Meta-Analysis: Effectiveness of Dental and Oral Health Education using Combination Method on Knowledge and Plaque Scores in Visually Impaired Children

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ABSTRACT

Background: Dental health education is important to improve people's dental and oral health. Visually impaired children have limited vision, so they need appropriate and appropriate methods for accepting visually impaired children by maximizing the provision of education through senses other than sight in carrying out treatment and prevention efforts. This study aimed to analyze the effectiveness of combination oral health education on the oral health knowledge and plaque scores in visually impaired children.

Subjects and Method: This was a meta-analysis with PICO model. Population: Visually impaired children. Intervention: dental health education ≥3 methods. Comparison: without education or <3 education methods. Outcome: oral hygiene knowledge and plaque scores. Article search was carried out using the keywords: ("dental health education" OR "oral hygiene" OR "oral health education") AND ("visually impaired children" OR "blind children") AND "randomized control trial". Studies published between 2013-2023 from the PubMed, Elsevier, Google Scholar, and Science Direct databases were included. Standarized mean difference (SMD) from selected articles were were analyzed using the Review Manager 5.4 tool.

Results: 10 RCTs from India and Indonesia were included in the meta-analysis. The use of combined education methods increased knowledge of oral hygiene compared to single education (SMD= 2.67; 95% CI= 1.05 to 4.30; p<0.001). Combined education method reduced plaque scores compared to single education (SMD= -0.82; 95% CI= -1.29 to -0.35; p<0.001).

Conclusion: Combination education methods increase oral hygiene knowledge and reduce plaque scores in visually impaired children.

Keywords: dental health education, DHE, visual impairment, combination method, knowledge, plaque score.

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BACKGROUND

Dental health education is the process of delivering information about dental and oral health to increase overall knowledge and help raise public awareness of the importance of oral hygiene and then instill dental and oral health maintenance habits. (Kindangen et al., 2021).

Visually impaired children have lack of ability to maintain good oral health, because they cannot detect and recognize oral diseases early (Chowdary, 2018). Blind people have a higher risk of developing caries because they are unable to see early signs of caries such as color changes which are indicators of the disease process. (Deolia, 2020).

The school system provides a conducive environment for teaching preventive oral health practices and improving oral health for disadvantaged populations (Bhor, 2016). Blind children have better hearing and touch sensitivity than normal children.

Oral health education programs and a variety of specially designed combined educational methods consist of audio aids, tactile aids, embossed images, booklets in Braille, 3-dimensional models and individual tooth brushing training (Kindangen et al., 2021; Aggarwal, 2018). This study aimed to analyze the effectiveness of oral health education using a combination method on the level of knowledge and plaque scores in blind children.

SUBJECTS AND METHOD

1. Study Design

This study was conducted using a systematic review and meta-analysis between 2013 and 2023. Search for this research article through databases, including: PubMed, Elsevier, Google Scholar and Science Direct using search keywords "Dental Health Education" OR "Oral Hygiene" OR "Oral Health Education") AND ("Visually Impaired Children" OR "Blind Children") AND Randomized Control Trial.

2. Step of Meta-Analysis

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

1) Formulate research questions in the PICO, including: Population: children with visual impairments. Intervention: dental health education >= 3 methods. Comparison: no education or single education. Outcome: knowledge of oral hygiene level and plaque score.

2) Search for primary study articles from various electronic and non-electronic databases.

3) Conduct screening and critical assessment of primary research articles (PubMed, SpringerLink, Elsevier, Google Scholar and Wiley Online Library).

4) Perform data extraction and synthesize effect estimates into RevMan 5.3.

5) Interpret and conclude the results.

3. Inclusion Criteria

The inclusion criteria used in this study were full-text articles using a Randomized Controlled Trial (RCT) design. The analysis used was multivariate with Standardized Mean Difference (SMD).

4. Exclusion Criteria

The exclusion criteria in this study were articles published before 2013 and articles that did not include a mean SD.

5. Operational Definition of Variables

Intervention providing education using a combination method is a dental and oral educational procedure using a combination of >3 methods.

Knowledge of oral hygiene is an increase in dental and oral knowledge and a decrease in plaque scores.

Plaque score is a score obtained through examination of soft deposits found on the tooth surface, which can include plaque, white material, and food debris.

6. Instruments

This study was guided by the PRISMA flow diagram and assessed the quality of research articles using the Critical Appraisal Checklist for Randomized Controlled Trial (RCT) tools.

7. Data analysis

The collected articles were processed using the Review Manager application (RevMan 5.4). Data processing is carried out by calculating effect sizes and heterogeneity values to determine the study combination model and form the final results of the meta analysis which are presented in the form of forest plots and funnel plots.

RESULTS

Search articles in this research through databases including PubMed, SpringerLink, Elsevier, Google Scholar and Wiley Online Library.

Figure 1 showed the initial search process, articles identified through databases search total of 408 articles. After the process of eliminating duplicate articles (n= 10 articles), 398 articles were obtained, 20 articles met the requirements for further full text review. Finally, there were 10 articles that met the requirements for full text review.

Figure 2 showed a map effectiveness of dental and oral health education using combination method on knowledge and plaque scores in Visually Impaired Childre will be included in the meta-analysis from 1 continent namely Asian. Table 1 showed quality assessment result of articles with a randomized controlled trial study included in meta-analysis.
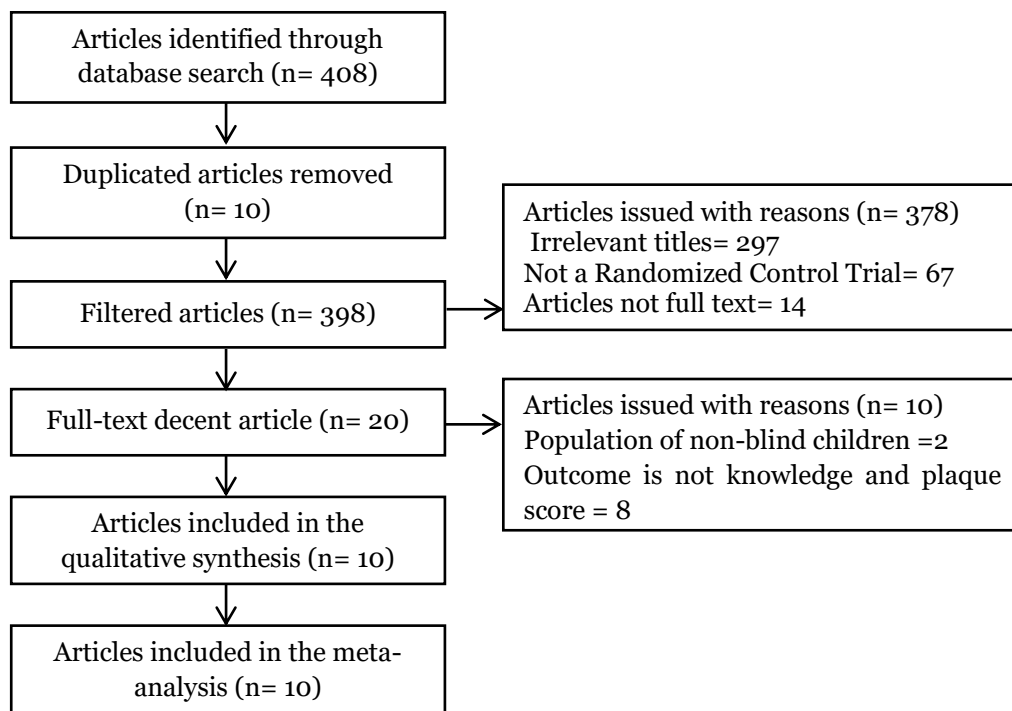
Figure 1. Results of PRISMA Flow diagrams effectiveness of dental and oral health education using combination method on knowledge and plaque scores

Figure 2. Research distribution map the effectiveness of dental and oral health education using combination method on knowledge and plaque scores

Table 1. The quality assessment result of the effectiveness of dental and oral health education using combination method on knowledge and plaque score (RCT).

Primary Study	Criteria														Total
	1				2		3		4			5		6	
	a	b	c	d	a	b	a	b	a	b	c	a	b		
Gautam et al. (2018)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Ganapathi el al. (2015)	2	1	2	2	2	2	2	2	2	2	2	2	2	2	27
Gautam et al. (2020)	2	1	2	2	2	2	2	2	1	2	2	2	2	2	26
KBhor et al. (2016)	2	1	2	2	2	2	2	2	1	2	2	2	2	2	26
Chowdary et al. (2016)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Sardana el al. (2019)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Das et al. (2018)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Alamsyah et al. (2017)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Depnath et al. (2017)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Deolia et al. (2019)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28

Description of the question criteria:

1. Formulation of research questions in PICO acronym:

a. Is the primary study population the same as the population in the PICO meta-analysis?

b. Is the operational definition of the intervention (exposure) in the primary studies consistent with the definition used in the meta-analysis?

c. Is the comparison used in the primary studies consistent with the definition intended in the meta-analysis?

d. Is the outcome variable studied in the primary studies consistent with the definition intended in the meta-analysis?

2. Method for selecting research subjects

a. Is the sample selected from the population in a way that ensures representativeness?"

b. Is the allocation of subjects into experimental and control groups done

through randomization? Random allocation is useful for controlling the influence of all confounding factors, both known and unknown to the researchers.

3. Methods for measuring comparisons (intervention) and outcome variables:

a. Are the intervention and outcome variables measured using the same instrument across all primary studies? If the outcome variable is measured with different instruments, the effect size used in the meta-analysis should be standardized, such as the Standardized Mean Difference.

b. If the variable is measured on a categorical scale, are the cutoffs or categories used consistent across primary studies?

4. Bias of the design

a. Was double-blinding implemented, meaning that both the research subjects and the research assistants measuring the outcome variable were unaware of the intervention status of the subjects?

b. Is there minimal risk of 'Loss-to-Follow-up Bias'?

c. Did the primary study researchers take measures to prevent or address potential biases, such as selecting highly motivated subjects, choosing subjects who are easy to follow, or providing incentives to minimize dropout?

5. Methods to control confounding:

a. Are outcome data compared between the experimental group and the control group after the intervention? Since subjects were randomly allocated to these groups before the intervention, both groups should have a comparable distribution of confounding factors prior to the intervention, allowing the effect of the intervention to be determined by comparing outcomes between the two groups after the intervention.

b. Are all data analyzed according to the initial randomization results? Randomization conducted before the intervention effectively controls for confounding factors only if all data are analyzed according to the original randomization.

6. Is there a conflict of interest with the research sponsor?

Description of scoring:
0= No; 1= Hesitate; 2= Yes.

Table 2 describes a summary of primary research of the effect of the combination method on oral hygiene in visually impaired children, a meta-analysis was carried out on 7 articles originating from India. The largest research population was found in a study conducted by Sardana et al. (2019) consisting of 70 people in the intervention group and 70 people in the control group, and the study with the smallest population, namely the study conducted by Gautam et al. (2018) as many 70 people in the intervention group and 70 people in the control group.

Table 2. Description of primary studies included in the meta-analysis of the effect of combined methods on oral hygiene (randomized controlled trial study)

Author (years)	Country	Sample		P	I	C	O
		I	C				
Gautam et al. (2018)	India	20	20	Visually Impaired Children	Dental education with Audio+ Braille +Tactile Techniques	Dental education with Audio+ Braille Techniques	Plaque Score
Ganapat hi et al.	India	40	40	Visually Impaired	Dental education with Audio+	Not given education	Plaque Score

Author (years)	Country	Sample I	Sample C	P	I	C	O
(2015) Gautam et al. (2020)	India	60	60	Children Visually Impaired Children	Braille+ Model Dental education with Audio+ Tactile + Braille+ Performance	Dental education with Braille	Plaque Score
KBhor et al. (2016)	India	37	37	Visually Impaired Children	Dental education with OHT+ booklet+ Braille	Dental education with Braille	Plaque Score
Chowdary et al. (2016)	India	40	40	Visually Impaired Children	Dental education with Verbal+ Audio+ Tactile	Dental education with verbal+ tactile	Plaque Score
Sardana et al. (2019)	India	74	74	Visually Impaired Children	Dental education with Audio story + JAWS	Dental education with Braille + model	Plaque Score
Das et al. (2018)	India	30	30	Visually Impaired Children	Dental education with Audio + Tactile + Dental models	Dental education with Audio+ braille	Plaque Score

Table 3. Mean, SD, and total sample data in the intervention and control groups regarding the effect of the combination method on oral hygiene in visually impaired children.

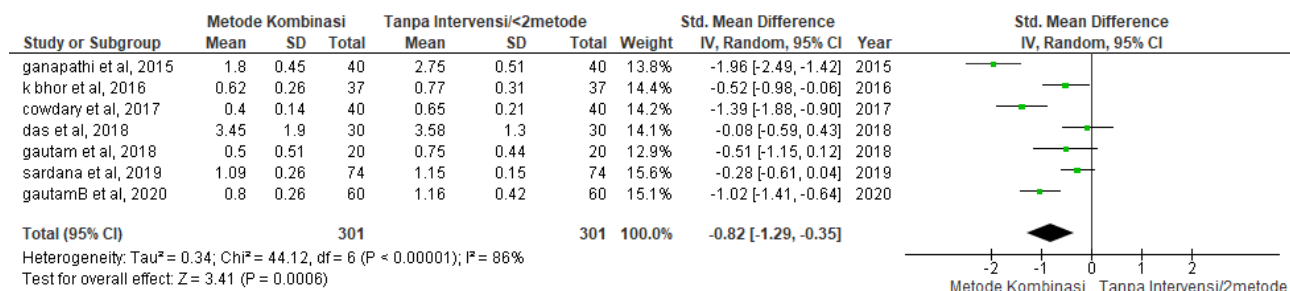| Author (year)	Intervention (Dental health education)			Control (No dental health education)		
	Mean	SD	n	Mean	SD	n
Gautam et al. (2018)	0.5	0.51	20	0.75	0.44	20
Ganapathi et al. (2015)	1.8	0.45	40	2.75	0.51	40
Gautam et al. (2020)	0.8	0.26	60	1.16	0.42	60
Bhor et al. (2016)	0.62	0.26	37	0.77	0.31	37
Cowdary et al. (2017)	0.4	0.14	40	0.65	0.21	40
Sardana et al. (2019)	1.09	0.26	74	1.15	0.15	74
Das et al. (2018)	3.45	1.9	30	3.58	1.3	30

Figure 3. Forest Plot the effect of combination methods on oral hygiene in visually impaired children.

Table 3 showed the variation of Mean, SD across each primary study the combination method on oral hygiene in visually impai-

red children included in the meta-analysis. The largest Mean in the intervention group showed by Das et al. (2018) (Mean= 3.45;

SD= 1.9) , and the smallest Mean in the intervention group conducted by Cowdary et al. (2017) (Mean= 0.40; SD= 0.14).

The aim of the study with a sample of 301 blind children was to report the effect of dental health education using a combination method on oral hygiene as represented by examining plaque scores (Figure 5). According to the results of the analysis,

dental health education using a combination method can reduce 0.82 units of plaque score compared to no education or only given education alone, and the results are statistically significant (SMD= -0.82; 95% CI= -1.29 to -0.35; p<0.001). Research data showed I^2= 86% so that the data distribution was declared heterogeneous (random effect model).
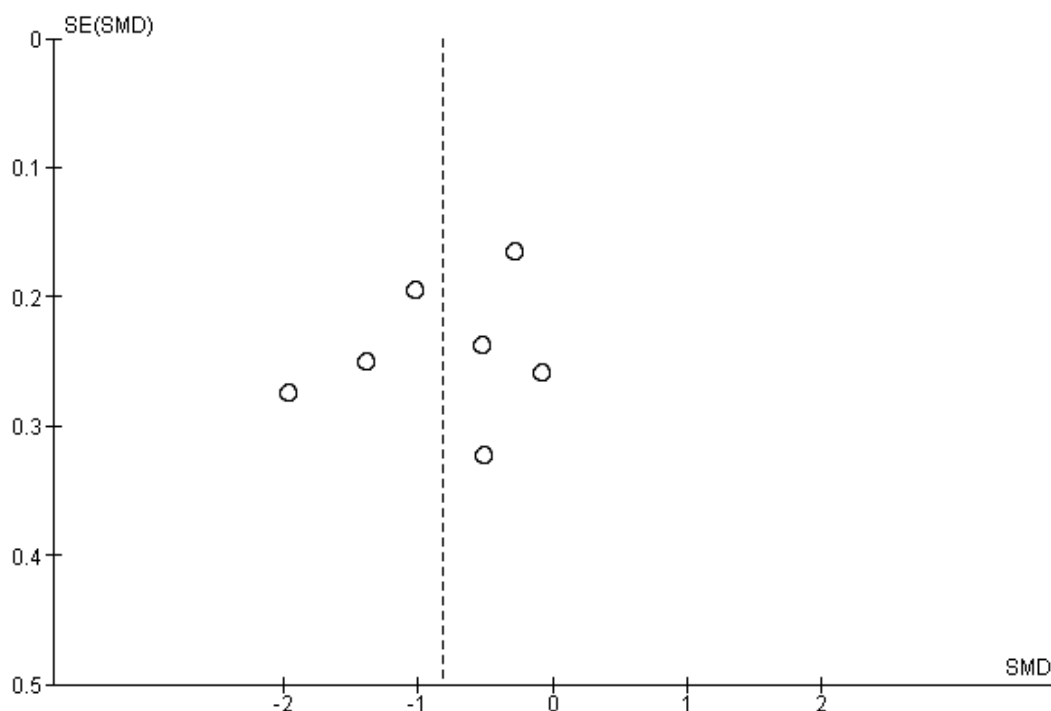

Figure 4. Funnel plot the effect of combination methods on oral hygiene in visually impaired children.

The funnel plot in figure 4 showed an even distribution of estimated effects between the right plot and the left plot. There were 3 plots on the left and 4 plots on the right. The funnel plot in Figure 6 regarding the

effect of combination methods on oral hygiene in blind children shows a symmetrical triangle. Thus, the funnel plot image showed the absence of regular publications.

Table 4. Primary descriptions included in the meta-analysis of the effect of combined methods on oral cavity knowledge (randomized controlled trial study).

Author (years)	Country	Sample		P	I	C	O
		I	C				
KBhor et al. (2016)	India	37	37	Visually Impaired Children	Dental education with OHT+ booklet+ Braille	Dental education with Braille	oral cavity knowledge
Gautam	India	60	60	Visually	Dental education	Dental	oral cavity

Author (years)	Country	Sample I	Sample C	P	I	C	O
et al. (2020)				Impaired Children	with Audio+ Tactile+ Braille+ Performance	education with Braille	knowledge
Ganapathi et al. (2015)	India	40	40	Visually Impaired Children	Dental education with Audio+ Braille+ Model	Not given education	oral cavity knowledge
Alamsyah et al. (2017)	Indonesia	49	44	Visually Impaired Children	Dental education with Audio +Braille+ Performance	Not given education	oral cavity knowledge
Depnath et al. (2017)	India	40	40	Visually Impaired Children	Dental education with Braille+ music+ booklet	Not given education	oral cavity knowledge
Deolia et al. (2019)	India	48	44	Visually Impaired Children	Dental education with audio+ tactile+ performance	Not given education	oral cavity knowledge
Das et al. (2018)	India	30	30	Visually Impaired Children	Dental education with Audio+ tactile+ dental model	Dental education with Audio + braille	oral cavity knowledge

Table 4 describes a summary of primary research of the effect of combined methods on oral cavity knowledge in visually impaired children, a meta-analysis was carried out on 7 articles originating from India and Indonesia. The largest research population was found in a study conducted by Gautam et al. (2020) consisting of 60 people in the intervention group and 60 people in the control group, and the study with the smallest population, namely the study conducted by Das et al. (2018) as many 30 people in the intervention group and 30 people in the control group.

Table 5. Mean, SD, and total sample data the effect of combined methods on oral cavity knowledg in visually impaired children.

Author (year)	Intervention (Dental health education)			Control (No dental health education)		
	Mean	SD	n	Mean	SD	n
Bhor et al. (20160	4.95	1.6	37	2.97	1.28	37
Gautam et al. (2020)	0.8	0.26	60	1.16	0.42	60
Ganapathi et al. (2015)	12.33	1.97	40	2.63	1.17	40
Alamsyah et al. (2017)	5.08	1.59	49	4.48	1.21	44
Debnadh et al. (2017)	8.97	2.9	40	3.18	2.3	40
Deolia et al. (2019)	8.21	0.58	48	1.98	0.81	44
Das et al. (2018)	13.73	2.71	30	9.56	2.19	30
Gautam et al. (2020)	0.8	0.26	60	1.16	0.42	60

Table 5 showed the variation of Mean, SD across each primary study the effect of combined methods on oral cavity knowledge included in the meta-analysis. The largest Mean in the intervention group showed by Das et al. (2018) (Mean= 13.73; SD= 2.71) ,

and the smallest Mean in the intervention group conducted by Gautam et al. (2020)
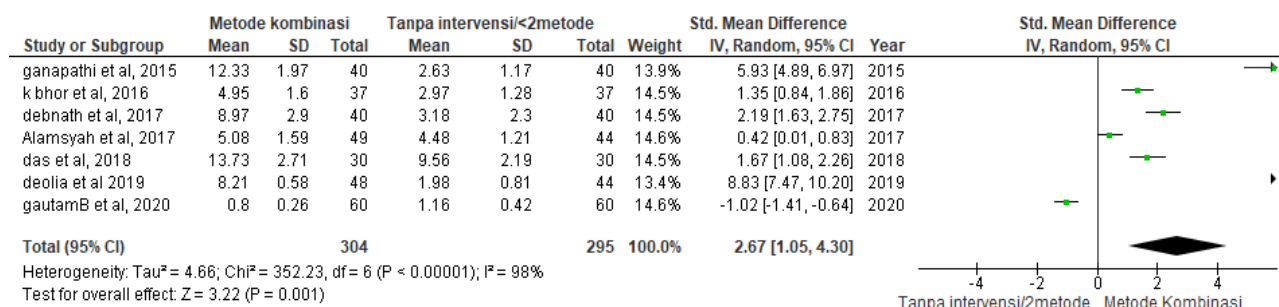
(Mean= 0.80; SD= 0.26).

Study or Subgroup	Metode kombinasi Mean	SD	Total	Tanpa intervensi/<2metode Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year	Std. Mean Difference IV, Random, 95% CI
ganapathi et al, 2015	12.33	1.97	40	2.63	1.17	40	13.9%	5.93 [4.89, 6.97]	2015	
k bhor et al, 2016	4.95	1.6	37	2.97	1.28	37	14.5%	1.35 [0.84, 1.86]	2016	
debnath et al, 2017	8.97	2.9	40	3.18	2.3	40	14.5%	2.19 [1.63, 2.75]	2017	
Alamsyah et al, 2017	5.08	1.59	49	4.48	1.21	44	14.6%	0.42 [0.01, 0.83]	2017	
das et al, 2018	13.73	2.71	30	9.56	2.19	30	14.5%	1.67 [1.08, 2.26]	2018	
deolia et al 2019	8.21	0.58	48	1.98	0.81	44	13.4%	8.83 [7.47, 10.20]	2019	
gautamB et al, 2020	0.8	0.26	60	1.16	0.42	60	14.6%	-1.02 [-1.41, -0.64]	2020	
Total (95% CI)			304			295	100.0%	2.67 [1.05, 4.30]		

Heterogeneity: Tau² = 4.66; Chi² = 352.23, df = 6 (P < 0.00001); I² = 98%
Test for overall effect: Z = 3.22 (P = 0.001)

Figure 5. Forest plot of the effect of combination methods on oral cavity knowledge in visually impaired children.

The aim of the study with a sample of 304 visually impaired children was to report the effect of dental health education using a combination method on oral cavity knowledge (Figure 3). According to the results of the analysis, dental health education using a combination method can increase by 2.67 units compared to no education or only being given education alone, and this was statistically significant (SMD= 2.67; 95% CI= 1.05 to 4.30; p<0.001). Research data showed I²= 98% so that the data distribution was declared heterogeneous (random effect model).
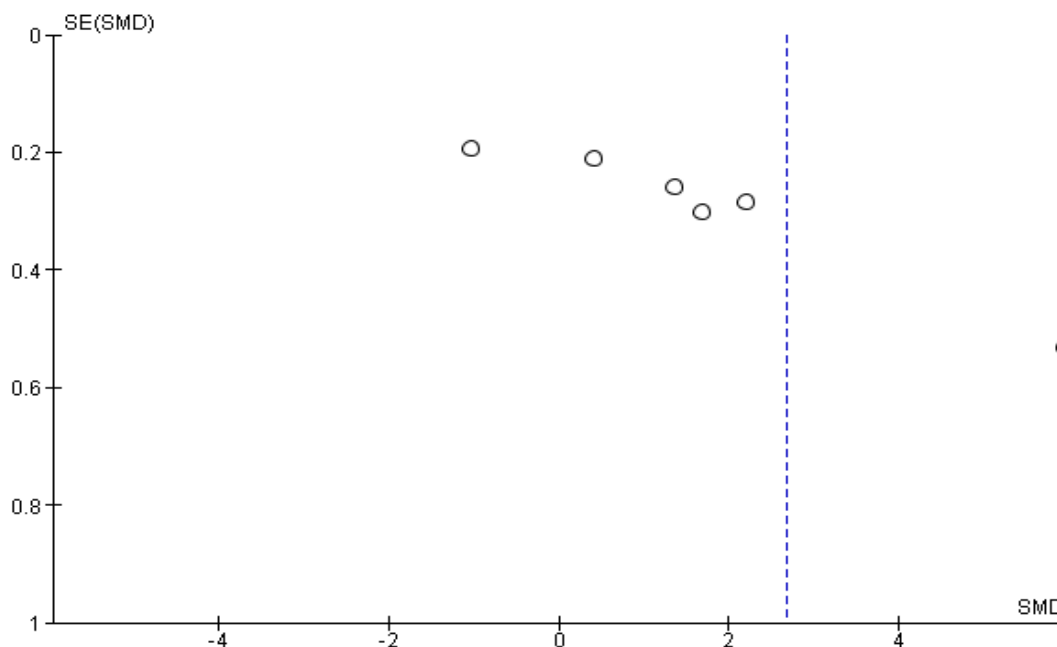

Figure 6. Funnel plot of the effect of combination methods on oral cavity knowledge in visually impaired children

The funnel plot in Figure 6 showed asymmetry between the right plot and the left plot. There were 5 plots on the left and 2 plots on the right. The funnel plot in Figure 4 regarding the effect of combination methods on oral cavity knowledge in blind chil-

dren showed a symmetrical triangle. This indicated that there was no publication bias.

DISCUSSION

This systematic review and meta-analysis study discusses the influence of the effectiveness of oral health education using a combination method on oral hygiene knowledge and plaque scores. Independent variable used in this study is the effectiveness of oral health education using a combination method. Meanwhile, the dependent variables used are oral hygiene knowledge and plaque score.

The systematic review and meta-analysis in this study entitled the effectiveness of dental and oral health education using a combination method on knowledge of hygiene levels and plaque scores in visually impaired children. According to the results of the analysis, the use of combined education methods can increase knowledge of hygiene levels by 2.67 units compared to single education (SMD= 2.67; 95% CI= 1.05 to 4.30; p<0.001) and combined education can reduce plaque scores by 0.82 units compared to single education (SMD = -0.82; 95% CI= -1.29 to -0.35; p<0.001). The independent variable analyzed was the provision of education using a combination method, while the dependent variable was the level of oral hygiene knowledge and reduction in plaque score.

Children with disabilities are challenged every day in their routine activities. There are many impacts of blindness, but one of the most common is the individual's inability to maintain oral health. Caries and gingivitis are the biggest problems for blind children in their oral cavity. OHE (Oral Health Education) regarding oral hygiene maintenance is more important to establish good oral hygiene routines and knowledge from an early age in these children. In particular, oral health education is key to preventing oral diseases, and educating school-aged children is always healthier because schools are the best environment to teach preventive dental health practices and through them education can reach their families and community members as well (Chowdary, 2017).

Dental and oral health education programs that use a combination of braille and audio media are media that rely on the senses of hearing and touch for blind children. This combination of media can significantly increase dental and oral hygiene knowledge in blind children after being given counseling. The reason of the combination media can increase dental and oral hygiene because the combination of braille and audio is a medium that relies on the sense of touch and hearing possessed by blind children.

The more senses are used in the learning process, the more knowledge the blind child will gain. However, it can still be argued that, if visually impaired children are trained properly, they will be able to remember tooth brushing techniques, thereby restoring good oral condition (Gautam, 2020).

AUTHOR CONTRIBUTION

FUNDING AND SPONSORSHIP

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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