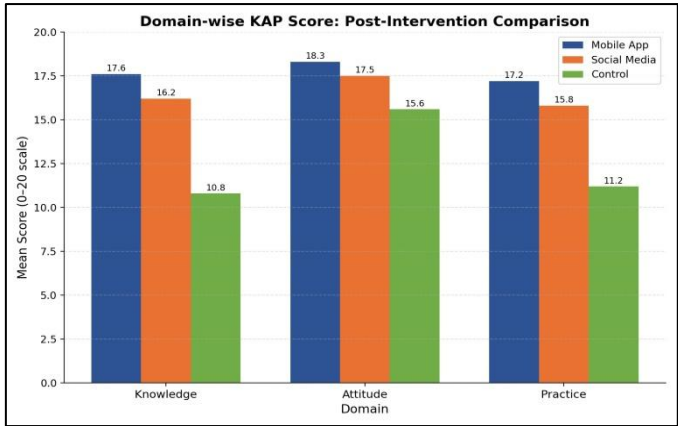


Figure 1: Domain-wise KAP comparison graph

Discussion:

This randomized controlled trial measured how well digital public health interventions could raise awareness about periodontitis boost knowledge, shape attitudes and encourage practices in an Indian community. The study compared three approaches: an application-based intervention, a social media campaign and a standard information control group. We checked to see how successful digital public health interventions were. The results show that both digital intervention strategies led to gains in KAP scores. The mobile application group achieved the overall improvement, followed by the social media group. The control group however showed a small increase. The rise in awareness and better behavioural outcomes is in line with earlier research that points to digital technologies becoming more powerful, in influencing oral health habits. We see that the growing acceptance of intelligence and digital tools in periodontology shows a shift toward technology-driven preventive dentistry, where clinicians and patients are increasingly using digital platforms in routine care [1]. I also notice that earlier reports have shown that mobile applications

and media-based interventions can successfully encourage positive changes in oral hygiene habits reinforcing the role of

digital platforms as helpers to traditional oral health education [2]. I find that current results are also confirmed by evidence that dental students and future professionals are becoming more aware and open to intelligence and digital health systems pointing to a strong future integration of artificial intelligence and digital health systems, into clinical practice [3]. Other studies have also shown that mobile applications and social media tools can help people change their habits. This is especially true for care and preventive dental habits. Because of this the results of our study seem reliable [4]. One thing I noticed in this study was that the mobile application group did better, than the social media group. I think this happened because mobile health applications are more interactive and feel more personal. Mobile health applications allow for feedback and help keep people engaged with their dental goals. The evidence that AI-enabled oral health tools, such as sensing toothbrushes paired with targeted mobile messages can greatly improve gum health and boost patient compliance is clear [5]. I find that the use of personalized and participatory (P4) medicine, within teledentistry systems is seen as a major shift that improves oral care and encourages patients to become more involved [6]. Tracking health data through phone-based systems has been shown to help people care for their mouths effectively by providing ongoing support and rapid answers [7]. These ideas match what we found here. People got better at taking care of their mouths because people saw reminders and received information. This helped people do better in the groups that received the help. Changing lifestyle habits is still very important for stopping gum disease from happening. Evidence shows that behavior and system issues play a role, in gum inflammation and in how periodontal disease gets worse. This shows how important it is to have prevention methods that go beyond just seeing the dentist [8]. In this situation digital health platforms offer ways to reach people and help people stay healthy. These platforms are a way to teach people and help

them build good habits. I have seen that this idea is backed up by reviews of health programs in dental care [9]. The role of media as a way to share health information is also becoming clearer in dental public health. Many dentists and dental professionals believe that social media is useful for talking with each other and for teaching patients. This supports the idea that social media's a good extra tool, for education [10]. However even though social media campaigns can reach people the quality of the content and how much people engage can vary a lot. I think this variation might explain why the improvement in the media group was lower than the improvement in the mobile application group in this study. Earlier randomized controlled trials have shown that mobile application-supported periodontal interventions do not improve measures but they also increase patients understanding and hand-eye coordination needed for oral hygiene. These results support the findings of the study [11]. Moreover web-based applications that are designed for plaque assessment and monitoring have been easy to use. They have helped patients take care of themselves and change their habits. This evidence reinforces the value of tools, for disease prevention [12]. The Selfie Dental Plaque Index is a tool that people can use to watch their plaque and has made it easier to check gum health from far away. The Selfie Dental Plaque Index also makes people feel more involved when they check their oral health. Even though many digital tools exist studies that look at groups still find that many people do not know enough about gum health. This shows that we still need proven health programs – the ones that were tested in this study. New studies also show how the environment and personal habits can make gum disease worse. The Selfie Dental Plaque Index reminds us that preventing disease is very important, in care. However worries about the differences in quality and how accurate the information is in patient-focused mouth health apps still exist. This shows that it is important to have checks and standards for content so that the health education given is reliable [16]. Programs that are based on evidence and focus on prevention through means have shown they work well in helping different groups understand mouth health better. These programs especially help reduce the gap, in access to mouth health education [17]. Also looking at videos that teach about dental care shows there are both chances and problems when it comes to making sure the information shared is correct and of good quality [18]. These results show how much we need tools that are built on real facts like the ones we used in this study. People are also starting to look at how keeping gums healthy can help the rest of the body during pregnancy. This really shows that periodontal health is a part of how healthy a person stays [19]. On top of that using things like intelligence and robots to teach about oral health is helping dentists learn more and stay interested. It seems like more dental workers are ready to welcome changes, in dentistry [20]. Lastly some studies looked at using teledentistry to find issues. Many dentists said they really like using tools to help with their work. This proves that telehealth and mobile tools are great for managing disease [21]. In oral healthcare, endodontics and restorative dentistry are essential. In order to integrate digital technologies for

endodontic diagnostic and restoration planning, endodontic software has become essential [22]. A Chlorhexidine mouthwash and oral hygiene practice helps to improve oral health [23-25]. According to Morariu *et al.*, a mobile app could encourage and direct patients in their oral hygiene practices [26]. When it comes to dental trends, social media has a big impact on oral health behaviour and can lead to periodontal problems [27]. AI-assisted monitoring enhanced periodontal clinical outcomes, plaque management, and self-care practices. According to the Hu *et al.* study [28], AI monitoring is a useful technique for improving periodontal treatment. According to research, social media-based reminders seem to be a promising supplement for increasing oral hygiene compliance during fixed orthodontic treatment [29]. This study looks at a growing amount of proof to show that organized digital public health tools can really help people in a part of India learn more about gum health and how to prevent gum disease. After looking at the results of this randomized controlled trial we found that using an application is better, than using social media campaigns when it comes to teaching people about gum health knowledge, attitudes and practices. Still both digital ways worked better, than old-fashioned teaching methods. This shows how much digital public health tools can truly change how we stop gum disease.

Conclusion:

We show that digital public health interventions help people to learn about periodontitis. It acts to prevent disease process better than school education methods. Both mobile app and social media strategies worked well. However the mobile application-based intervention saw results in all KAP domains. These platforms can be helpful to control periodontal disease.

Advancement to knowledge:

We have noticed that mobile applications, also known as mHealth are now part of health programs that focus on periodontitis and endodontic management. Mobile applications change the way we treat disease. Mobile applications send motivating messages that track how well treatment works and give hygiene tips giving power to patients. In the end mobile applications close the distance, between professional treatments.

Future perspective:

Future research needs to run long-term multicentre trials that look at clinical periodontal measurements. Future research must also test AI-driven personalized programs that help people keep up their good habits. Future research will watch how these tools change behaviour and support lasting improvement.

Limitation:

The study depends heavily on self-reported questionnaire data and a short-term follow-up. Because of this the study may not fully capture the long-term clinical periodontal outcomes.

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