# The innovation of Oral Health Education Media for Visually Impaired Children: Which One Brings the Best Impact of Change?

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# The innovation of Oral Health Education Media for Visually Impaired Children: Which One Brings the Best Impact of Change?

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**Objective:**

Maintaining oral health is a challenge for visually impaired children. There were various innovations of oral health education media carried out to bring an impact on oral health knowledge, behavior, and status. This paper was aimed to systematically investigate the innovation of oral health education media for visually impaired children which bring the best impact of change.

**Methods:**

A systematic searching strategy in Scopus, PubMed, ProQuest, ScienceDirect, EBSCO, SAGE, and Cochrane Library database was applied in this study, then followed PRISMA guideline. Studies that investigate the innovation of oral health education media for visually impaired children and its impact of change in the last 10 years were included.

**Results:**

Out of 653 studies identified, 10 were included in the data synthesis. Audio, braille, audio-tactile performance (ATP), verbal, tactile, or combinations was proven to be utilized as the alternative media innovation for oral health education which impacts the improvement of oral health behavior and oral hygiene status.

**Conclusions:**

The combination of oral health education media which involve various senses should be chosen as oral health education media for visually impaired children due to its innovation has proven brings the best impact in the improvement of their oral health behavior and oral health status.

**Key-words: Oral Health Education, Media Innovation, Visually Impaired Children, Review**

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## 1. Introduction

Oral health has long been recognized as an integral part of general health.[1] The presence of dental caries can cause pain, discomfort, and affect physical functions such as chewing, speaking, and smiling which can affect the social role of individuals.[2] Dental caries is closely related to oral health behavior in sugar consumption, brushing habits, and routine dental check-ups to the dentist.[3] Maintaining oral health is a challenge for children, especially for children with special needs.

Children with special needs are a term used in clinical diagnosis and functional development to describe individuals who need medical, mental, and psychological assistance. Visually impaired children are the individuals most facing great challenges to survive compared to other categories of special needs children.[4] The difficulty in recognizing their condition due to visual inability in children with visual impairments certainly requires special attention, especially in maintaining oral health conditions.[5], [6]

Visually impaired children need early intervention to improve function in daily life and social participation and more general welfare aspects such as quality of life and psychosocial functioning.[7] The International Classification of Functioning, Disability, and The Health for Children and Youth (ICF-CY) of the World Health Organization (WHO) made the concept of participation for children relevant. ICF-CY defines participation as an individual's involvement in life situations. The participation components of ICF-CY, namely, learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal interactions and relationships, main areas of life, and community, social and civic life.[8]

Interventions involving children with visual impairments have been developed and implemented earlier. Various forms of intervention are carried out to determine the effectiveness of learning for visually impaired children which can increase knowledge, attitudes, and practices that are expected to have an impact on their behavior of maintaining oral health. This paper was aimed to systematically investigate the innovation of oral health education media for visually impaired children which bring the best impact of change.

## 2. Materials and Methods

### 2.1. Data Sources and Search Strategy

This study was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and checklist.[9] A searching strategy was systematically applied in 7 databases (Scopus, PubMed, Proquest, ScienceDirect, EBSCO, SAGE, and Cochrane Library) using "Visually Impaired Children" OR "Blind Children" AND "Oral Health" as keywords. Six hundred fifty-three results were found based on the filter applied. The database results were imported into Mendeley to remove the duplicates. Four hundred forty-nine records were screened, 422 excluded based on the title, and abstracts relevance. Then 27 articles could be assessed for eligibility. There were 5 articles with no full text available and 12 articles didn't meet inclusion and exclusion criteria. At last, 10 articles were included in this study. The PRISMA flowchart diagram of the study inclusion process was shown in figure 1.

### 2.2. Inclusion and Exclusion Criteria

We included interventional studies that met the following inclusion criteria based on PICO. P: Study participants were visually impaired children or blind children of school age, I: Studies used innovation of oral health education media interventions, C: Studies that compare oral hygiene status before and after the intervention in oral health education within the group or comparison among groups of interventions, and O: Studies that assessed the impact of oral health education in oral health knowledge, behavior and status as measuring the outcome. We excluded studies over the last 10 years, non-interventional studies, and did not use innovation of oral health education media for intervention.

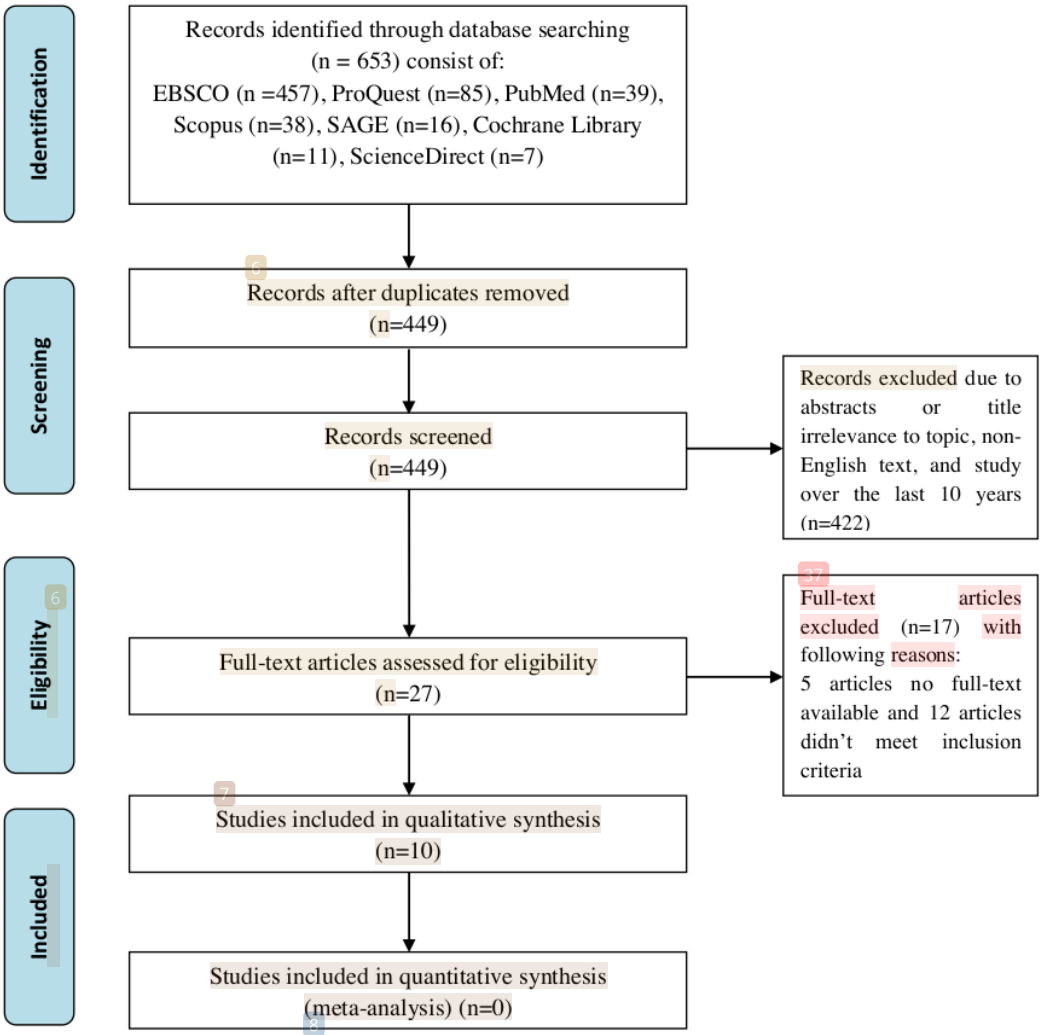


**Figure 1. PRISMA flow diagram of study inclusion process**[9]

### 2.3. Risk of Bias Assessment

The included studies in this systematic review were interventional studies in RCT or non-RCT design. The assessment of bias risk used was Cochrane Collaboration's tool for RCT and ROBINS-I

for non-RCT.[10], [11] Two studies in RCT design included in this study were in unclear risk for the overall risk of bias (Table 1).[12], [13] It was due to most of the information is the low or unclear risk of bias in all domains. While eight studies in non-RCT design included in this study were at serious risk for overall risk of bias due to serious risk in at least one domain (Table 2).[14]–[21] Although the risks of bias assessment results among the studies were varied, this assessment was not an exclusion factor in this study. It was due to the important finding of those studies that must be considered to evaluate the impact of the innovation of oral health education media intervention for visually impaired children.

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**Table 1. Cochrane Collaboration Risk of Bias Tool for RCT of Included Studies**

| Included Studies | Random Sequence Generation | Allocation Concealment | Blinding Participants and Personnel | Blinding Outcome Assessment | Incomplete Outcome Data | Selective Reporting | Free of Other Bias |
|---|---|---|---|---|---|---|---|
| Gautam, et. al (2018)[12] | Unclear risk | Unclear risk | Unclear risk | Unclear risk | Low risk | Low risk | Low risk |
| Deshpande, et. al (2017)[13] | Unclear risk | Unclear risk | Unclear risk | Unclear risk | Low risk | Low risk | Low risk |

**Table 2. Risk of Bias in Non-randomized Studies – of Interventions (ROBINS-I) of Included Studies**

| Included Studies | Bias due to confounding | Bias in the selection of participants | Bias in the classification of interventions | Bias due to deviations from intended interventions | Bias due to missing data | Bias in measurement of outcomes | Bias in selection of reported results | The overall risk of bias |
|---|---|---|---|---|---|---|---|---|
| Suharsini, et. al (2017)[14] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Moderate risk | Serious risk |
| Hebbal, et. al (2012)[15] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Low risk | Serious risk |
| Aggarwal, et. al (2019)[16] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Moderate risk | Serious risk |
| Tiwari, et. al (2019)[17] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Low risk | Serious risk |
| Khurana, et. al (2019)[18] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Low risk | Serious risk |
| Chowdary, et. | Serious risk | Low risk | Low risk | Low risk | Low risk | No | Moderate | Serious risk |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| al (2016)[19] | | | | | | information | risk | |
| Sardana, et. al (2019)[20] | Serious risk | Low risk | Low risk | Low risk | Low risk | Moderate risk | Low risk | Serious risk |
| Debnath, et. al (2017)[21] | Serious risk | Low risk | Low risk | Low risk | Low risk | No information | Low risk | Serious risk |

The Cochrane Collaboration's tool for assessing the risk of bias in RCT design was based on 7 domains.[10] In random sequence generation, allocation concealment, blinding participants and personnel, and blinding of outcome measurement domains, the studies included were unclear risk of bias due to lack of information explained by the author in both studies. The incomplete outcome data domain showed a low risk of bias due to no loss to follow-up and no intention to treat in both studies. Selective reporting domains also showed a low risk of bias due to both studies reported all outcome measurements. Both studies were free of other probable bias.[10], [12], [13]

ROBINS-I (Risk of Bias in Non-randomized Studies – of Intervention) was used to analyze potential bias in 8 non-RCT studies.[11] It was consist of 8 domains to determine the bias. All non-RCT included studies that had a serious risk in bias due to the confounding domain. All the studies did not control any possible confounding factors that may affect the results.[14]–[21] Bias in the selection of participants, classification of intervention, deviation from intended intervention, and missing data domains in all non-RCT studies were at low risk.[14]–[21] Six of 8 studies showed at moderate risk of bias in the measurement of outcome domain due to the examiner were not blinded but it was only minimally influenced by knowledge of the intervention received by study participants[14]–[18], [20] and other two studies[19], [21] were no information explained about any potential bias in the measurement of outcome. Bias in the selection of reported results domain was low to moderate risk of bias. Three studies showed a moderate risk of bias in this domain due to not clear enough defined the outcome measurement,[14], [16], [19] whereas other eight studies were at low risk of bias in this domain because the studies were clear in the statistical analysis plan.[15], [17], [18], [20], [21]

## 3. Results

### 3.1. Study Selection

Of 653 articles that were found based on keywords of searching, 449 articles remained after removing the duplicate. There were 422 articles excluded due to abstracts and title irrelevance to the topic, non-English text, and study over the last 10 years. So that 27 articles were assessed for eligibility of the full text. Based on the inclusion and exclusion criteria mentioned above, 17 articles were not included in this study. Then, 10 articles were included for the systematic review.

### 3.2. General Study Characteristics

General characteristics of 10 articles included in this study were shown in table 3. There was one study published in 2012, 2016, and 2019, 3 studies in 2017, and 4 studies in 2018. The types of study design of intervention were 2 RCT articles and 8 non-RCT articles. Eight studies used a combination of at least 2 or more innovative types of oral health education media. The rest studies used audio, Braille, audio-tactile performance (ATP), verbal and tactile. The included studies were varied in designing the intervention such as for the maximum time to evaluate the impact, the number of reinforcement performed, and the type of evaluation the impact of innovation in oral health education media used.

**Table 3. General Characteristics of Included Studies**

| Categories | Number of Studies | % |
|---|---|---|

| | | |
|---|---|---|
| Year of publishing | | |
| 2012 | 1 | 10% |
| 2016 | 1 | 10% |
| 2017 | 3 | 30% |
| 2018 | 1 | 10% |
| 2019 | 4 | 40% |
| Type of study design intervention | | |
| RCT | 2 | 20% |
| Non-RCT | 8 | 80% |
| The innovation of Oral Health Education Media Used | | |
| Audio | 1 | 6.25% |
| Braille | 3 | 18.75% |
| Audio-tactile performance (ATP) | 3 | 18.75% |
| Verbal and tactile | 1 | 6.25% |
| Combination at least 2 or more types above | 8 | 50% |
| Maximum Time for Evaluation of The Impact | | |
| < 1 month | 1 | 10% |
| 1 – 3 months | 2 | 20% |
| 4 – 6 months | 4 | 40% |
| 7 – 12 months | 2 | 20% |
| > 12 months | 1 | 10% |
| Number of Reinforcement Performed After Intervention | | |

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| | | |
|---|---|---|
| 1 – 3 times | 3 | 30% |
| 4 – 6 times | 3 | 30% |
| 7 – 10 times | 1 | 10% |
| Not mentioned | 3 | 30% |
| Evaluation of the Impact | | |
| Clinical Impact Evaluation Only | 6 | 60% |
| Behavior and Clinical Impact Evaluation | 4 | 40% |

Table 4 showed the details of the characteristics of the included studies. There were various innovations of oral health education media used and their impact on visually impaired children. The ages of participants were 5 – 18 years old in range. The sample sizes used in the studies were varied from 30 – 165 visually impaired children.

**Table 4. Details Characteristics of Included Studies**

| No. | Author and Year | Study Design | Sample Size | Age of Participants (years old) | Type of Innovation in Oral Health Education Media Intervention Used |
|---|---|---|---|---|---|
| 1. | Gautam, et. al (2018)[12] | RCT | 60 visually impaired children | 6 – 16 y.o | Group A: Audio + Braille<br>Group B: Audio + Tactile<br>Group C: Audio + Braille + Tactile |
| 2. | Deshpande, et. al (2017)[13] | RCT | 60 visually impaired children | 12 – 16 y.o | Group 1: Braille<br>Group 2: ATP<br>Group 3: Braille + ATP |
| 3. | Suharsini, et. al (2017)[14] | Non-RCT | 30 visually impaired children | 7 – 12 y.o | Tooth-brushing instruction with song and typodont aid dental model<br>No control group or other |

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| | | | | | intervention for comparison |
| 4. | Hebbal, et. al (2012)[15] | Non-RCT | 96 visually impaired children | 6 – 18 y.o | Audio-tactile performance (ATP) technique<br>No control group or other intervention for comparison |
| 5. | Chowdary, et. al (2016)[19] | Non-RCT | 120 visually impaired children | 6 – 16 y.o | Group 1: Verbal and Tactile<br>Group 2: Verbal and Braille<br>Group 3: Verbal, Braille, and Tactile<br>No control group |
| 6. | Sardana, et. al (2019)[20] | Non-RCT | 148 visually impaired children | 14,85 ± 3,41 y.o | Group 1: Braille + Plastic models or Auditory Sensations<br>Group 2: Audio Story + JAWS (Job Access With Speech)<br>No control group |
| 7. | Debnath, et. al (2017)[21] | Non-RCT | 40 visually impaired children | 8 – 18 y.o | Intervention by music-based brushing technique, cast models, and oral health education talk and booklet in Braille<br>No control group or other intervention for comparison |
| 8. | Aggarwal, et. al (2019)[16] | Non-RCT | 120 visually impaired children | 5 – 15 y.o | Audio aid + Braille booklet + Individualized training.<br>No control group or other intervention for comparison |

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|---|---|---|---|---|---|
| 9. | Tiwari, et. al (2019)[17] | Non-RCT | 90 visually impaired children | 12 – 15 y.o | Group 1: ATP<br>Group 2: Braille<br>Group 3: ATP + Braille<br>(Audio tactile performance)<br>No control group |
| 10. | Khurana, et. al (2019)[18] | Non-RCT | 165 visually impaired children | 7 – 9 y.o | Groups were divided according to the type of visual impairment:<br>Group 1: Completely blind children<br>Group 2: Partially blind children<br>Intervention: Braille instruction of oral health education.<br>No control group |

**Table 5. Evaluation of the Impact of Various Type of Innovation in Oral Health Education Media Used in Included Studies**

| No. | Author and Year | Type of Innovation in Oral Health Education Media Intervention Used | Reinforcement Performance | Time for Evaluation of the Impact | Type of Evaluation of The Impact | Outcome Measurements | Results |
|---|---|---|---|---|---|---|---|
| 1. | Gautam, et. al (2018)[12] | Group A:<br>Audio + Braille<br>Group B:<br>Audio + Tactile<br>Group C:<br>Audio + Braille + Tactile | No reinforcement (only instructed to continue maintaining oral hygiene) | - Pre-intervention<br>- One month after the intervention<br>- Three months after the intervention | Clinical Impact | 1. Plaque index<br>2. Gingival index | Mean of plaque index score at all time intervals in the individual group showed a statistically significant decrease compared to the baseline<br>While the mean of gingival index score at all time intervals in a combination of audio, braille, and a tactile group showed a statistically significant |

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|---|---|---|---|---|---|---|---|
| | | | | | | | decrease compared to the baseline and other groups |
| 2. | Deshpande, et. al (2017)[13] | Group 1: Braille<br>Group 2: ATP<br>Group 3:<br>Braille + ATP | Reinforcement was carried out on the 7th day and after 1 month of the first education | - Pre-intervention<br>- One month after the 1st intervention | Clinical Impact | Plaque index | Plaque index increased in group 1, while in group 2 and 3 decreased<br>Post plaque index comparison among groups showed a significant difference.<br>Braille and ATP technique of oral health education proved to be the most effective media to teach oral hygiene |
| 3. | Suharsini, et. al | Tooth-brushing instruction with song and typodont | No reinforcement | - Pre-intervention | Clinical Impact | Plaque index | Using audio song and typodont aid dental model for oral health |

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|---|---|---|---|---|---|---|---|
| | (2017)[14] | aid dental model<br><br>No control group or other intervention for comparison | | - One week after the intervention | | | education showed significantly different before and after the intervention |
| 4. | Hebbal, et. al (2012)[15] | Audio-tactile performance (ATP) technique<br><br>No control group or other intervention for comparison | Reinforcement was performed at an interval of 9 months | - Pre-intervention<br>- Eighteen months after the intervention | Clinical Impact | Plaque index | Mean plaque index score before and after oral health education using ATP showed a statistically significant difference |
| 5. | Chowdary, et. al (2016)[19] | Group 1: Verbal and Tactile<br><br>Group 2: Verbal and Braille<br><br>Group 3: Verbal, Braille, and Tactile | Reinforcement was performed after 1 week of intervention | - Pre-intervention<br>- One month after the intervention<br>- Three months after the | Clinical Impact | 1. Plaque index<br>2. Gingival index | Reduction of plaque index and gingival index score in all groups.<br><br>The highest reduction plaque index score was in Group III |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | No control group | | - intervention<br>- Six months after the intervention | | | The highest reduction of gingival index score was in Group II<br>Combination of verbal, braille, and tactile mode of oral health educational aids proved effective |
| 6. | Sardana, et. al (2019)[20] | Group 1: Braille + Plastic models or Auditory Sensations<br>Group 2: Audio story + JAWS (Job Access With Speech)<br>No control group | Reinforcement was performed once every month | - Pre-intervention<br>- Three months after the 1st intervention<br>- Six months after the 1st intervention | Clinical Impact | 1. Plaque index<br>2. Gingival index | Mean plaque and gingival scores in groups 1 and 2 showed significant improvement at the 6-months evaluation. |
| 7. | Debnath, et. al | Intervention by music-based | Reinforcement was performed | - Pre-intervention | Behavior Impact | Questionnaire of knowledge, | KAP was significantly increased |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (2017)[21] | brushing technique, cast models, and oral health education talk and booklet in Braille<br><br>No control group or other intervention for comparison | once a month for six months | - Six months after the 1st intervention | | attitude, and practice (KAP) regarding oral health care | |
| | | | | | Clinical Impact | Plaque index | The dental plaque score was reduced significantly |
| 8. | Aggarwal, et. al (2019)[16] | Audio aid + Braille Booklet + Individualized training.<br><br>No control group or other intervention for comparison | Reinforcement was performed every month for nine months | - Pre-intervention<br>- Nine months after the 1st intervention | Behavior Impact | A questionnaire-based on WHO | Frequency of cleaning teeth showed statistically significant improvement from once a day to two or more times a day |
| | | | | | Clinical Impact | 1. DMFT/S and dmft/s<br>2. Plaque index | Plaque index score showed a statistically significant decrease at |

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| | | | | | | | the end of nine months after the intervention of an oral health education program |
| 9. | Tiwari, et. al (2019)[17] | Group 1: ATP<br>Group 2: Braille<br>Group 3: ATP+Braille<br>(Audio-tactile performance) | Reinforcement was performed at 21 days, 3, 6, and 9 months | - Pre-intervention<br>- At 21 days<br>- At 3 month<br>- At 6 month<br>- At 9 months | Behavior Impact | Questionnaire of oral hygiene knowledge, attitude, and practice | All children could brush independently and the knowledge, attitude, and practice of oral health were significantly increased |
| | | | | | Clinical Impact | 1. Plaque index<br>2. Gingival index | Plaque and gingival index scores showed the highest percentage of reduction in group 3 compared to group 1 and 2 |
| 10. | Khurana, et. al (2019)[18] | Groups were divided according to the type of visual | No reinforcement | - Pre-intervention<br>- At the end of | Behavior Impact | Questionnaire of oral hygiene knowledge, attitude, and | There were highly significant improvement of tooth-brushing behavior |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | impairment:<br><br>Group 1: Completely blind children<br><br>Group 2: Partially blind children<br><br>Intervention: Braille and verbal instruction of oral health education.<br><br>No control group | | - 5 months after the 1st intervention (oral health practice)<br>- Twice at the end of every 2 months after the 1st intervention (oral hygiene status) | | practice | related to the frequency twice a day and proper technique of tooth-brushing after receiving oral health education |
| | | | | | Clinical Impact | 1. Plaque index<br>2. Gingival index | Plaque index and gingival index score showed statistically significant in both groups completely and partially blind children |

### 3.3. Type of Innovation in Oral Health Education Media Intervention Used

Oral health education was delivered in various types of innovation of media intervention. All studies focus on involving other visual senses such as hearing and touch senses. There were audio[20], Braille[13], [17], [18], ATP (audio-tactile performance)[13], [15], [17], verbal and tactile[19] or combinations media intervention used in delivering oral health education for visually impaired children.[12]–[14], [16], [17], [19]–[21]

### 3.4. Outcome Measurement

The studies included measured the impact of oral health education among visually impaired children both behavior and clinical outcome. Four studies measured oral health as an outcome. [12], [16]–[18], [21] Meanwhile, the clinical outcome of oral health status measurement used in the studies varied which at least using Loe and Silness' plaque index score for evaluating the oral hygiene performance of visually impaired children after the intervention was delivered. Furthermore, 5 studies also measured gingival index scores for evaluating the gingival condition.[12], [17]–[20].

## 4. Discussion

### 4.1. Summary of the results

Most of the included studies were aimed to assess the impact of various types of innovation in oral health education media for visually impaired children.[12]–[21] There were various outcome measurements used in the studies such as in oral health behavior [12], [16]–[18], [21] and oral health status as the clinical outcome which consisted of oral hygiene performance measured by plaque index score[12]–[21], and gingival condition measured by gingival index score.[12], [17]–[20]

### 4.2. Impact on Oral Health Behavior

Oral health behavior is closely related to dietary habits, tooth-brushing behavior, and dental visit attendance[3]. The present study found that visually impaired children need to be delivered the information related to oral health behavior. Various types of innovation in oral health education media intervention used in the included studies found improvement in oral health knowledge, attitude, and practice related to oral health behavior.

In a study conducted by Aggarwal et. al (2018), there was significant oral health behavior change after intervention. Oral health education media used in the study was a combination of audio aid, braille, booklet, and individualized training which was reinforced every month for nine months. The oral health behavior assessed was the frequency of cleaning teeth in visually impaired children. There was a significant change from once a day into two or more times a day ($p<0.01$).[16]

Tiwari et. al (2018) showed oral health behavior in the detailed aspect related to tooth-brushing behavior and dietary habit. Using audio-tactile performance (ATP), Braille, and a

combination of ATP + and Braille media, oral health education was delivered to visually impaired children. Before the intervention, most of the visually impaired children were not able to brush their teeth, unaware of sweet and sticky food consumption, and basic tooth morphology. The study also reported that they were a lack of information about oral health and its prevention. The improvement had been shown in this study after the intervention was delivered. All children could brush independently and the knowledge, attitude, and practice of oral health were significantly increased ($p<0.001$).[17]

The lack of information about oral health among visually impaired children was also reported in a study conducted by Khurana, et.al (2019). Before the intervention, 52.12% of children only brush their teeth once a day, and 12.12% of children not used to brush every day. Using Braille text and verbal media for delivering oral hygiene instruction, the improvement of tooth-brushing behavior was shown. There was a highly significant improvement of tooth-brushing behavior related to the frequency twice a day and proper technique of tooth-brushing after receiving oral health education ($p<0.001$).[18]

Those three studies were in line with Debnath, et.al (2017) which delivered the information of brushing teeth twice daily, flossing once a day, cleaning the tongue, rinsing the mouth after a meal, eating nutritious food, limiting snacks between meals, and visiting dentist every six months to visually impaired children. This study used a combination of music-based brushing techniques, cast models, and oral health education talk and booklet in Braille as the innovative media to deliver oral health messages. The knowledge, attitude, and practice score before and after intervention were statistically improved in this study ($p<0.001$).[21]

Intervention through oral health education can promote oral health behavior change related to dietary habits, tooth-brushing behavior, and dental attendance, not an exception for visually impaired children. Due to their visual inability to recognize their oral health condition, innovations of education media were recommended to use for delivering information related to oral health. The positive impact on oral health behavior showed in the included studies using any type of oral health education media innovation were an indication that information related to oral health was successfully delivered for visually impaired children.

### 4.3. Impact on Oral Health Status

#### 4.3.1. Impact on Oral Hygiene Measured by Plaque Index Score

Oral hygiene status measured for evaluating the state of oral hygiene according to the amount of plaque accumulation which depended on oral health behavior related to tooth-brushing and dietary habit.[22] Loe and Sillness's plaque index score has long been used as the measurement of oral hygiene index which is measured according to the soft debris and mineralized deposits in teeth.[23] According to this measurement, the included studies showed various results among visually impaired children.

Most included studies showed significant plaque index score reduction after receiving oral health education using any type of media innovation in a time interval determined by each researcher [12]–[21]. The comparison among the group in which different oral health education media innovations were used for intervention was also reported in the studies. The included

studies showed using combination media innovations when delivering oral health education brings the best impact.[13], [17], [19]

The study conducted by Chowdary, et. al (2016) reported that using a combination media of verbal, Braille, and tactile media intervention showed the highest plaque index score reduction among participants. Delivering oral health education using this combination of media motivated them in performing tooth-brushing so that there was a significant improvement in their oral hygiene.[19] Tiwari, et. al (2018) also reported that using ATP and Braille media intervention gives a greater impact on the reduction of plaque index score. ATP technique was proven to be an effective communication tool for delivering information related to a tooth-brushing technique for visually impaired children. Moreover, the Braille text was used to help them collect the information learned. Combining these media for delivering information related to oral health brings the best impact in reducing plaque index score according to this study.[17] In line with the previous study explained, Deshpande, et.al (2018) suggested using ATP and Braille text as media intervention for delivering oral health education to visually impaired children.[13] The improvement of oral hygiene statues measured by plaque index score is important to indicate that oral health education is successfully delivered by using various innovative media for visually impaired children.

#### 4.3.2. Impact on Gingival Condition Measured by Gingival Index Score

Gingival condition is also important to evaluate the success of delivering oral health messages for visually impaired children in addition to the previous impact explained before. The accumulation of plaque can cause the inflammation of the gingival which can be recognized as gingival redness, edema, or bleeding through specific examination.[24] Only five studies were using gingival index score measurement for evaluating the impact of various innovations of oral health education media on gingival conditions among visually impaired children. All the studies showed a significant reduction of gingival index score after the intervention was delivered.[12], [17]–[20]

Khurana, et. al (2019) reported that using Braille instruction of oral health education was effective to improve the gingival index score.[18] A study conducted by Tiwari, et. al (2018) reported that using a combination of ATP and Braille effective to reduce gingival index score compared to single media of ATP or Braille intervention only.[17] Chowdary et. al (2016) study showed that using a combination media of verbal and Braille when delivering oral health education gives the highest reduction of gingival index score compared to other combination media in their study.[19] Gautam et. al (2018) also reported that using a combination of three media intervention which consists of audio, Braille, and tactile was a highly significant effect to reduce the gingival score index compared to the group with a combination that uses only two media either audio and tactile or audio and braille.[12]

Results explained above showed that delivering oral health education is also important to prevent further gingival inflammation among visually impaired children. The improvement of the gingival condition proved that using a combination of media innovation in delivering oral health education for visually impaired children is effective.

### 4.4. Limitation of the studies

Since the studies included in this systematic review were heterogenic in sample size, age of participants, type of intervention, the maximum time in evaluating the impact, and reinforcement performance in each study, the effectiveness of intervention among studies cannot be compared quantitatively.[12]–[21] However, this systematic review explained the impact of interventions as results of each included study in detail. Moreover, from this finding, we can consider using any type of media innovation when delivering oral health education among visually impaired children.

## 5. Conclusion

Visually impaired children need access to information and oral health-related care. Oral health education programs need to be specially formulated by using appropriate media innovation when delivering oral health education to improve their ability to maintain their oral health. This systematic review recommends the education program planner considering media innovation when delivering oral health education for visually impaired children such as audio, Braille, audio-tactile performance (ATP), verbal, tactile, or combinations of those media. We found that using combinations of media bring the best impact to oral health behavior and oral health status of visually impaired children due to the more combination used the more involving various senses in understanding information related oral health. Further studies including the homogeneity of the maximum duration of intervention in RCT design are needed to analyze how long the intervention should be delivered to get the best result in maintaining oral health behavior among visually impaired children.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19