

Effect of Mobile Application Use on Oral Hygiene among Orthodontics Users: Meta-Analysis

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ABSTRACT

Background: The high prevalence of malocclusion causes the need for orthodontic treatment to increase. The results of the 2018 National Basic Health Research, the prevalence of dental and oral problems is 57.6%, especially in adolescents. Oral hygiene is an important factor that must be controlled by patients during orthodontic treatment because it can affect the quality and time of treatment. The mobile application is here to facilitate and provide optimal dental health information to orthodontic users. This study aims to analyze and estimate the influence of mobile applications on oral hygiene in orthodontic users.

Subjects and Method: This study used a systematic review and meta-analysis by following PICO, Population: orthodontic patients. Interventions: mobile applications. Comparison: without a mobile application. Outcome: oral hygiene. The data used were obtained from scientific research articles from electronic databases including Pubmed, Google Scholar, Science Direct Randomized Control Trial (RCT) designs from 2013 to 2023 which report effect sizes with Mean and SD. The keywords used are “orthodontic” AND “oral hygiene” OR “oral health” AND “mobile application” OR “app”. The selection of articles was carried out using the PRISMA flowchart. Data were analyzed using Review Manager software version 5.3.

Results: A total of 9 articles with eligible RCT designs from Asia and Europe were selected for the systematic review and meta-analysis. The results of the meta-analysis showed that oral hygiene for orthodontic users who used mobile applications was better than those who did not use mobile applications, and was statistically significant (SMD= -0.59; 95% CI= -0.90 to 0.29; p= .001).

Conclusion: Mobile application improves oral hygiene in orthodontic users.

Keywords: mobile application, oral hygiene, orthodontics.

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BACKGROUND

Malocclusion is an important oral health problem. The results of the 2018 National

Basic Health Research, the prevalence of dental and oral problems is 57.6%, especially in adolescents (RI Ministry of Health,

2018). Fixed orthodontics is one of the most common types of orthodontic treatment used to correct malocclusion (Anuwongnukhroh et al., 2017). Therefore, orthodontic treatment has become increasingly popular over the last few years. This happens because more and more people are realizing the benefits of orthodontic treatment in correcting malocclusions, increasing function, aesthetics, and self-esteem in patients (Anuwongnukhroh et al., 2017).

The process of orthodontic treatment is very complex. Complaints on oral hygiene are one of the most common factors in fixed orthodontic treatment. Orthodontic treatment can affect oral hygiene, because it tends to retain food debris and plaque which makes it difficult to clean. Dental plaque in orthodontic patients can be two to three times higher than in patients without orthodontics. This can lead to gingivitis, white spot lesions and caries (et al., 2011).

Mehra et al. states that 5% to 10% of orthodontic patients fail to complete their treatment simply because of oral hygiene problems. It is known that patient compliance can be challenging during prolonged orthodontic therapy, especially in adolescents; Therefore, oral hygiene instructions and patient motivation play an important role in maintaining effective plaque control. Control of oral hygiene in orthodontic patients requires adherence so that the treatment is carried out optimally.

The use of mobile applications is currently growing rapidly. Several studies have reported that mobile applications are effective in improving oral hygiene in orthodontic users. Research conducted by Zotti et al. (2016) regarding the effect of application-based discussion room participation in improving the oral hygiene of orthodontic patients and found an increase in compliance and oral health status. Based

on this background description, a comprehensive study is needed from various primary studies on the effect of mobile applications on oral hygiene behavior in orthodontic users by synthesizing the results of previous primary studies.

SUBJECTS AND METHOD

1. Study Design

This research is a research that uses systematic review and meta-analysis methods. The articles used were obtained from several electronic databases including PubMed, Google Scholar, Science Direct with the Randomized Control Trial research design whose publications were from 2013 to 2023. The keywords used in the search were "orthodontic" AND "oral hygiene" OR "oral zhealth" AND "mobile application" OR "app".

2. Step of Meta-Analysis

The meta-analysis was carried out in five steps as follows:

- 1) Formulate research questions in the PICO format (Population, Intervention, Comparison, Outcome).
- 2) Search for primary study articles from various electronic and non-electronic databases.
- 3) Conduct screening and critical assessment of primary research articles.
- 4) Perform data extraction and synthesize effect estimates into RevMan 5.3.
- 5) Interpret and conclude the results

3. Inclusion Criteria

The inclusion criteria in this study were full text articles using the Randomized Controlled Trial (RCT) research method from 2013 to 2023 with mobile application interventions and the outcome analyzed was oral hygiene in orthodontic users reported by Mean and Standard Deviation (SD).

4. Exclusion Criteria

The exclusion criteria in this study were that the results of the study were not fully

and clearly explained, the population and the interventions carried out were different.

5. Operational Definition of Variables

The study was conducted by considering the eligibility criteria defined using the PICO model (Population: patients using orthodontics, Intervention: mobile application, Control: without mobile application, Outcome: oral hygiene).

Orthodontics is a treatment that aims to improve the alignment of crowded teeth, correct rotational (rotary teeth) and apical deviations of the teeth, correct the relationship between incisors and create a good maxillary and mandibular occlusion relationship.

Mobile application is a software program that runs on a cell phone, to get access related to dental health to improve oral hygiene for orthodontic users whenever and wherever needed.

Oral Hygiene is the cleanliness of the oral cavity which is known through the plaque index score (plaque index), gingival index and (gingival index, or white spot lesion (WSL) bleeding index) gingival bleeding index.

6. Instruments

This study adopts the PRISMA flowchart and uses a cross-sectional critical assessment study of CEBM.

7. Data Analysis

Data analysis was performed using Review Manager software version 5.3. The odds ratio with 95% CI is calculated from the adjusted Mean and SD. The Forest Plot was used to describe effect sizes and the Funnel Plot to describe publication bias. The analysis was carried out by looking for the heterogeneity consistency value (I^2) of the research results used.

RESULTS

The meta-analysis begins with determining the research problem using PICO as a

reference to search for relevant articles. Article searches were conducted through several electronic databases including: Pubmed, Google Scholar, Science Direct. There are 9 articles originating from China, Iran, India, Italy, the Netherlands, Belgium and Brazil. The article review process can be seen in the PRISMA flowchart as follows.

The data used comes from searching primary articles from databases such as Google Scholar, Science Direct, and Pubmed from 2013 to 2023. The search was carried out using the keywords “orthodontic” AND “oral hygiene” OR “oral health” AND “mobile application” OR “apps”. The process of selecting and reviewing articles is carried out using the PRISMA flowchart.

In this meta-analysis, a number of articles with RCT research designs will be used. The initial search results obtained a number of 1290 articles from a predetermined database as well as from various other searches. After removing duplicate articles, 786 articles were obtained. At the screening stage, 739 articles were obtained by removing the article because the article did not meet the criteria on the grounds that the title was irrelevant, not RCT, not full-text and not in English or Indonesian. The researcher reviewed the 47 articles that had been obtained and found 9 articles that met the criteria. 38 articles were excluded with the reason that the outcome was not in the form of oral hygiene, the intervention was carried out by a mobile application and the articles did not have a mean and SD. There were 9 articles included in the qualitative synthesis, then 9 articles that met the criteria were selected again. In these 9 articles a quantitative synthesis of the meta-analyses will be carried out (Figure 1).

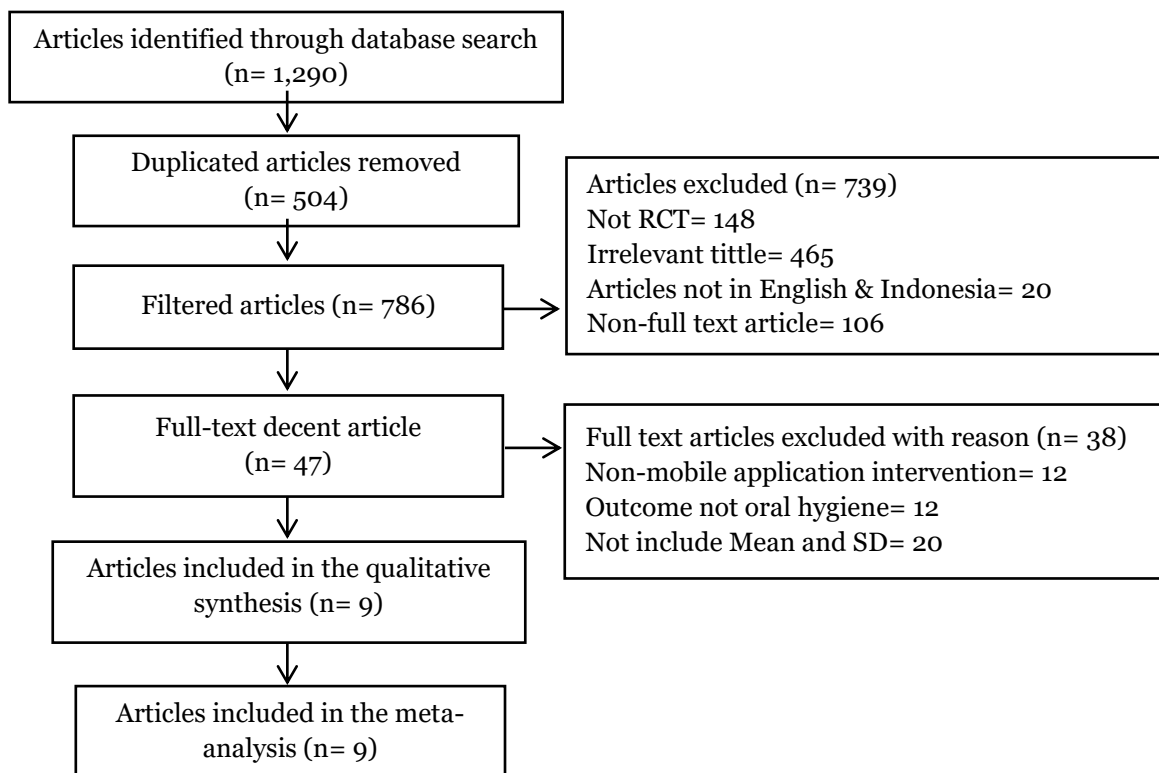


Figure 1. Results of PRISMA Flow Diagrams on the effect of mobile applications on oral hygiene in orthodontic users



Figure 2. Research Distribution Map on the effect of mobile applications on oral hygiene in orthodontic users

Figure 2 showed that the research locations for the effect of mobile applications on oral

hygiene in orthodontic users were 4 studies from the Asian continent (2 studies from

China, 1 study from Iran, and 1 study from India) and 5 studies from the European continent (2 studies from Italy, 1 study from the Netherlands, 1 study from Belgium, and 1 study from Brazil). Assessment of research quality used the Critical App-

raisal Skills Program Randomized Controlled Trial Standard Checklist (CASP for RCT) in research on the effect of mobile applications on oral hygiene in orthodontic users (see Table 1).

Table 1. Assessment of the quality of a randomized controlled trial study on the effect of mobile applications on oral hygiene behavior in orthodontic users.

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Jejurikar et al. (2014)	2	2	2	2	2	2	2	2	2	2	2	2	24
Li et al. (2015)	2	2	2	2	2	2	2	2	2	2	2	2	24
Zotti et al. (2016)	2	2	2	2	2	2	2	2	2	2	2	2	24
Scheerman et al. (2019)	2	1	2	2	2	2	2	2	2	2	2	2	23
Farhadifard et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Deleuse et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Scribante et al. (2021)	2	2	2	2	2	2	2	2	2	2	2	2	24
Wu et al. (2022)	2	1	2	2	2	2	2	2	2	2	2	2	23
Santos et al. (2022)	2	2	2	2	2	2	2	2	2	2	2	2	24

Description of the question criteria:

1. Does the study clearly address the focused issue?
2. Did the author use the appropriate method to answer the research question?
3. Was the sample measured accurately to minimize bias?
4. Are the subjects and settings of the study described in detail?
5. Are the study instruments valid and reliable?
6. Was the sample size based on pre-study consideration?
7. Could a satisfactory response rate be achieved?
8. Was statistical significance assessed?
9. Was a confidence interval given for the main result?
10. Are the results applicable to designated populations?
11. Could there be confounding factors that have not been recorded?
12. Are the results be applied to the local community?

Description of scoring:

- 0= No
- 1= Hesitate
- 2= Yes

The forest plot in Figure 3 shows the effect of mobile application on oral hygiene in orthodontic users, and this effect is statistically significant. (SMD= -0.59; 95% CI= -0.90 to 0.29; p< 0.001). The forest plot also showed high heterogeneity of

effect estimates between studies (I²= 71%; p< 0.001). Thus, the calculation of the average effect estimate uses the random effect model approach.

The funnel plot in Figure 4 shows a more or less symmetrical distribution of

effect estimates between studies to the right and left of the vertical mean estimate line. Thus, this funnel plot shows no publication bias in the meta-analysis. High heteroge-

neity is based on the variation or diversity between populations as seen from the different number of samples between the experimental group and the control group.

Table 2. PICO of cross-sectional articles perceived susceptibility.

Author (years)	Country	Sample	P	I	C	O
Jejurikar et al. (2014)	India	50	Orthodontic patients aged 13-19 years	Using the mobile text messaging app	without a text messaging mobile app	oral hygiene (modified Turesky plaque index score mean)
Li et al. (2015)	China	112	Adult orthodontic patient	Using a WeChat-based mobile app	regular maintenance without WeChat	oral hygiene (average Oorthodontic plaque index/OPI score)
Zotti et al. (2016)	Italia	80	Adult orthodontic patient	Using Whatsapp with the name Brush Game	without a mobile app	oral hygiene (mean plaque index score)
Scheerman et al. (2019)	Netherland	132	Orthodontic patients aged 12-16 years	Using the White Teeth mobile app	regular care without the White Teeth mobile app	oral hygiene (mean plaque index score)
Farhadifard et al. (2020)	Iran	120	Orthodontic patients aged 15-25 years	Using the “Brush DJ” mobile app	verbal oral hygiene instructions	oral hygiene (mean plaque index score)
Deleuse et al. (2020)	Belgium	34	Orthodontic patients aged 12-18 years	Using a mobile app	verbal oral hygiene instructions	oral hygiene (mean plaque index score)
Scribante et al. (2021)	Italy	40	Orthodontic patient	using instagram	verbal oral hygiene instructions	oral hygiene (mean plaque index score)
Wu et al. (2022)	China	44	Orthodontic patients aged 17-29 years	Using the mini-WeChat “Clean Teeth”	Oral and dental health education	oral hygiene (mean plaque index score)
Santos et al. (2022)	Brazil	16	Orthodontic patients aged 14-19 years	Using a mobile app	without a mobile app	oral hygiene (VPI index score / Visible Plaque Index)

DISCUSSION

The results of a meta-analysis of 9 articles related to the effect of mobile applications on oral hygiene in orthodontic users experienced an increase of 0.59 units better than without mobile applications and statistically significant (SMD = -0.59; 95% CI

= -0.90 to 0.29; p< 0.001) (I²=71%; p< 0.001).

Research on the effect of mobile applications on oral hygiene in orthodontic users is marked by not touching the horizontal line of each study with the vertical line on the forest plot. This

significance value is influenced by several factors, including in the 6 articles the number of samples between the control group and the intervention group is the same so that the number of proportions for both is balanced.

Mobile applications, also known as mobile applications, are computer programs that run on mobile devices (Rupnik and Krisper, 2009). Currently the mobile

application has been widely used. This is because mobile applications are easy, user-friendly, inexpensive, can be downloaded and run on most mobile phones. Mobile applications are used for a broad range of functions such as calling, messaging, browsing, chatting, social networking communication, audio, video, games and others (Mazumder and Islam, 2018).

Table 3. aOR and 95% CI data of the effect of mobile applications on oral hygiene in orthodontic users.

(Author, year)	Mobile Application		Non-Mobile Application	
	Mean	SD	Mean	SD
Jejurikar et al. (2014)	0.71	0.53	1.04	0.73
Li et al. (2015)	2.46	0.57	2.49	0.55
Zotti et al. (2016)	1.45	0.34	1.8	0.45
Scheerman et al. (2019)	52.41	29.02	62.97	25.71
Farhadifard et al. (2020)	69.18	11.84	70.90	8.89
Deleuse et al. (2020)	1.2	0.52	1.4	0.38
Scribante et al. (2021)	0.47	0.27	0.57	0.21
Wu et al. (2022)	0.81	0.46	1.61	0.56
Santos et al. (2022)	32.10	7.72	43.59	34.71

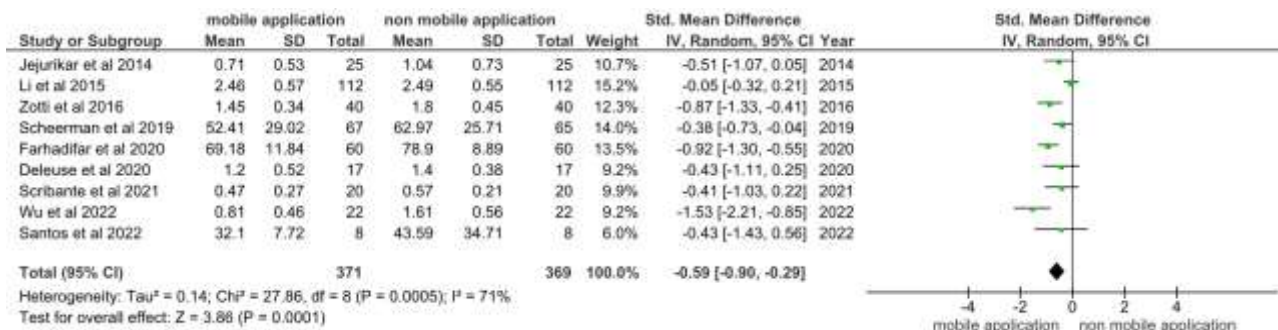


Figure 3. Forest plot of the effect of mobile applications on oral hygiene behavior in orthodontic users

The use of mobile applications during orthodontic treatment can assist in compliance with orthodontic patient oral hygiene. Oral hygiene is an important factor that is controlled by the patient during orthodontic treatment, which can affect the quality and time of treatment. Optimal oral hygiene requires thorough and clear instructions, adequate tools, and patient care,

which are important factors for obtaining compliance (Cozzani et al., 2016).

Several studies have shown the effect of mobile applications on oral hygiene in orthodontic users, one of which is a study conducted by Farhadifard et al. (2020) who examined the effectiveness of mobile applications on oral hygiene of orthodontic users with a total of 120 study subjects, using a mobile application called Brush DJ.

The results show (Mean= 78.90; SD=8.89). higher than after the mobile app “Brush DJ” intervention (Mean= 69.18; SD=11.84). A meta-analysis was conducted on 9 primary randomized control trials conducted from 2 continents, namely Asia and Europe with a total sample of 740. Orthodontic patients who used a mobile appli-

cation experienced an increase in oral hygiene 0.59 units better than without a mobile application and statistically significant (SMD= -0.59; 95% CI=-0.90 to -0.29; p= < 0.001). These results also show high heterogeneity of effect estimates between studies (I²= 71 %; p< 0.001).

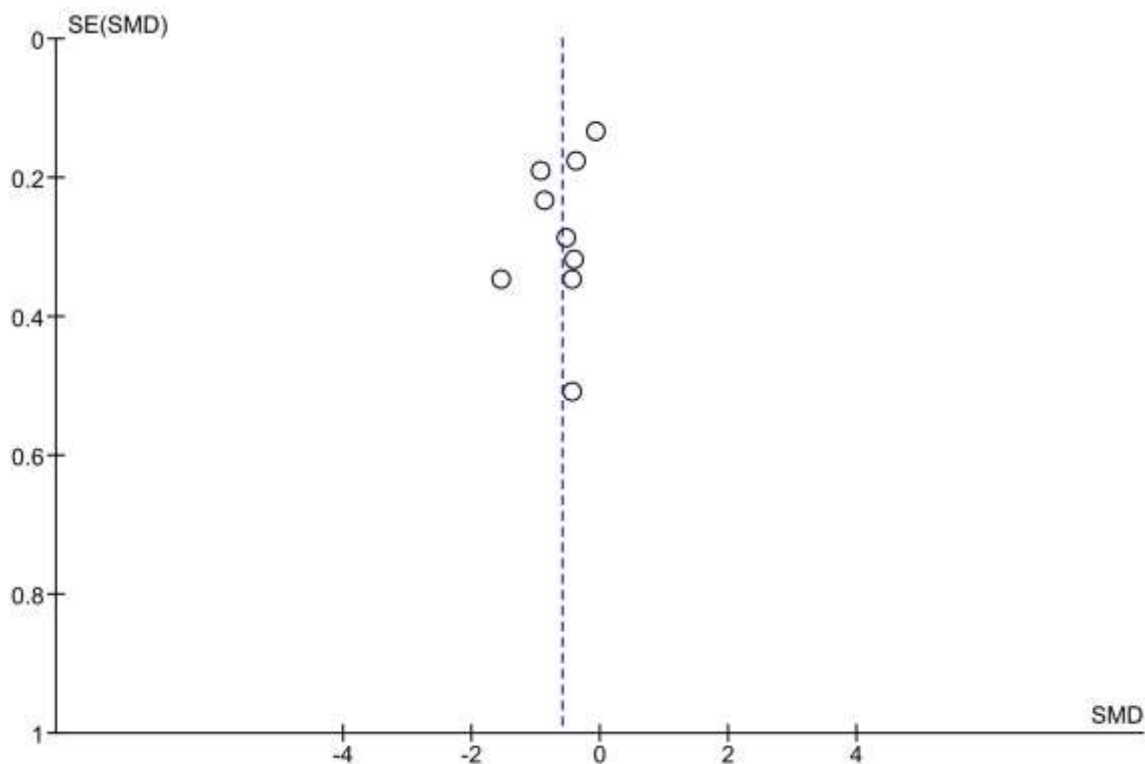


Figure 4. Funnel plot of the effect of perceived susceptibility on the utilization of Pap smear screening service

The results of the distribution of effect estimates between studies were more or less symmetrical to the right and left of the vertical mean of the estimate indicating that there was no publication bias in this meta-analytic study. The limitation of this research is that it only uses 3 databases, namely PubMed, Google Scholar, and Science Direct, so it ignores other database sources. In addition, this research also has limitations in translating languages so that it only uses articles published in English

and then ignores articles published in other languages.

AUTHOR CONTRIBUTION

Dini Hapsari is the main researcher who selects topics, searches for and collects research data. Eti Poncorini Pamungkasari and Argyo Demartoto analyzed the data and reviewed research documents.

FUNDING AND SPONSORSHIP

This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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