Journal of Epidemiology and Public Health (2023), 08(02): 205-212
Masters Program in Public Health, Universitas Sebelas Maret

Meta-Analysis

Meta-Analysis the Effectiveness of Fluoride Varnish Use to Prevent Deciduous Dental Caries in Children

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ABSTRACT

Background: Oral health has improved in the last century but the prevalence of dental caries in children remains a significant clinical problem. Giving fluoride varnish directly to the surface of a child's teeth can prevent caries. This study aims to analyze the effect of using fluoride varnish on the prevention of dental caries in children.
Subjects and Method: This research is a systematic review and meta-analysis research by considering the eligibility criteria using the PICO model. Population: children. Intervention: fluoride varnish. Comparison: do not use fluoride varnish. Outcome: DMF-T. Articles in this study were searched through the PubMed, Google Scholar, Science Direct, ProQuest databases with the keywords "effectiveness" AND "fluoride" AND "dental caries" AND "prevention" AND ("child OR children") AND "randomized controlled trial". The inclusion criteria in this study were full-text articles from 2000 to 2022 with randomized controlled trials (RCT) designs and mean SD effect sizes. This study uses PRISMA flow diagrams and uses the Revman 5.3 application for analysis.
Results: A meta-analysis of 5 articles showed that the use of fluoride varnish reduced DMFT 1.21 units lower, compared to those not using fluoride varnish in children. The results of the meta-analysis were statistically significant (SMD = -1.21; 95% CI = -3.15 to 0.74; p= 0.220).
Conclusion: The use of fluoride varnish may decrease DMFT in children.

Keywords: dental caries, Fluoride varnish

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Cite this as:
Utomo AI, Murti B, Pamungkasari EP (2023). Meta-Analysis the Effectiveness of Fluoride Varnish Use to Prevent Deciduous Dental Caries in Children. J Epidemiol Public Health. 08(02): 205-212. https://doi.org/10.26911/jepublichealth.2023.08.02.05.

BACKGROUND

Dental and oral disease is a disease that is widespread in Indonesian society and can be a source of infection that can affect several systemic diseases. Causative factors of dental and oral disease are influenced by environmental factors, behavior and dental and oral health services. Oral health has improved in the last century but the prevalence of dental caries in children remains a significant clinical problem. Caries with a distinctive pattern and often occurring in children under 6 years of age are commonly called early childhood caries (ECC) (Jagan et al., 2018).

Early childhood caries (ECC) is one of the most common diseases in children worldwide. ECC is driven by the dysbiotic state of oral microorganisms which is primarily caused by a sugar-rich diet. In addition, poor oral hygiene or inadequate removal of dental plaque. Children with extensive ECC

are at high risk for developing caries with the permanent teeth or will have other problems with speaking or eating. To prevent ECC, several strategies must be considered. Children should brush their teeth with toothpaste containing soft ingredients. Parents/caregivers should help their children brush their teeth (Jagan et al., 2018).

The Global Burden of Disease Study estimates that 2.4 billion people suffer from permanent dental caries and 486 million children suffer from primary dental caries. Dental caries occurs when microbial biofilms (plaque) that form on tooth surfaces convert free sugars contained in food and drinks into acids which dissolve tooth enamel and dentin over time. With persistently high intakes of free sugars, inadequate exposure to fluoride and without microbial biofilms that can be removed regularly, tooth structure is destroyed, resulting in the development of cavities and pain, impacting oral health-related quality of life, and, at stages advanced disease, tooth loss and systemic infection (WHO, 2019).

The topical application of fluoride varnish was developed around 1960 as a treatment by administering fluoride varnish directly to the surface of a child's teeth with the aim of giving the fluoride varnish the opportunity to penetrate the enamel, which in turn, the fluoride varnish ions will replace the hydroxyl ions in the enamel so that it can increase the resistance of the enamel to acid attack. thus preventing caries. The use of fluoride varnish is used because the procedure is simple, easy and well accepted by pediatric patients (Jagan et al., 2018).

Recent studies have shown that if fluoride varnish is consumed during the period of tooth formation, enamel will be more resistant to acid attack. The existence of these various mechanisms provides added value to fluoride varnish in caries prevention (Yani et al., 20015). Fluoride varnish has a role in stimulating the tooth remineralization process which will stop the ongoing caries process (Ongole, 2017). Based on the background described above, the purpose of this study was to analyze the effect of using fluoride varnish on the prevention of dental caries in children.

SUBJECTS AND METHOD

1. Study Design

This research is a systematic review and meta-analysis study using PRISMA flow diagrams and the Critical Appraisal Skills Program (CASP) for RCT. The articles in this study were obtained from several databases, namely: PubMed, Google Scholar, Science Direct, ProQuest. The time of the selected study results is in the period 2000-2022. Article searches were carried out using the keywords “effectiveness” AND “fluoride” AND “dental caries” AND “prevention” AND (“child OR children”) AND “randomized controlled trial”.

2. Steps of Meta-Analysis

The meta-analysis was carried out through 5 steps as follows:

1) Formulate research questions using the PICO model
2) Search for primary study research articles from online databases such as Pubmed, Google Schoolar, Science Direct, Research gate, and Springer.
3) Conduct screening and quality assessment of primary study articles.
4) Extract and analyze data into the RevMan 5.3 application.
5) Interpret the results and conclusions.

3. Inclusion Criteria

The inclusion criteria in this study included: full-paper articles with a randomized controlled trial (RCT) study design, articles using English, interventions in articles using fluoride varnish, study subjects were pediatric patients aged 6 months– 5 years and

study outcomes is DMF-T.

4. Exclusion Criteria

The exclusion criteria in this study were the non-compliant RCT research intervention (fluoride varnish) but other interventions namely brushing teeth, knowledge about brushing teeth, ohi-s research outcomes and research subjects were patients with immature teeth and patients with caries that were too severe.

5. Operational Definition of Variables

Article search was carried out by considering the eligibility criteria using the PICO model. The population in this study are children. The research intervention used was fluoride varnish. The comparison in this study was not using fluoride varnish and the research outcome was DMF-T.

The DMF-T is a clinical instrument for assessing caries in primary teeth. Primary tooth caries is a process of demineralization caused by an interaction between microorganisms, carbohydrates in food and enamel on the first teeth to grow.

Fluoride varnish is a material that sticks to the surface of the teeth, is yellow in color, semi-liquid, contains fluoride resin and contains alcohol which can speed up the drying process. The instrument used is a micro applicator.

6. Study Instruments

This study uses PRISMA flow diagrams for systematic review and Critical Appraisal Skills Program (CASP) for RCT for meta-analysis.

7. Data Analysis

Data analysis was performed using Software Review Manager (RevMan) which was used to calculate the overall mean difference, describing the confidence interval (CI) = 95% with the effect model and I2 or heterogeneity of the data.

RESULTS

Through several databases including PubMed, Google Scholar, Science Direct and ProQuest. This study uses PRISMA flow diagrams for systematic review as shown in Figure 1.

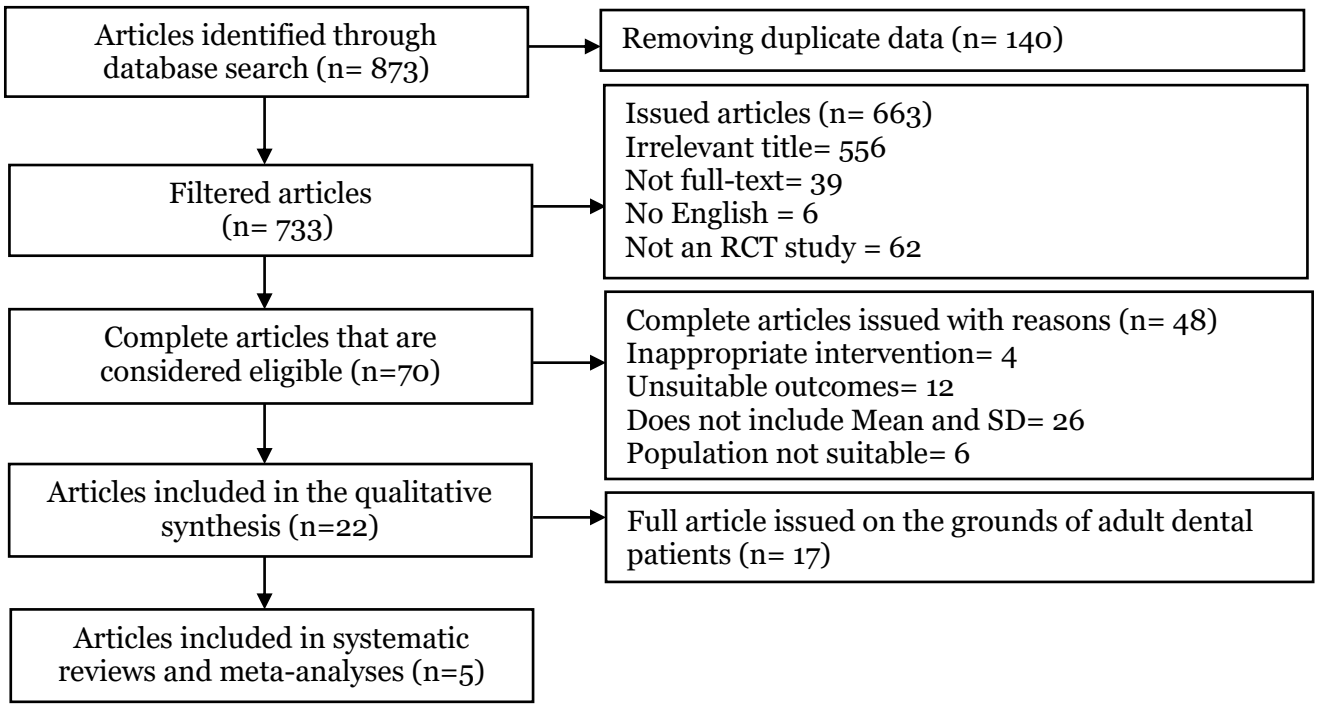

Figure 1. PRISMA Flowchart

The initial search results found 873 identified articles. In the double article screening, 140 double articles were found which were then deduplicated to obtain 733 articles. Furthermore, an initial screening was carried out and as many as 70 articles were identified that were considered feasible for a full text review. The results of the articles that met the qualitative requirements were reviewed again. The final results of the article review obtained 5 articles that met the quantitative requirements for meta-analysis. Research related to the use of fluoride varnish to prevent cavities in children, consists of 5 articles originating from 3 continents namely, Asia, Europe and America as shown in Figure 2.

Figure 2. Map of the primary study article area of the effectiveness of fluoride varnish use to prevent deciduous dental caries in children

Table 1. Critical appraisal checklist for Randomized Control Trial (RCT) studies in meta-analysis

Primary Study	Criteria of Questions											Total
	1	2	3	4	5	6	7	8	9	10	11	
Agouropoulos *et al.* (2014)	1	1	1	1	1	1	1	1	1	1	1	11
Jiang *et al.* (2014)	1	1	0	1	1	1	1	1	1	1	1	10
Latifi-Xhemajli *et al.* (2019)	1	1	1	1	1	1	1	1	1	1	0	10
Lawrence *et al.* (2008)	1	1	0	1	1	1	1	1	1	1	0	9
Oliveira *et al.* (2014)	1	1	1	1	1	1	1	0	1	1	0	9

Description of the question criteria:

1 = Does the experiment clearly answer the clinical problem?
2 = Is the intervention given to patients done randomly?
3 = Are patients, health workers, and researchers blinded?
4 = Were the study groups similar at the start of the study?
5 = Outside of the intervention studied, were the study groups treated the same?
6 = Were all patients included in the study properly accounted for in the conclusions? Were all patients analyzed according to the randomized study groups?
7 = Is the effect of the intervention large enough?
8 = How precise is the estimation of the effect of the intervention?

9 = Are the results applicable to the context of practice or local populations?
10 = Were all other clinically important outcomes considered in this article?
11 = Do the benefits provided by the intervention outweigh the costs and disadvantages?

Description of the answer score:
0 = No
1 = Hesitant

In Table 1, the researchers assessed the quality of the research using the Critical Appraisal Skill Program (CASP). Based on Table 2. it can be seen that out of a total of 5 articles with a total sample of 2,430 participants. The research articles came from the Asian continent, the European continent and the Americas with all DMF-T outcomes and most of the research interventions in the form of fluoride varnish application. As for the comparison does not use fluoride varnish.

Table 2. Description of the primary studies included in the meta-analysis of fluoride varnish use in preventing dental caries (N=2,430)

Author (year)	Location	Sample size	P	I	C	O
Agouropoulos et al. (2014)	Greece	328	Preschoolers	Fluoride varnish	Didn't gived fluoride varnish	DMF-T
Jiang et al. (2014)	Hongkong	271	Children aged 8 to 23 months	Fluoride varnish	Placebo	DMF-T
Latifi-Xhemajli et al. (2019)	Kosovo	504	Children aged 21 months and 45 months	Fluoride varnish	Placebo	DMF-T
Lawrence et al. (2008)	Canada	1,146	Children aged 6 months to 5 years from the SLZ community (20 Communi-ties)	Fluoride varnish	Placebo	DMF-T
Oliveira *et al.* (2014)	Brazil	181	Children aged 1-4 years	Fluoride varnish	Placebo	DMF-T

Table 3. Effect estimates (Mean SD) of all primary studies performed in the meta-analysis (N=2,430)

Author (Yeaar)	*Fluoride varnish*		Non- *Fluoride varnish*	
	Mean	SD	Mean	SD
Agouropoulos *et al.* (2014)	2.90	5.30	3	5.20
Jiang *et al.* (2014)	0.30	1	0.30	1.20
Latifi-Xhemajli *et al.* (2019)	5.20	10.50	10.10	12.90
Lawrence *et al.* (2008)	10.17	0.46	13.47	0.90
Oliveira *et al.* (2014)	1.80	3.90	2.50	4

The results of the meta-analysis are presented in the form of a forest plot. Forest plot is a diagram that shows information from each studied study and is an estimate of the overall results. Apart from forest plots, in the meta-analysis there is also a funnel plot. The funnel plot illustrates the occurrence of publication bias

by showing the relationship between the study effect size and the sample size of the various studies studied. Interpretation of the results of the meta-analysis process can be seen through the forest plot. Figure 3 shows that there is an effect of using fluoride varnish on the occurrence of caries in primary teeth. The effect is statistically significant. Children who used fluoride varnish had an average DMFT 1.21 times lower than those who did not use fluoride varnish (SMD= -1.21; 95% CI = -3.15 to 0.74; p=0.220). The Forest Plot in Figure 3 also shows the heterogeneity of the effect between studies which is also the magnitude of I^2 = 100%; p<0.001. Thus the average calculation is carried out using the Random Effect Model (REM) approach.

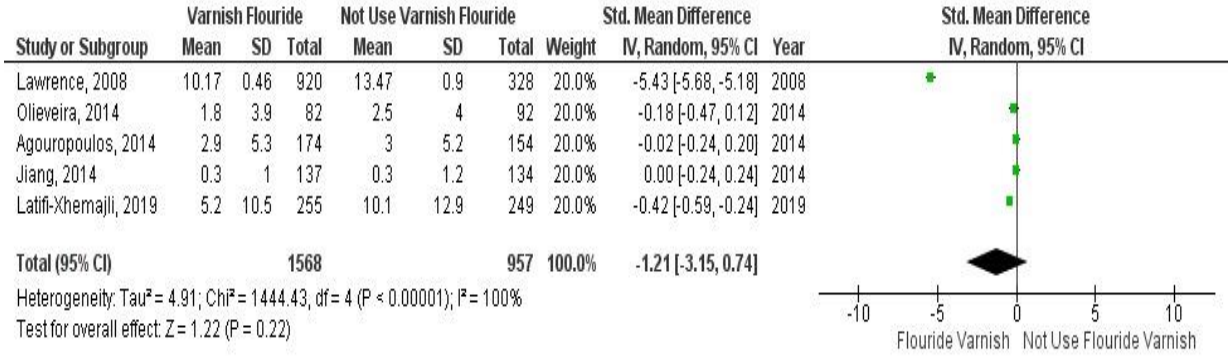

Figure 3 Forest Plot Use of fluoride varnish against DMF-T

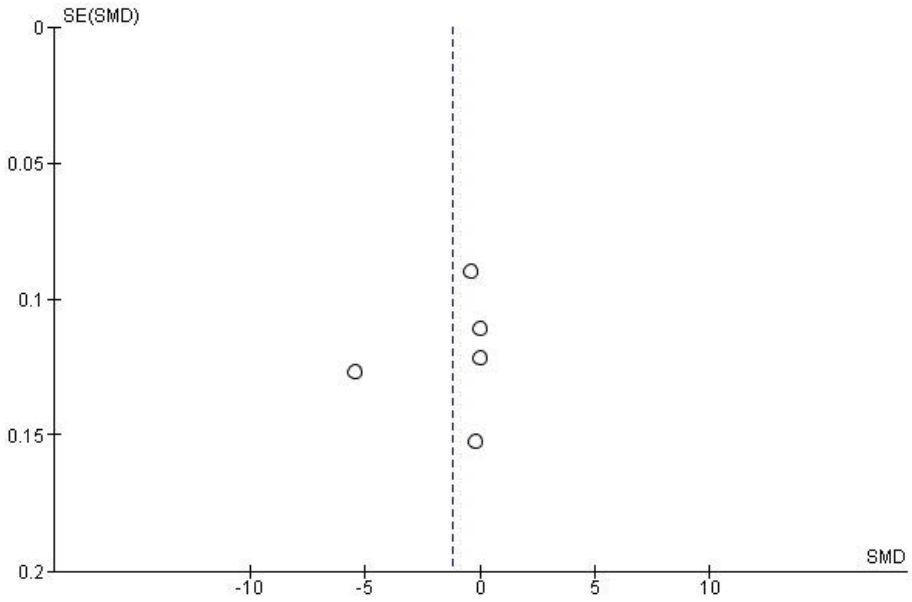

Figure 4 Funnel Plot Use of fluoride varnish against DMF-T

Based on Figure 4, it shows that the distribution of effect estimates is more located on the right than on the left. The average effect vertical line thus shows publication bias because the distribution of effect estimates in the funnel plot is located to the right of the vertical line while the average effect estimate (diamond shape) is located to the left of the vertical line hypothesis 0, then the publication bias reduces the true effect (under estimate).

DISCUSSION

Early childhood caries (ECC) is one of the most common diseases in children worldwide. Fluoride varnish is a material that sticks to the surface of the teeth, is yellow in color, semi-liquid, contains fluoride resin and contains alcohol which can speed up the drying process. This material contains 5% sodium fluoride. The method of use is applied to the enamel which aims to keep fluoride in contact with the teeth for a long time (Beltran et al., 2000).

Based on the results of a meta-analysis of 5 articles, it was shown that the use of fluoride varnish had an average DMFT 1.21 times lower, compared to those who didnt use fluoride varnish. The results of the meta-analysis were statistically significant (SMD= -1.21; 95% CI= -3.15 to 0.74; p= 0.220). The heterogeneity of the research data showed I^2 = 100%, p <0.001 so that the distribution of the data was declared heterogeneous Random Effect Model.

The results of this study are in line with those conducted by Lawrence et al. (2008) in early childhood in Aborigines for 2 years which showed a clinical outcome for the main effectiveness variable, namely an increase in 'net' DMF, the study found a decrease of 18.3 % (or PF) at ECC level among First Nations children. The mean net DMF-T increase in children assigned to semiannual FV application and caregiver counseling was 2.88 (Mean= 2.88; SD= 0.13) and 3.49 (Mean= 2.49; SD= 0.23) in the counseling only group (p= 0.160).

Research conducted by Ohnmar et al. (2009) is also in line with the results of this study. Giving children a combination of iodine varnish and tropical fluoride varnish can prevent caries. At study entry, the mean age deft was 8.9 (SD= 4.6) for the intervention group and 9.4 (SD= 5.1) for the control group and the results were not different for the two groups (t=1.10; p=0.270). Every child in a given school receives the same intervention. Children in the combination treatment were twice as likely to be caries-free in permanent molars than children in the fluoride only cohort. Antimicrobials tend to be most effective when the permanent teeth are first erupting and the occlusal surfaces have not yet been colonized. In contrast, PVP-iodine does not appear to protect primary infected and severely damaged primary teeth.

Based on results and the discussion above, it can be concluded that a meta-analysis on 5 articles from 3 continents namely, Asia, Europe, and America showed that the use of fluoride varnish had a DMFT 1.21 times lower, compared to those not using fluoride varnish. This shows that fluoride varnish can prevent primary dental caries in children. The results of this study support the theory that the use of fluoride varnish can prevent dental caries in young children. This research is not without its limitations, so it is hoped that future research can develop research on the use of fluoride varnish in children in preventing caries in primary teeth with a much broader target.

AUTHOR CONTRIBUTION

Asrori Ibnu Utomo is the main researcher who selects research topics, collects data and conducts research.

ACKNOWLEDGEMENT

The authors thank the database providers in the form of PubMed, Google Scholar, Science Direct and ProQuest.

FUNDINGS AND SPONSORSHIP

The study was self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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