

Effects of Educational Interventions on Oral Hygiene: A Systematic Review and Meta-Analysis

Sakineh Dadipoor

Hormozgan University of Medical Sciences

Mohtasham Ghaffari

Shaheed Beheshti University of Medical Sciences

Abbas Alipour

Mazandaran University of Medical Sciences

Ali Safari-Moradabadi (✉ alisafari_31@yahoo.com)

Shahid Beheshti University of Medical Sciences <https://orcid.org/0000-0002-8310-5160>

Research article

Keywords: Oral Hygiene, Oral Health, Health Promotion, Intervention, Systematic Review, Meta-Analysis

Posted Date: October 10th, 2019

DOI: <https://doi.org/10.21203/rs.2.15898/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: This study assesses the impact of school based educational interventions on oral hygiene of students conducted worldwide. This is a systematic review and Meta-Analysis. **Methods:** Our investigation was conducted in electronic databases including MEDLINE Ovid, Embase Ovid, Scopus, Web of Science from 2000 to march 2018. The data were extracted based on a standard data collection form specific to observational studies, and entered into RevMan2014. Twelve studies of students in this review finally entered the study including five individual RCTs, four cluster-RCTs, and three quasi-experimental studies. **Results:** Meta-analyses showed a significant difference in knowledge (SMD 3.31, 95% CI 2.52 to 4.11; $P < 0.001$), attitude (SMD 1.99, 95% CI 0.43 to 3.54; $P < 0.01$), behavior (SMD 4.74, 95% CI 3.70 to 5.77; $P < 0.001$), plaque index (SMD -1.01, 95% CI -1.50 to -0.51; $P < 0.001$) and Gingival index (SMD 0.33, 95% CI -0.36 to 1.02; $P = 0.34$) for students receiving educational interventions compared to those receiving usual care. **Discussion:** The focus of the present study is the efficacy of all oral health education and promotion interventions, especially in terms of short-term outcomes. Since long-term and short-term results are of tremendous importance for oral and dental education programs, it will be possible to make these interventions in the future with several target groups, including families and teachers.

Introduction

Oral hygiene is a basic component of public health and well-being [1, 2]. "Oral health has multifaceted nature that provides the ability of speaking, smiling, smelling, tasting, touching, chewing and swallowing, which helps expressing emotions confidently and prevents the diseases without the feeling of pain and discomfort" [3]. Poor oral health such as dental caries, periodontal disorders and missing tooth are important public health issues around the world given the fact that poor oral hygiene has wide-spreading impacts on overall health and quality of life. Some common diseases are caused from the direct effect of untreated oral health problems [4]. There is a link between poor oral health and social-behavioral and environmental factors possibly leading to poor nutrition, absence from work and school, pain and suffering, and increased healthcare costs [5, 6]. The statistics show a quarter of the world's population suffers from oral disorders [7, 8]. Tooth decay is common in about 50 % of the world's population [9]. The World Health Organization reported in 2015 that most of the adults and schoolchildren experience dental caries and 5%-15% of most populations are affected by severe periodontitis [10]. Many school based oral health programs, mainly educational interventions, have been conducted worldwide; however, their impact is not adequately clear. Considering the cost of these interventions, it is crucial for public health managers, especially in developing countries, to conduct evidence-based effective preventive measures against diseases while promoting oral health [11-13]. This review aims to contribute to this aim. In this study, authors have defined school based oral health-related educational interventions as educational programmes utilizing different educational methods such as lectures, demonstrations and practical program targeting students individually or in groups in schools. The aim of this

study is to evaluate the effects of school based oral health interventions programs on students' oral hygiene, knowledge, attitude, and practice.

Methods

Types of studies

Individually randomized controlled trials (RCTs) or cluster-RCTs including quasi-experimental studies were used to enhance oral hygiene (dental plaque), associated awareness, and attitude, performance of students using one or more school-based oral health education and/or oral health promotion interventions programs (the case group in comparison with consistent oral hygiene education (the control group)).

Inclusion criteria were according to the PICO's criteria:

Population: Studies that have evaluated the primary, middle, and high schools in their communities without paying attention to their oral health conditions;

Intervention: School based educational interventions to improve the level of oral hygiene in students;

Comparison: Studies, which compared the participants in terms of the absence and in the presence of oral health-educating interventions;

Outcome: Studies that assess the results of oral health and oral health-related awareness, mindset and behavior: Studies that covered any RCT or quasi-experimental were selected to undergo an oral hygiene interventions programs;

Types of participants

Male and female students at primary and secondary schools were selected for this study. Most of them were 6-18 years old.

Types of interventions

Any RCT or quasi-experimental were selected to undergo the oral health interventions programs versus typical oral health care and education and also quasi-experimental studies as well as interventions with no educational or oral hygiene promotion components as controls.

Types of outcome measures

- Oral health-related awareness, mindset and behavior of students: determined by any tools applied in the included studies (e.g. questionnaire or interview).
- Gingival index measured by Gingival scores.
- Dental plaque measured by plaque scores.
- DMFT

Search methods to select the studies

This systematic review was based on the search strategy developed for MEDLINE Ovid and Embase (Pico). The search strategy used a combination of controlled keywords and free-

text terms.

Electronic searches

The following electronic databases were searched (2000 to march 2018) ([Supplement 1](#)):

- MEDLINE Ovid (see Appendix 1).
- Embase Ovid) (see Appendix 2).
- Scopus (see Appendix 3).
- Web of Science (see Appendix 4).

When searching the electronic databases, authors placed no restrictions on language of publication.

Data collection and analysis

The search strategy was conducted by two of the review authors (ASM, SD). The first phase was a search in the titles and abstracts. The second phase was marked by a thorough checking through the articles in full-text by both authors independently.

Data extraction and management

The data were extracted based on a data collection form specific to observational studies. The collected data included author's name, publication year, country, sample size, frequency for each group, participants, age range, effects, delivery type, language, study design, details of the intervention, outcome measures, and follow-up. The extracted data were entered in Excel software 2010 in accordance with the above-mentioned categories.

Data extraction was done independently by two review authors (AS, SD) by applying a standard survey data collection, which was put into Review Manager 5 Software (RevMan 2014). The review authors were not blinded to authors of included studies. If disagreement occurred, the two review authors would try to solve it through discussion; otherwise, they would seek consultation with a third review author and finally those articles that were mutually agreed-upon were selected for inclusion. Data was extracted based on the fidelity of the intervention implementation. If, information on the afore-mentioned issues was insufficient, authors gathered additional information through contacting authors of the primary studies. The Cochrane Collaboration tool was applied to evaluate the risk of bias.

Evaluation of heterogeneity

Heterogeneity was evaluated statistically by the authors; it was also quantified among studies included in each analysis using the I^2 statistic. All studies were analyzed regarding the interventions and outcomes.

Data synthesis

Studies were categorized based on the intervention programs. For each intervention type, meta-analyses were performed to be reasonable clinically and methodologically homogeneous; random-effects models used for all analyses.

Measures of treatment effect

To assess the change of variables, mean difference (MD) was applied and its matching 95% confidence interval (CI) was used if the same tool was used. Moreover, if the used tools were not similar, the standardized mean difference was used (SMD).

Results

Results of the search

Two review authors (ASM, SD) screened 309 abstracts for inclusion, and assessed 37 publications in full text. Finally, 12 Studies had the eligibility criteria. Studies in English and Persian were included in the study.

Excluded studies

We excluded 25 studies: fifteen had no educational component; six included students; and four assessed no predefined outcomes ([Supplement 2](#)).

Duration of follow-up

Follow-up for two studies was one month [14, 15], and for six studies ranged from one month to three months [16-21]; for two studies was from three months to six months [22, 23], and a study was followed up after nine months [24]. In one study, follow-up time was not reported. Authors categorized studies covering less than three months as short term and more than three months as long term ([Supplement 3](#)).

Some interventions were complex interventions, which involved more than one active component. All educational interventions covered theoretical or practical education sessions, or both, on oral health for students as one of the key intervention components, while the number of intervention components was different significantly among studies.

Authors categorized the interventions into two groups: educational intervention based on the theoretical and usual ([Table 1](#)).

Table-1: Characteristics of studies Based on the to the variables studied

Author	Year	country	Participant	Sample size	Sample size in each group					language
					Ig1	Ig2	Ig3	Ig4	Cg	
larkhora et	2018	Iran	Primary school	90	45	-	-	-	45	Persian
andrashekar al.	2014	India	Middle school	141	36	35	36	-	34	English
napathi et al	2015	India	Middle school	200	40	40	40	40	40	English
leem et al.	2012	Pakistan	Primary school	200	40	40	40	40	40	English
Arzoo and Adhy	2013	Indian	Middle school	568	141	143	-	-	284	English
Assani et al.	2016	Iran	Middle school	80	40	-	-	-	40	Persian
Abduganov et	2018	Uzbekistan	High School	86	42	-	-	-	44	English
Alana et al.	2017	Indian	Middle school	200	50	50	50	-	50	English
Hamadkhah al.	2013	Iran	Middle school	300	100	100	-	-	100	Persian
Agipuram et	2016	India	Middle school	450	150	150	-	-	150	English
Abdani et al.	2009	Iran	High School	388	135	130	-	-	150	English
Ang et al.	2009	Taiwanese	High School	135	67	-	-	-	68	English

Author	effects	Time point	Oral health-related Outcomes					
			Gingival index	knowledge	attitude	behavior	Dental plaque	DMFT
larkhora et	Short-term	4w	-	ü	ü	ü	-	-
andrashekar al.	Short-term	3m	ü	-	-	-	ü	ü
napathi et al	Short-term	8w	-	ü	-	-	ü	-
leem et al.	Long-term	6m	-	ü	-	ü	ü	-

Dr. Cruz and Adhya	Long-term	9m	ü	ü	-	ü	ü	-
Assani et al.	Short-term	1m	-	ü	ü	ü	-	-
Adnanov et	Short-term	2m	-	ü	ü	ü	-	-
Alana et al.	Short-term	1.5m	-	ü	-	-	-	ü
Alhamadkhah et al.	Short-term	3m	-	ü	ü	ü	-	-
Alagipuram et	Long-term	6m	ü	ü	-	ü	ü	-
Alzaidani et al.	Short-term	3m	ü	-	-	-	ü	-
Alag et al.	-	N /R	-	ü	ü	ü	-	-

Included studies

We included five individual RCTs [17-19, 23, 24], four cluster-RCTs [16, 21, 22, 25], and three Quasi- experimental [14, 15, 20] with 2838 students as participants (Table 2).

Table 2: The main findings of studies reviewed

Author	Study Design	Model of delivery	group	Outcomes assessed ¹
Andarkhora et al.	Quasi-experimental	Film, lecture	Ig1: lecture	K, A, B
			Ig2: Multi Media	
			Control group	
Chandrashekar et al.	Cluster-RCT _s	Brochure, demonstration the model	Ig1: DHE by a qualified Dentist + using the audio-visual aids	PI, DMFT, GI
			Ig2: DHE by the trained school teachers	
			Ig3: DHE by the trained school teachers + oral hygiene aids (tooth brush and tooth paste)	
			Control group	
Ganapathi et al	RCT _s	Audio record, pamphlets	Ig1: Audio record	K, PI
			Ig2: Pamphlets	
			Ig3: Tooth models	
			Ig4: Multisensory	
			Control group	
Haleem et al.	Cluster-RCT _s	Booklet supplemented, session	Ig1: Dentist-led	K, B, PI
			Ig2: Teacher-led	
			Ig3: Peer-led	
			Ig4: Self-learning	

			Control group	
D'Cruz and Aradhya	RCT _S	Pamphlets, demonstration the model	Ig1: A lecture using a PowerPoint presentation	K, B, PI, GI
			Ig2: lecture, a demonstration of the tooth brushing method	
			Control group	
Hassani et al.	Quasi-experimental	Booklet, CD, session	Ig	K, A, P
			Control group	
Khudanov et al.	RCT _S	Lesson, lecture, messages, demonstrational models	Ig	K, A, P
			Control group	
Sadana et al.	RCT _S	Audio record, pamphlets	Ig1: verbal communication	K, DMFT
			Ig2: verbal communication and self-educational pamphlets	
			Ig3: audiovisual aids and verbal communication	
			Control group	
Mohamadkhah et al.	Quasi-experimental	Film, lecture	Ig1: film Group	K, A, P
			Ig2: lecture Group	
			Control group	
Vangipuram et al.	RCT _S	Power point presentation, chalk and talk presentation, using charts, posters, booklets and tooth brushing demonstration models	Ig1: peer Group	K, B, PI, GI
			Ig2: dentist Group	
			Control group	
Yazdani et al.	Cluster-RCT _S	Leaflet, Videotape	Ig1: Leaflet Group	PI, GI
			Ig2: Videotape Group	

			Control group	
Yang et al.	Cluster-RCT _s	lectures, role-playing, small group discussion and group contests	Intervention group	K, A, B
			Control group	

Outcomes assessed¹: K (knowledge), A (Attitude), B (behavior), PI (Plaque index), GI (Gingival Index), DMFT (decayed, missed, filled permanent tooth).

Measured outcomes

Oral health-related knowledge

Based on the results, ten studies reported oral health-related knowledge of students [14, 15, 17-20, 22, 24, 25]; all studies Oral health-related knowledge assessed by self-administered questionnaires. Data of twelve studies on students' awareness were combined in the current study. Moreover, ten studies at high and unclear risk of bias including 2309 members of students were combined in a meta-analysis. Compared to students with no education, students receiving educational interventions were significantly different in terms of knowledge (SMD 3.31, 95% CI 2.52 to 4.11; $P < 0.001$) (Figure 1).

Oral health-related attitude

Oral health-related attitude of students was evaluated by six studies [14, 15, 18, 20]. Self-administered questionnaires were applied with Likert scale. Self-administered questionnaires were applied with Likert scale. Six studies including 1141 members of students were combined in a meta-analysis by the authors. In contrast to students with no education, students receiving educational interventions differed significantly in terms of the attitude (SMD 1.99, 95% CI 0.43 to 3.54; $P < 0.001$) (Figure 2).

Oral health-related behavior

Oral health-related behavior of students was evaluated by eight studies [14, 15, 18, 20, 22, 24]. Eight studies including 1909 members of students were combined in a meta-analysis by the authors. Contrary to students with no education, students receiving educational interventions were different significantly in terms of the attitude (SMD 4.74, 95% CI 3.70 to 5.77; $P < 0.001$) (Figure 3).

Dental plaque index

We meta-analyzed six studies [16-19, 21-24] and involving 1947 students. In comparison with students with no education, students receiving educational interventions were significantly different in terms of the dental plaque scores (SMD -1.01, 95% CI -1.50 to -0.51; $P < 0.001$) (Figure 4).

Gingival index

Authors meta-analyzed four studies [16, 21, 23, 24] and involving 1541 students. Contrary to students with no education, students receiving educational interventions were considerably different in terms of gingival scores (SMD 0.33, 95% CI -0.36 to 1.02; $P = 0.34$) (Supplement 4).

Overall risk of bias

None of the studies reported low risk of bias. A high risk of bias in assessment of risk of bias was observed in eight studies [14, 15, 17, 20-24]. The other four studies were at unclear risk of bias [16, 18, 19, 24, 25] ([Supplement 5](#)).

Discussion

The studies suggested positive effects of OHE on oral health-related knowledge in short term. Compared to those without education, students receiving educational interventions were significantly different in knowledge. Therefore the effectiveness of oral health education-related program could lead to increase of knowledge, attitude and behavior. According to the results by Kay and Locker, it was possible to enhance knowledge by dental health education [26]. Nevertheless, Pieper et al. argued that tooth decay could be decreased by preventive services even with no change in knowledge and health behavior [27]. On the other hand, one of the ways to increase knowledge and attitudes can be engaging other groups in educational interventions. Naker reported that the education when more effective on the students that involvement of other groups, such as parents, as teachers [28].

Systematic review shows that OHE in a range of sample sizes efficiently enhanced oral health-related behavior. Studies were more effective when OHE aimed school student and when important others were included. A significant progression in oral health-related behavior was observed by Alsada et al., Kowash et al., Vachirarojpisan et al. and Rong et al. Besides, all the above-mentioned studies covered important others like care givers and mothers of children in the intervention of the target groups that affected the practice of the target group efficiently [29-32].

Since the students spend most of their time at school, schools can provide an important and effective context for improving oral and dental health. Aljanakh et al. reported the role of the school in promoting the oral health behavior of students [33].

It seems that teachers can succeed in upgrading their students' knowledge, which can be attributed to students' trust in the material transferred by teachers. Sukhabogi et al. reported that a teacher with an adequate knowledge of oral hygiene could play an important role in oral health education of students [34].

The results of meta-analysis show that in contrast to students with no education, students receiving educational interventions were significantly different. The results of the meta-analysis indicated that the educational program in the intervention group were able to improve the students' positive attitude towards health behaviors. Effective education and raising awareness can be one of the reasons for positive attitudes among students. On the other hand, improving attitude can lead to health behavior. Studies have shown that there is a positive relationship between positive attitude and frequent tooth brushing of students [35-37]. Moreover, the positive attitude of educational staff can lead to a positive attitude in students. A study showed that teachers who have a positive attitude towards oral hygiene of students can be a positive role model, and vice versa, teachers with a negative attitude would have an unfavorable effect on students' health behaviors [34]. The role of health education and promoting health in promoting oral hygiene is crucial. Educational interventions will be more effective when they are based on theories. According to the studies recommendations, the oral health knowledge, attitude, and behavior were improved

by oral health education based on theories and it is possible to use them to develop theoretical structure of the interventions [38-41].

The results of gingivitis outcome in meta-analysis showed that there was difference between the experimental and control groups indicating that oral health intervention had effect on gingivitis reduction. The results showed that majority of the studies had a short-term follow-up period. Therefore, there is a need to assess long-term studies, which can evaluate the effects of the education practices on those outcomes, especially because the goal of the education actions in the settings such as school is to prevent oral disorder and expand healthy behaviors and practices.

Compared to students with no education, students receiving educational interventions were significantly different in terms of dental plaque scores. These review showed the impact of OHE on plaque levels on short term. The systematic review of Prabhu and John showed that oral health educational interventions and consequently improvements in individuals' knowledge, attitude, and oral health-related practice were effective in improving oral health indexes status such as reduction in dental plaque, gingival bleeding, and significant decline in dental caries [42]. Teachers are also trained in many countries and are used as a powerful tool for reducing dental plaque and improving oral hygiene among students (Petersen & Kwan, 2004). Therefore, health education and health promotion should be an essential element in educating teachers and other educational staff. Because the role of teachers in this field is very significant and valuable, they can affect thousands of students and families [33].

Most of the studies reported data on short-term effects (three or six months). Seemingly, follow-up period was sensible for outcome like plaque and gingivitis. Nonetheless, it should be emphasized that it was no adequate for other outcomes like knowledge and attitude. It is possible that constant impressions on knowledge and attitudes for school are required to pave the way for behavioral changes in oral health care. Thus, outcomes should be measured in future studies in the longer term.

Our comprehensive search strategy confirmed that publication bias is not seemly. Studies selection and data extraction, and analyses were done independently by two review authors. In addition, disagreements, if necessary, were resolved through consensus or consultation with a third review author.

Conclusions

Results of the present study shows that majority of included education programs included singular or short-term program interventions, and the evaluation of the outcomes were done in the short term. Two classes of interventions (education of oral health promoting behavior and prevention services) have positive effects on oral and dental health. Meanwhile, the strategies of teaching students and involving parents and school staff in training have a greater impact on improving oral health and increasing knowledge, improving the attitude and behavior of students, and continuing community-based education, using programs Modular training and combination techniques, the use of behavior change models and theories, follow up and provision of preventive services can be the best way of designing and planning interventions to improve oral health in students. In addition, majority of the studies investigated short-term impacts: thus, further intervention studies are required to differentiate the efficacy of the oral health-related educational intervention programs for students, especially in terms of students' oral health-related quality of life and oral hygiene.

Declarations

Ethics approval and consent to participate

The study has been approved by the Ethics Committee of the School of Public Health & Neuroscience Research Centre in Shahid Beheshti University of Medical Sciences; Approval ID: IR.SBMU.PHNS.REC.1397.051 : Approval Date:2019-01-15).

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Competing interests

The authors have no conflicts of interest.

Funding

This study is sponsored by Shahid Beheshti University of Medical Sciences in Tehran. The funding agencies had no role in the design of study, data collection and analysis, or presentation of the results.

Authors' contributions

MGH, SD, and ASM designed the study. ASM, AA and SD wrote the first draft. All authors contributed to writing, revising, and approved the final manuscript.

Acknowledgments

The authors would like to thank the research deputy of Shahid Beheshti University of Medical Sciences for their financial support.

References

1. Haque SE, Rahman M, Itsuko K, Mutahara M, Kayako S, Tsutsumi A, Islam MJ, Mostofa MG: **Effect of a school-based oral health education in preventing untreated dental caries and increasing knowledge, attitude, and practices among adolescents in Bangladesh.** *BMC Oral Health* 2016, **16**(1).
2. Ghaffari M, Rakhshanderou S, Safari-Moradabadi A, Torabi S: **Oral and dental health care during pregnancy: Evaluating a theory-driven intervention.** *Oral Dis* 2018, **24**(8):1606-1614.
3. Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ: **A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health.** *J Public Health Dent* 2017, **77**(1):3-5.
4. Falahi A: **Determinants of dental health behaviors among Iranian students.** *Int J Health Promot Educ* 2015, **3**(1):15-24.
5. Murphey C: **Oral health experiences of pregnant and parenting adolescent women: a qualitative descriptive study.** *Int J Nurs Stud* 2013, **50**(6):768-775.

6. Wang T-F, Huang C-M, Chou C, Yu S: **Effect of oral health education programs for caregivers on oral hygiene of the elderly: A systemic review and meta-analysis.** *Int J Nurs Stud* 2015, **52**(6):1090-1096.
7. Beaglehole R: **The oral health atlas: mapping a neglected global health issue:** FDI World Dental Federation; 2009.
8. Ghaffari M, Rakhshanderou S, Ramezankhani A, Buunk-Werkhoven Y, Noroozi M, Armoon B: **Are educating and promoting interventions effective in oral health?: A systematic review.** *Int J Dent Hyg* 2018, **16**(1):48-58.
9. Balasubramanian M, Brennan D, Fox C, Hewett S: **Oral health challenges.** In., edn.: FDI World Dental Federation; 2015.
10. Bracksley-O'Grady SA, Dickson-Swift VA, Anderson KS, Gussy MG: **Health promotion training in dental and oral health degrees: a scoping review.** *J Dent Educ* 2015, **79**(5):584-591.
11. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, Murray CJ: **Global burden of oral conditions in 1990-2010: a systematic analysis.** *J Dent Res* 2013, **92**(7):592-597.
12. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C: **The global burden of oral diseases and risks to oral health.** *Bull World Health Organ* 2005, **83**:661-669.
13. Stein C, Santos NML, Hilgert JB, Hugo FN: **Effectiveness of oral health education on oral hygiene and dental caries in schoolchildren: Systematic review and meta-analysis.** *Community Dent Oral Epidemiol* 2018, **46**(1):30-37.
14. Andarkhora F, Bohrani M, Goodarzi A: **Comparison of the Effect of Lecture and Multimedia Screening on Oral Health Behavior of Students in Tehran.** *MCS* 2018, **4**(3):213-220.
15. Hassani L, Aghamolaei T, Ghanbarnejad A, Madani A, Alizadeh A, Safari Moradabadi A: **The effect of educational intervention based on BASNEF model on the students' oral health.** *J Res Health* 2016.
16. Chandrashekar BR, Suma S, Sukhabogi JR, Manjunath BC, Kallury A: **Oral health promotion among rural school children through teachers: an interventional study.** *Indian J Public Health* 2014, **58**(4):235-240.
17. Ganapathi AK, Namineni S, Vaakavaaka PH, Vavamsilatha K, Das R, Devi M, Akkaloori A, Kumbakonam A: **Effectiveness of various sensory input methods in dental health education among blind children- a comparative study.** *J Clin Diagn Res* 2015, **9**(10):ZC75-ZC78.
18. Khudanov B, Jung HI, Kahharova D, Lee JW, Hamidov I, Lee ES, Kim BI: **Effect of an oral health education program based on the use of quantitative light-induced fluorescence technology in Uzbekistan adolescents.** *Photodiagnosis Photodyn Ther* 2018, **21**:379-384.

19. Sadana G, Gupta T, Aggarwal N, Rai HK, Bhargava A, Walia S: **Evaluation of the Impact of Oral Health Education on Oral Hygiene Knowledge and Plaque Control of School-going Children in the City of Amritsar.** *Journal of International Society of Preventive & Community Dentistry* 2017, **7**(5):259-263.
20. Mohamadkhah F, Shokravi FA, Faghihzadeh S, Ghaffarifar S: **The effect of digital media programs on the oral health promotion in the health office: A quasi-experimental study.** *Shiraz E Med J* 2013, **14**(1).
21. Yazdani R, Vehkalahti MM, Nouri M, Murto H: **School-based education to improve oral cleanliness and gingival health in adolescents in Tehran, Iran.** *Int J Paediatr Dent* 2009, **19**(4):274-281.
22. Haleem A, Siddiqui MI, Khan AA: **School-based strategies for oral health education of adolescents—a cluster randomized controlled trial.** *BMC Oral Health* 2012, **12**:54.
23. Vangipuram S, Jha A, Raju R, Bashyam M: **Effectiveness of peer group and conventional method (Dentist) of oral health education programme among 12-15 year old school children - A randomized controlled trial.** *J Clin Diagn Res* 2016, **10**(5):ZC125-ZC129.
24. D'Cruz AM, Aradhya S: **Impact of oral health education on oral hygiene knowledge, practices, plaque control and gingival health of 13- to 15-year-old school children in Bangalore city.** *Int J Dent Hyg* 2013, **11**(2):126-133.
25. Yang YH, Sue RL, Warnakulasuriya S, Dasanayake AP: **Promoting better oral health practices among aboriginal Taiwanese adolescents: A school based oral health education intervention program.** *J Health Care Poor Underserved* 2009, **20**(4 SUPPL.):41-50.
26. Kay E, Locker D: **Is dental health education effective? A systematic review of current evidence.** *Community Dent Oral Epidemiol* 1996, **24**(4):231-235.
27. Pieper K, Weber K, Margraf-Stiksrud J, Stein S, Heinzl-Gutenbrunner M, Jablonski-Momeni A: **Evaluation of an intensified preventive programme aimed at 12-year-olds with increased caries risk.** *J Public Health* 2012, **20**(2):151-157.
28. Nakre PD, Harikiran A: **Effectiveness of oral health education programs: A systematic review.** *Journal of International Society of Preventive & Community Dentistry* 2013, **3**(2):103.
29. Rong WS, Bian JY, Wang WJ, De Wang J: **Effectiveness of an oral health education and caries prevention program in kindergartens in China.** *Community Dent Oral Epidemiol* 2003, **31**(6):412-416.
30. Vachirarojpisan T, Shinada K, Kawaguchi Y: **The process and outcome of a programme for preventing early childhood caries in Thailand.** *Community Dent Health* 2005, **22**(4):253-259.

31. Alsada LH, Sigal MJ, Limeback H, Fiege J, Kulkarni GV: **Development and testing of an audio-visual aid for improving infant oral health through primary caregiver education.** *J Can Dent Assoc* 2005, **71**(4):241.
32. Kowash M, Pinfield A, Smith J, Curzon M: **Dental health education: effectiveness on oral health of a long-term health education programme for mothers with young children.** *Br Dent J* 2000, **188**(4):201.
33. Aljanakh M, Siddiqui AA, Mirza AJ: **Teachers' knowledge about oral health and their interest in oral health education in Hail, Saudi Arabia.** *Int J Health Sci* 2016, **10**(1):87.
34. Sukhabogi JR, Shekar BC, Hameed IA: **Knowledge, attitude and practices related to oral health among English and Telugu medium school teachers in two districts of Andhra Pradesh, India: a comparative study.** *J Indian Assoc Public Health Dent* 2014, **12**(4):306.
35. Asgari I, Tabatabaei Fakhar M: **Attitude toward Tooth Brushing and the Validity of the Questionnaire Based on Self-efficacy in Brushing in the 13-15 Years Adolescents in Isfahan, Iran.** *J Mas Den Sch* 2018, **42**(4):329-339.
36. Åström AN: **Changes in oral health related knowledge, attitudes and behaviours following school based oral health education and atraumatic restorative treatment in rural Tanzania.** *Nor Epidemiol* 2012, **22**(1).
37. Al Subait AA, Alousaimi M, Geeverghese A, Ali A, El Metwally A: **Oral health knowledge, attitude and behavior among students of age 10–18 years old attending Jenadriyah festival Riyadh; a cross-sectional study.** *Saudi J Dent Res* 2016, **7**(1):45-50.
38. Solhi M, Zadeh DS, Seraj B, Zadeh SF: **The application of the health belief model in oral health education.** *Iran J Public Health* 2010, **39**(4):114.
39. Yekaninejad MS, Eshraghian MR, Nourijelyani K, Mohammad K, Foroushani AR, Zayeri F, Pakpour AH, Moscowchi A, Tarashi M: **Effect of a school-based oral health-education program on Iranian children: results from a group randomized trial.** *Eur J Oral Sci* 2012, **120**(5):429-437.
40. Pakpour AH, Yekaninejad MS, Sniehotta FF, Updegraff JA, Dombrowski SU: **The effectiveness of gain-versus loss-framed health messages in improving oral health in Iranian secondary schools: a cluster-randomized controlled trial.** *Ann Behav Med* 2013, **47**(3):376-387.
41. Blake H, Dawett B, Leighton P, Rose-Brady L, Deery C: **school-based educational intervention to improve children's oral health-related knowledge.** *Health Promot Pract* 2015, **16**(4):571-582.
42. Prabhu S, John J: **Oral health education for improving oral health status of school children—a systematic review.** *IOSR J Dent Med Sci* 2015, **14**(2):101-106.

Figures

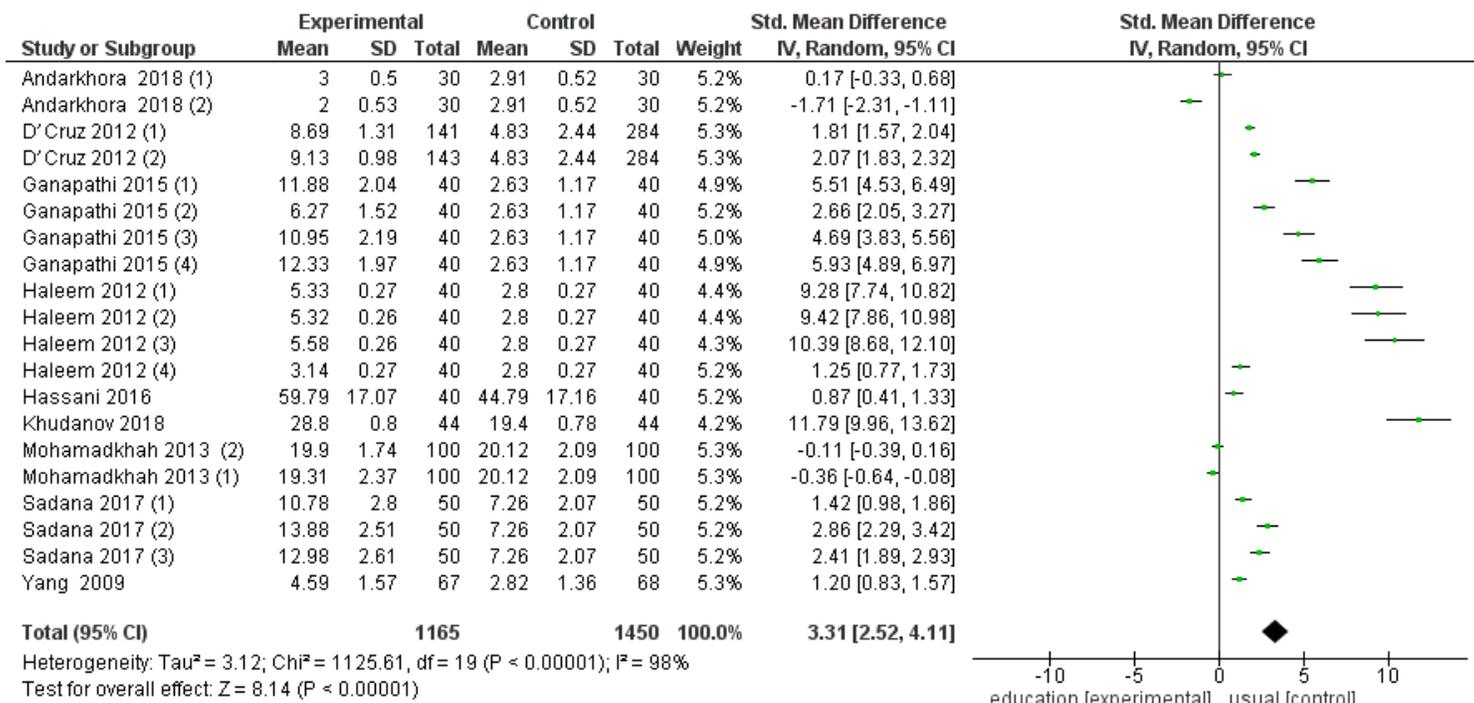


Figure 1

Comparison Educational intervention versus usual care, Outcome Oral health-related knowledge.

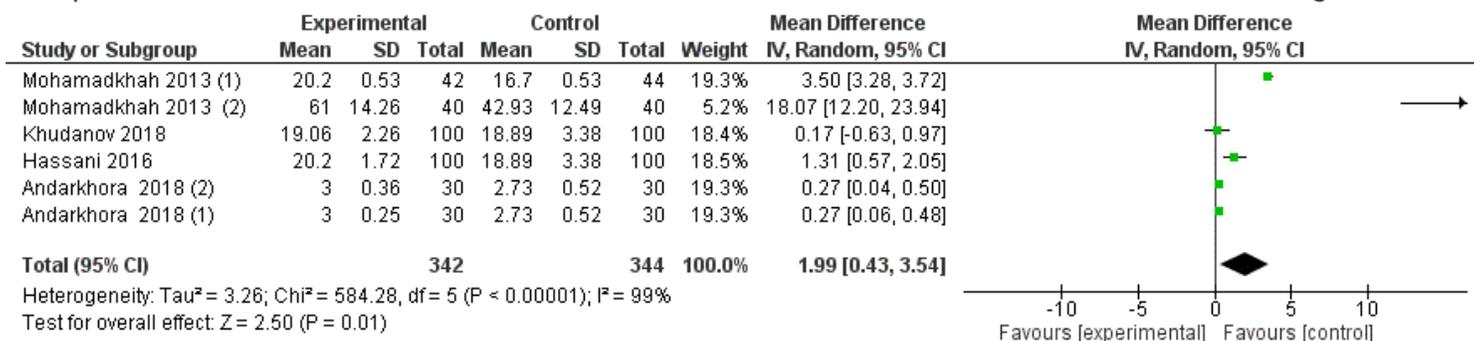


Figure 2

Comparison Educational intervention versus usual care, Outcome Oral health-related attitude.

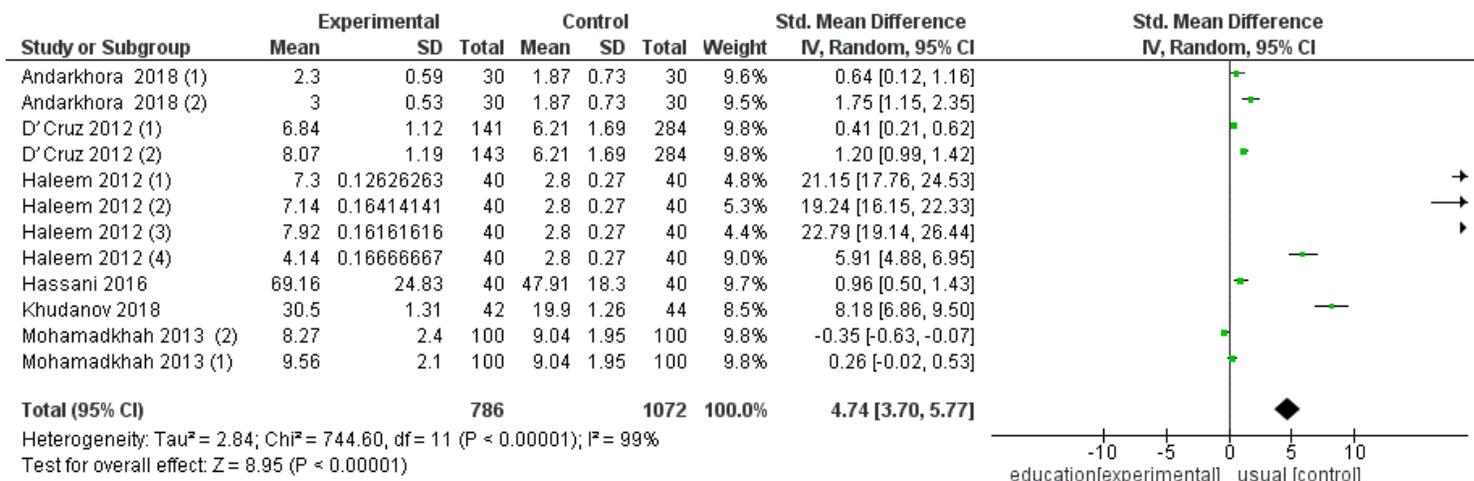


Figure 3

Comparison Educational intervention versus usual care, Outcome Oral health-related behavior.

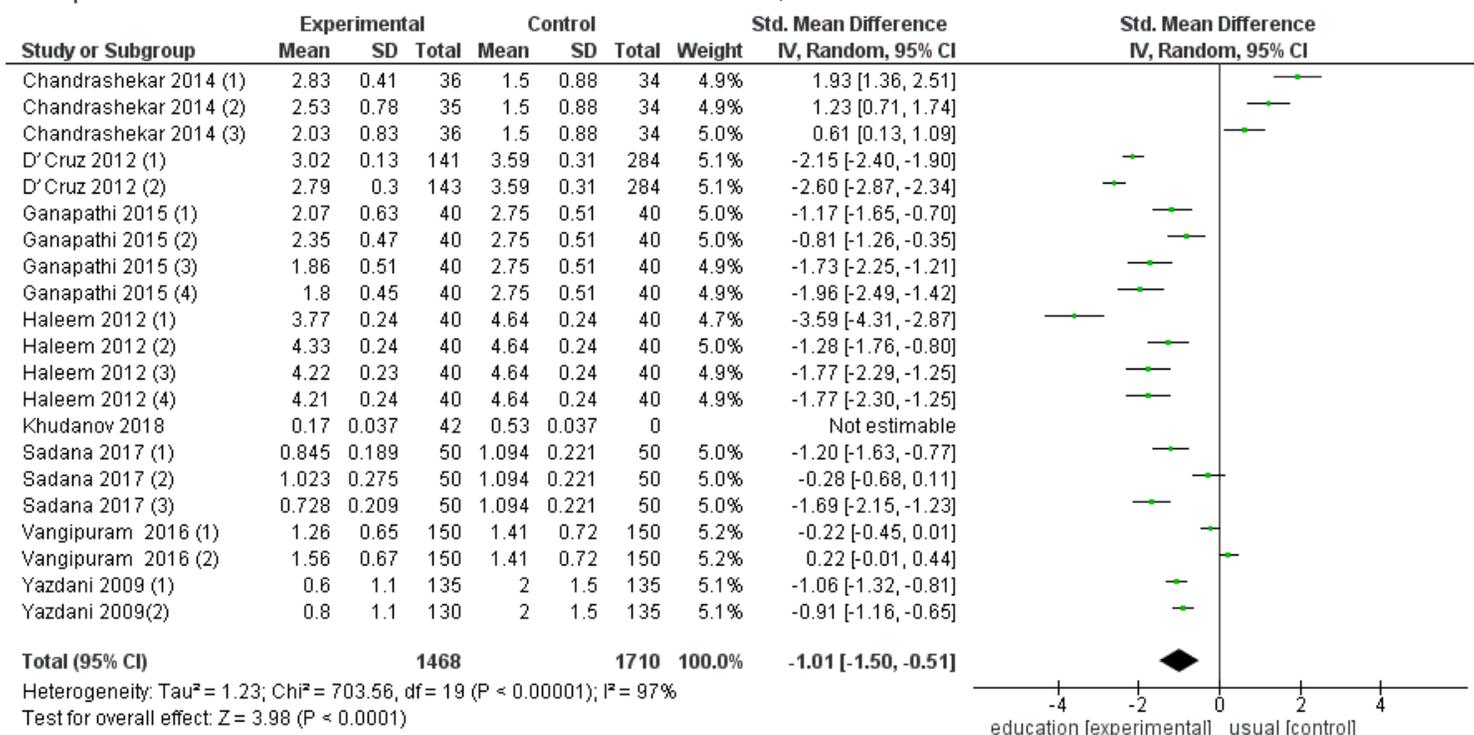


Figure 4

Comparison Educational intervention versus usual care, Outcome plaque index.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementary1.docx](#)

- [Supplementary5.docx](#)
- [Supplementary4.docx](#)
- [Supplementary2.docx](#)
- [Supplementary3.docx](#)