

## Impact of Motivational Interviewing on Parental Risk-Related Behaviors and Knowledge of Early Childhood Caries: A Systematic Review

### Abstract

**Background:** Behavior is important in dental disease etiology, so behavioral interventions are needed for prevention and treatment. Motivational interviewing (MI) has been proposed as a potentially useful behavioral intervention for prevention of early childhood caries. **Methods:** Studies have evaluated the effectiveness of MI on reduction of the risk-related behaviors for early childhood caries (ECC) compared to dental health education (DHE). The aim of this systematic review was to assess the scientific evidence on MI applied to change parental risk-related behaviors. The potentially eligible studies involved the assessment of caries-related behaviors in caregivers receiving MI. Electronic search of English published literature was performed in February 2020 in the Scopus, Cochrane, PubMed, and Embase databases. Assessment of risk of bias was done by the Cochrane risk of bias tool. **Results:** Of 329 articles retrieved initially, seven were eligible for inclusion in this review. Four studies evaluated the behavior of tooth brushing and four studies assessed the cariogenic feeding practice, while only one study investigated the behavior of checking teeth for pre-cavities. Moreover, two studies examined dental attendance for varnish fluoride use and oral health-related knowledge. It was not possible to perform a meta-analysis. **Conclusions:** Generally, results support the application of MI to improve the “dental attendance behavior for fluoride use” and participants’ knowledge. However, the results were inconclusive for other behaviors. We need further and better designed interventions to completely evaluate the impact of MI on specific ECC-related behaviors.

**Keywords:** Behavior, dental caries, motivational Interviewing, risk

### Introduction

Early childhood caries (ECC) is a preventable illness that is defined as the existence of one or more decayed, missing, or filled teeth (due to caries) in the primary teeth in children aged less than six.<sup>[1]</sup> Although the most common preventive approach for child caries is parental education, research does not support the efficacy of merely parental education in decreasing ECC.<sup>[2,3]</sup> Evidence shows that providing the individuals with accurate information may help them to modify their behaviors, but this method alone will not cause behavior change.<sup>[4]</sup> It has been found that education alone is not effective because a health professional’s direct persuasion is often carried out with no regard for the parents’ preparation to modify their behaviors.<sup>[5]</sup>

Dental health education has been known as the gold standard among different non-invasive preventive interventions for

children at the risk of developing caries. In this approach, parents or caregivers will be given information about children’s dental health via pamphlets, posters and media campaign.<sup>[6]</sup> Motivational interviewing (MI) is one of the methods of behavior change which reduces the individual’s resistance to change.<sup>[7]</sup> It helps people to explore and resolve their uncertainty toward change as a client-centered but directive counseling strategy.<sup>[8]</sup> This strategy has been successfully applied to various health behaviors such as substance use disorders,<sup>[9,10]</sup> smoking,<sup>[11,12]</sup> diet and exercise, and medication dependence.<sup>[13]</sup> Moreover, it has been reported that MI is efficacious in guiding patients to apply changes to the oral health-related behaviors like snacking and tooth brushing habits.<sup>[14-16]</sup>

A systematic review in 2014 on the efficacy of MI in enhancing oral health showed inconclusive effect of MI on most oral health outcomes. The authors argued that better interventions should be developed

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to completely evaluate the effect of MI on oral health and determine a proper dose for motivational counseling. Moreover, further interventional studies on specific oral health-related behaviors and systematic reviews have been suggested to target this area of research from a narrower perspective.<sup>[7]</sup>

Given the new publications in recent years, this study was aimed to systematically review the randomized clinical trials (RCTs) to assess the effect of MI-based parental interventions on reducing the ECC-related behaviors compared to traditional dental health education (DHE) and to determine their limitations.

## Methods

This systematic review was performed based on the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA statement).<sup>[17]</sup> This review was supported by Isfahan University of Medical Sciences Research under award code of IR.MUI.RESEARCH.REC.1399.228.

### Search strategy

A search for relevant studies was done after defining a well-focused PICO question and inclusion/exclusion criteria [Table 1]. The articles assessed were conducted on the parents/caregivers (P, population) trained by MI after the birth of their children (I, intervention), compared to no education or traditional DHE provided following the birth of their children (C, comparison), and their behavior modifications was evaluated (O, outcome).

The selection of key words was based on the MeSH and non-MeSH terms in simple or multiple conjunctions. The Embase, Scopus, Cochrane, and PubMed databases were searched, with no filters applied except for language, i.e., only the studies in English language were evaluated. Moreover, a manual search was performed to retrieve the probably missing articles. The latest date of database search in this research was February 2020. The strategies of database search are presented in Table 2.

### Selection of studies

Two authors (ShM and AK) searched the above-mentioned databases independently using the developed search strategy. Endnote software version 8 (Thomson Reuters,

NY, USA) was used for eliminating duplicated studies, final confirmation, and cross matching. The authors reviewed the abstracts of the articles and selected the articles that met the inclusion criteria. The full-texts of the chosen abstracts were screened, as a result of which some studies were excluded. The correlation coefficients between the search results of two authors regarding the abstract and full-text were 0.93 and 1, respectively. In the case of any disagreements between two authors, the third author (RF) evaluated the disagreements and made the final decision.

### Assessment of risk of bias

Each study was assessed for inner methodological risk of bias based on the Cochrane collaboration tool. This tool takes into account the selection, performance, detection, attrition, reporting, and other sources of bias (including industry-related bias or professional interest) and makes use of three reporting terms: high risk of bias, unclear risk of bias, and low risk of bias. Using this approach, each article was then categorized according to the risk of bias. Trials with a high risk of bias in at least one item were considered to have an overall high risk of bias, trials with an unclear risk of bias in one or more major domains were regarded as having a moderate risk of bias, and trials with a low risk of bias in all domains were considered to have an overall low risk of bias.

The data gathered for each study included the authors' name, publication year, characteristics of samples, studied groups and their sample size, number of MI sessions, duration of MI sessions, measured outcome, final conclusion, and follow-up duration.

## Results

A flow diagram of the search strategy is shown in Figure 1. The search yielded a total of 329 articles (44 on Embase, 114 on Cochrane, 44 on Scopus, and 169 on MEDLINE (PubMed)). The abstracts of 74 articles were evaluated after excluding the similar and irrelevant ones. Therefore, 14 articles remained for full-text analysis, from which seven<sup>[3,18-23]</sup> were excluded with reasons presented in Table 3. Finally, the remaining articles<sup>[2,5,6,14,15,24,25]</sup> were included in the evidence table. The descriptive results and parameters obtained for each study are indicated in Table 4.

A detailed assessment of risk of bias is indicated in Figure 2. Due to lack of the blinding of participants and personnel, all articles studied had an overall high risk of bias. Lack of the counselors' blinding explains this bias to some extent.

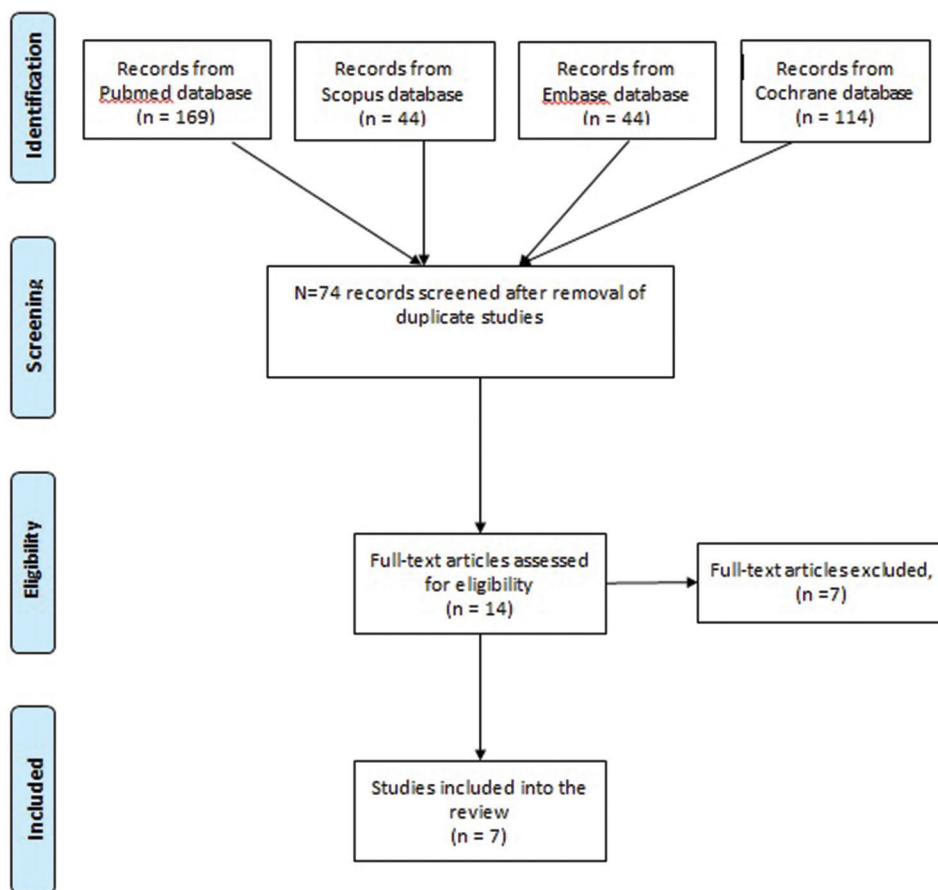
All the reviewed articles were randomized clinical trials (RCTs) that had included a total of 2888 participants in intervention and control groups. They received MI versus no education or traditional DHE, respectively.

**Table 1: Inclusion and exclusion criteria**

Inclusion criteria	Exclusion criteria
English-language studies that investigated the effectiveness of MI on ECC risk-related behaviors	Case reports Editorial letters Pilot studies
Studies that evaluated MI intervention against traditional dental health education	Historical reviews Studies in languages other than English Cohorts

**Table 2: Search strategy applied for each database**

Data base	Search strategy
Pubmed/ cochrane	(parent or child or children or preschool children or infants or mother or pregnant women) and (motivational interviewing or motivational counseling or behavior interviewing or motivational change or motivational enhancement therapy or motivational intervention or motivational consultation or direct counseling or client centered counseling or patient centered counseling) and (traditional health education or conventional education or control or education or oral health promotion) and (dental caries or tooth caries or tooth decay or early childhood caries or ECC or oral health-related behavior or oral health-related risks or ECC-related risks or cavitated lesion or non-cavitated lesion or oral hygiene)
Scopus/ Embase	("Parent" or "child" or "children" or "preschool children" or "infants" or "mother" or "pregnant woman") and ("motivational interviewing" or "motivational counseling" or "behavior interviewing" or "motivational change" or "motivational enhancement therapy" or "motivational intervention" or "motivational consultation") and ("traditional health education" or "conventional education" or "control" or "education" or "oral health promotion") and ("dental caries" or "tooth caries" or "tooth decay" or "early childhood caries" or "ECC" or "oral health-related behavior" or "oral health-related risks" or "ECC-related risks" or "cavitated lesion" or "noncavitated lesion")



**Figure 1: Flowchart**

As for the number of MI sessions, all studies trained the participants in one session except the study of Henahaw *et al.*<sup>[25]</sup> in which the mean number of sessions the participants attended was 2.8. The duration of MI sessions was variable from 20 to 45 minutes. Moreover, the follow-up period in four studies was 24 months,<sup>[5,6,24,25]</sup> while it was 1-8 months in three other trials.<sup>[2,14,15]</sup>

The behavioral outcomes varied among the reviewed studies. Harrison *et al.*<sup>[5]</sup> and Weinstein *et al.*<sup>[24]</sup> evaluated only the number of visits for varnish fluoride use, but

others assessed more parameters such as cariogenic feeding practice, tooth cleaning frequency, and checking for pre-cavities. In addition, some studies evaluated the clinical outcomes. For example, Harrison *et al.*,<sup>[5]</sup> Henshaw *et al.*,<sup>[25]</sup> and Manchanda *et al.*<sup>[2]</sup> reported the number of decayed, missed, and filled teeth/surfaces. Further, Weinstein *et al.*<sup>[24]</sup> reported the incidence of new dental caries. However, this systematic review was not aimed to evaluate these clinical outcomes.

**Table 3: Excluded studies at full-text level with reason**

Study	Reason for exclusion
Saengtipbovorn 2017	Different intervention condition
Kressin 2009	Different intervention condition
Reidy 2015	Different population
Batliner 2018	Different control condition
Harrison 2012	Isn't reporting behavioral outcome
Weinstein 2004	Isn't reporting behavioral outcome
Colvara 2018	Isn't reporting behavioral outcome

**Number of visits for fluoride varnish application**

Two studies investigated this outcome and found that the number of visits for fluoride varnish use was significantly higher in the MI group than in the DHE group after a 24-month follow-up.<sup>[5,24]</sup>

**Checking for pre-cavities**

This behavior was assessed by Ismail *et al.* over a 2-years follow-up. They indicated that MI approach significantly promoted the caregivers' checking for pre-cavities compared to DHE (P value = 0.03).<sup>[6]</sup>

**Table 4: Evidence table**

Author Year country	Sample characteristics	Study groups		Number of MI session	Duration of MI session (min)	conclusion	Follow-up (months)
		Control	Test				
Harrison/2007/ Canada	205/Mothers of 6-18-month-old children	DHE	MI + DHE	1	45	Number of fluoride varnish visits: MI > control (P=0.001)	24
Fruedenthal/ 2010/USA	72/mothers of 6-24 month old children	no formal education	MI	1	20-30	Tooth cleaning freq. (pre-vs. post-test): increased frequency in MI group (P=0.001)/no significant change in control (P=0.796). Cariogenic feeding practice (pre-vs. post-test): including bottle giving, snacking time or frequency of sweets used for reward: no significant difference in MI or Control	1
Weinstein/2006/ Canada	240/Mothers of 6-18 Month old children	DHE Total	DHE + MI	1	45	Number of fluoride varnish visits: MI > control. P=not reported	24
Naidu/2015/ Trinidad	79/mothers of <6 years old children	DHE	MI + DHE	1	30	Tooth cleaning freq.: increased frequency in MI vs. control group (P<0.01). Oral health knowledge (pre- vs. posttest): increased knowledge of appropriate size of toothpaste and safest time to give snacks in MI. (P<0.05) but not in control. Increased knowledge of appropriate brushing position and F-varnish freq. in MI and Control (P<0.05 and P<0.001 respectively)	4
Manchanda/2014/ India	387/mothers of 6-18 months old children	B: DHE C: No formal education	A: MI + DHE	1	Not informed	Cariogenic feeding practice (pre- vs. posttest). Bottle feeding at demand and night feeding through bottle decreased in A & B (but not C). Increase of taking sugar items between meals in all three groups was observed. Use of tooth brush for cleaning teeth increased in all groups.	8
Ismail AI, Ondersma S/2011/USA	599/caregiver of 0-5 years old children	DHE	MI + DHE	1	40	Checking for precavities: MI > control (P=0.03). Tooth cleaning freq. : including: brushing at bedtime, brushing 2 times per day: No differences between MI and DHE groups. (P>0.05). Cariogenic feeding practice : including giving healthy food and nonsugary snacks: No differences between MI and DHE groups. (P>0.05)	24
Henshaw/2018/ USA	906/pregnant women in 3 <sup>rd</sup> trimester or primary caregivers of <6 years old child	DHE	MI + DHE	Up to 9	30	Oral health knowledge: MI > control (P=0.0310). Tooth cleaning freq.: No differences between MI and DHE groups (P=0.221). Cariogenic feeding practice: Including sugar sweetened beverage intake: No differences between MI and DHE groups (P=0.422)	24



Figure 2: Assessment of risk of bias

### Tooth cleaning frequency

As one of the most frequently studied behaviors, four studies investigated tooth cleaning frequency.<sup>[6,14,15,25]</sup>

Naidu *et al.*<sup>[15]</sup> showed the significant improvement of this behavior in the MI group versus the DHE group ( $p < 0.01$ ), but two other studies rejected this result.<sup>[6,25]</sup> In their study, Fruedenthal *et al.*<sup>[14]</sup> did not make inter-group comparisons. They showed a significant increase in the frequency of tooth cleaning in the MI group following a one-month follow-up. However, this increase was not statistically significant in the control group. In addition, Manchanda *et al.* reported a rising trend in toothbrush use as an aid to tooth cleaning in children after an 8-months follow-up in the MI, DHE, and no education groups.<sup>[2]</sup>

### Cariogenic feeding practice

Four articles evaluated this outcome.<sup>[2,6,14,25]</sup> Ismail *et al.*<sup>[6]</sup> and Henshaw *et al.*<sup>[25]</sup> reported that MI did not significantly

promote this behavior in the MI group versus the DHE group ( $P > 0.05$  and  $P = 0.422$ , respectively). Fruedenthal *et al.*<sup>[14]</sup> reported that neither MI nor DHE were able to change this behavior in the studied participants after one month, confirming the results of the above study.

Manchanda *et al.*<sup>[2]</sup> indicated a remarkable decline in “bottle feeding at demand” and “night feeding through bottle” after 8 months in both MI and DHE groups. Conversely, the behavior “giving sugary items between meals” was improved. The data of inter-group comparisons were not reported in this research.

Fruedenthal *et al.*<sup>[14]</sup> evaluated the “shared utensil use behavior” and reported a significant decline in MI group after one month ( $p = 0.035$ ). However, this declining trend was not statistically significant in the DHE group ( $p = 1.00$ ).

### Knowledge

Naidu *et al.*<sup>[15]</sup> and Henshaw *et al.*<sup>[25]</sup> examined the impact of MI on the caregivers’ improved oral health-related

knowledge. They concluded that the participants' knowledge significantly improved in the MI versus DHE group after a 24-month follow-up ( $p = 0.031$ ).

Naidu *et al.*<sup>[15]</sup> indicated that the knowledge of mothers undergoing MI significantly increased from baseline after 4 months in four items of "appropriate size of toothpaste for children", "the safest time to give snacks", "appropriate position for tooth brushing", and "appropriate number of visits for fluoride varnish" ( $p < 0.05$ ). However, there was only a significant increase in the control group for the last two items ( $p < 0.001$ ).

## Discussion

A new field of research in dentistry is application of brief interventions. There has been special interest in the application of MI owing to its efficacy in modifying the behavior in domains such as addiction, diabetes management, and smoking cessation.<sup>[26]</sup>

MI has been found to be efficient in altering specific behaviors in specific settings. However, it is essential to acknowledge behavior change as a science and find out the special mechanisms involved in behavior change.<sup>[27]</sup> In contrast to other fields, caregivers undergo MI for ECC, but children are intended to benefit from it. Moreover, the disease complexity may make it challenging to understand the MI mechanisms.<sup>[25]</sup> Several behaviors on the part of the caregivers, such as cariogenic feeding practice, tooth cleaning frequency, and dental attendance, have been found to be associated with ECC.

The studies recruited in this systematic review vary drastically in their assessed behaviors, number of participants, follow-up period, and MI protocol.

### Dental attendance for fluoride varnish

MI showed a prominent impact on dental attendance for varnish fluoride use. Yet, other behavioral outcomes were assessed by questionnaires, dental attendance was the only outcome evaluated through the patient's dental documents. Weinstein *et al.*<sup>[24]</sup> and Harrison *et al.*<sup>[5]</sup> reported that families undergoing MI attended the fluoride varnish therapy much more routinely than the control families, indicating that MI mothers welcomed these fluoride varnish visits much more than the control mothers. These authors also reported the reduced clinical incidence and severity of childhood caries in MI group, which can be due to more use of fluoride varnish. Fidelity to MI protocol was evaluated by reviewing the audiotapes in both studies, where the participants were low-income south Asian immigrants. A systematic review in 2013 showed that not being dependent on the risk of caries, use of fluoride varnishes twice to four times a day either in the permanent or primary dentition were linked to a significant decrease in caries rate.<sup>[28]</sup>

Reidy *et al.*<sup>[20]</sup> also evaluated dental attendance for preventive and restorative treatments in children following

MI intervention. The participants were volunteer pregnant women who underwent pre- and post-natal MI or DHE. They reported that dental attendance did not increase significantly from baseline either in the MI or DHE groups. Since pregnant women have high motivation for active participation in the preventive care for their children,<sup>[29]</sup> the study of Reidy *et al.*<sup>[20]</sup> was different from other studies in mothers' baseline motivation and preparedness for change. Furthermore, choosing volunteers as participants led to a high-risk of selection bias in this study.

### Tooth cleaning frequency

Tooth cleaning frequency was studied as an outcome via various variables. In the studies of Ismail *et al.*<sup>[6]</sup> and Henshaw *et al.*,<sup>[25]</sup> the tooth brushing behavior twice per day was not improved by MI intervention versus DHE following a two-year follow-up. Ismail *et al.* showed no significant increase in children's tooth brushing at bedtime. Moreover, MI did not significantly reduce the clinical rate of ECC in these studies. Ismail *et al.*<sup>[6]</sup> argued that the broad nature of specific changes in their study might have prohibited the potential of MI to influence certain oral health behaviors. In addition, they indicated an improvement in the caregiver's oral health behaviors related to checking the child for "pre-cavities", which was linked to the researchers' more focus on pre-cavities and their prevention than other behaviors.

In their study, Naidu *et al.*<sup>[15]</sup> reported children's weekly brushing as an outcome and showed that MI enhanced this behavior after four months. However, the number of participants was much lower than that of the studies of Ismail *et al.*<sup>[6]</sup> and Henshaw *et al.*<sup>[25]</sup> In addition, this study did not evaluate fidelity to MI protocol, while two other studies used motivational interviewing treatment integrity (MITI) code, the most frequently used tool for evaluating MI fidelity in RCTs.<sup>[30]</sup>

### Cariogenic feeding practice

Another outcome evaluated in the studies was the caregivers' cariogenic feeding practice. Variables selected for this assessment included "the frequency of sweets used for reward or behavior modification",<sup>[14]</sup> "bottles given while awake<sup>[14]</sup> or at bedtime<sup>[2,14]</sup>", "sugar sweetened beverage intake",<sup>[25]</sup> and "providing child with non-sugared snacks and healthy meals".<sup>[6]</sup>

Previous studies have revealed that ECC is higher in the bottle-fed children.<sup>[31]</sup> Moreover, use of sugar sweetened beverages elevated dental caries rate among children and adolescents.<sup>[27]</sup>

Two studies with a larger sample size and a longer follow-up period reported no significant change between MI and DHE groups in cariogenic feeding behavior.<sup>[6,25]</sup> They also showed MI intervention versus DHE had no significant effect on the clinical rate of ECC. Showing a high risk

of reporting bias, Manchanda *et al.*<sup>[2]</sup> and Freudenthal *et al.*<sup>[14]</sup> did not report the inter-group comparisons. In addition, these investigations did not assess fidelity to MI intervention. Conducting a study on volunteer participants, Freudenthal *et al.*<sup>[14]</sup> also reported a high risk of selection bias. They showed neither MI nor DHE changed the cariogenic feeding behavior after one month, while Manchanda *et al.*<sup>[2]</sup> indicated MI and DHE decreased “bottle feeding at demand” and “night feeding through bottle” behaviors after an 8-month follow-up period.

The results of MI effect on cariogenic feeding behaviors are inconclusive since various variables have been assessed in these few number of studies. More well-designed studies are suggested to explore this subject.

### Oral health-related knowledge

MI has been shown to improve the participants’ knowledge about specific subjects, including women’s knowledge of vaginal birth<sup>[32]</sup> and patients’ knowledge of stroke.<sup>[33]</sup>

Regarding the oral health-related knowledge, two studies<sup>[15,25]</sup> evaluated the impact of MI approach on the caregivers’ knowledge. They both indicated the prominent impact of MI. In a well-planned study, Henshaw *et al.*<sup>[25]</sup> argued that although the participants’ oral health-related knowledge promoted significantly in MI group versus DHE group, it did not translate into significant group differences in the previously mentioned oral health-related behaviors. As for the proper frequency of varnish fluoride use, Naidu *et al.*<sup>[15]</sup> reported an improvement in the participants’ knowledge after 4 months in both MI and DHE groups. Regarding “the safe time for giving sugary drinks and snacks to children”, knowledge improvement was found to be significant merely in the MI group.

Follow-up telephone calls were used as boosters in MI intervention in all studies. Harrison *et al.*<sup>[22]</sup> showed further follow-up might decrease the chance of relapse in the MI-related behavior changes.

With respect to quality assessment, all studies were found to have random sampling based on Cochrane collaboration tool for assessment of risk of bias. Regarding allocation concealment, the data in the majority of studies were inadequate, so they were reported to have an unclear risk of bias.<sup>[2,15,24,25]</sup> In all studies, the blinding of personnel and participants was not possible owing to the nature of motivational counseling. The behavioral outcome was assessed with sufficient blinding of outcome evaluators in all studies, so they had a low risk of detection bias. In their study, Naidu *et al.*<sup>[15]</sup> and Ismail *et al.*<sup>[6]</sup> revealed a drop-out rate of a >25% and did not provide clear information regarding the balance of remaining samples in the control and case groups; hence, it was graded as having a high risk of attrition bias.

Paucity of high-quality studies with similar standard methodology, low number of samples, and short follow-up

period were some limitations of this review. Further, we were not able to summarize a quantitative assessment of the articles included because of the heterogeneity of studies. The low number of publications and variety of behaviors evaluated further made the interpretation of available evidence difficult.

Considering these limitations, further studies are suggested to evaluate the effect of MI on larger sample sizes using standardized MI protocols for oral health evaluation with high loyalty to the MI spirit.

### Conclusion

Although MI approach showed a significant impact on “dental visit for fluoride varnish” and “participants’ knowledge improvement”, further well-designed trials are needed to evaluate the impact of MI on the oral health-related behaviors using standardized MI protocol and exploring more specific variables.

Why this paper is important:

- Behavior is important in dental disease etiology, so behavioral interventions are needed for prevention and treatment. Motivational interviewing (MI) has been proposed as a potentially useful behavioral intervention for prevention of early childhood caries. Studies have evaluated the effectiveness of MI targeting parents/caregivers for reduction of the risk-related behaviors of early childhood caries (ECC) compared to dental health education (DHE).
- It is important to review the outcomes to find out the behaviors that can be improved by MI as well as to reveal the limitations of these studies for considering in the future research.

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### Conflicts of interest

There are no conflicts of interest.

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