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.[1] 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.[2,3] 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.[4] 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.[5]

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.[6] Motivational interviewing (MI) is one of the methods of behavior change which reduces the individual’s resistance to change.[7] It helps people to explore and resolve their uncertainty toward change as a client-centered but directive counseling strategy.[8] This strategy has been successfully applied to various health behaviors such as substance use disorders,[9,10] smoking,[11,12] diet and exercise, and medication dependence.[13] 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.[14-16]

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...
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.\[7\]

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).\[17\] 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\[5,16-23\] were excluded with reasons presented in Table 3. Finally, the remaining articles\[2,5,6,14,15,24,25\] 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.
As for the number of MI sessions, all studies trained the participants in one session except the study of Henahaw et al.\(^\text{[25]}\) 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,\(^\text{[5,6,24,25]}\) while it was 1-8 months in three other trials.\(^\text{[2,14,15]}\)

The behavioral outcomes varied among the reviewed studies. Harrison et al.\(^\text{[5]}\) and Weinstein et al.\(^\text{[24]}\) 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.\(^\text{[5]}\), Henshaw et al.\(^\text{[25]}\), and Manchanda et al.\(^\text{[2]}\) reported the number of decayed, missed, and filled teeth/surfaces. Further, Weinstein et al.\(^\text{[24]}\) reported the incidence of new dental caries. However, this systematic review was not aimed to evaluate these clinical outcomes.
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.\cite{5,24}

Checking for pre-cavities

This behavior was assessed by Ismail \textit{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).\cite{6}

### 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   |

### Table 4: Evidence table

| Author Year            | Sample characteristics | Study groups | MI session | Duration of MI session (min) | Conclusion | Follow-up (months) |
|------------------------|------------------------|--------------|------------|-----------------------------|------------|--------------------|
| 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 | MI no formal education | 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) 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. 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. \cite{P<0.05}. Cariogenic feeding practice: including giving healthy food and non-sugary snacks: No differences between MI and DHE groups. (P<0.05) | 4      |
| Manchanda/2014/India   | 387/mothers of 6-18 months old children | B: DHE C: No formal education | A: MI + DHE | 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. 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 non-sugary snacks: No differences between MI and DHE groups. (P<0.05) | 8      |
| Ismail AI, Ondersman S/2011/USA | 599/caregiver of 0-5 years old children | DHE MI + DHE | 1          | 40                          | 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      |
| Henshaw/2018/USA       | 906/pregnant women in 3rd 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      |
Tooth cleaning frequency

As one of the most frequently studied behaviors, four studies investigated tooth cleaning frequency.\cite{6,14,15,25}

Naidu et al.\cite{15} 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.\cite{6,25} In their study, Freudenthal et al.\cite{14} 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.\cite{2}

Cariogenic feeding practice

Four articles evaluated this outcome.\cite{2,6,14,25} Ismail et al.\cite{6} and Henshaw et al.\cite{25} 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). Freudenthal et al.\cite{14} 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.\cite{2} 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.

Freudenthal et al.\cite{14} 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.\cite{15} and Henshaw et al.\cite{25} 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.\textsuperscript{[15]} 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.\textsuperscript{[26]}

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.\textsuperscript{[27]} 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.\textsuperscript{[25]} 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. Weinsten et al.\textsuperscript{[24]} and Harrison et al.\textsuperscript{[9]} 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.\textsuperscript{[29]}

Reidy et al.\textsuperscript{[20]} 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,\textsuperscript{[29]} the study of Reidy et al.\textsuperscript{[20]} 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.\textsuperscript{[6]} and Henshaw et al.,\textsuperscript{[25]} 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.\textsuperscript{[6]} 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.\textsuperscript{[15]} 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.\textsuperscript{[6]} and Henshaw et al.\textsuperscript{[25]} 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.\textsuperscript{[10]}

**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”,\textsuperscript{[14]} “bottles given while awake”\textsuperscript{[14]} or at bedtime,\textsuperscript{[2,14]} “sugar sweetened beverage intake”,\textsuperscript{[25]} and “providing child with non-sugared snacks and healthy meals”.\textsuperscript{[6]}

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

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.\textsuperscript{[6,25]} 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.[14] and Freudenthal et al.[13] 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.[13] 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.[14] 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[15] and patients’ knowledge of stroke.[13]

Regarding the oral health-related knowledge, two studies[15,25] 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.[25] 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.[15] 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.[22] 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.[2,15,24,25] 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.[15] and Ismail et al.[9] 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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