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Motivational interviewing for preventing early childhood caries: A systematic review and meta-analysis

Beatriz Carriconde Colvara[1] | Daniel Demétrio Faustino-Silva[2] | Elisabeth Meyer[3] |
Fernando Neves Hugo[1] | Roger Keller Celeste[1] | Juliana Balbinot Hilgert[1,4]

[1]Graduate Program in Dentistry, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

[2]Graduate Program in Assessment Technology for the National Health System (SUS), Grupo Hospitalar Conceição (GHC), Porto Alegre, Brazil

[3]Graduate Health Sciences Program, Cardiology Institute (IC/FUC), Porto Alegre, Brazil

[4]Graduate Program in Epidemiology, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

Correspondence
Beatriz Carriconde Colvara, Department of Preventive and Social Dentistry, Federal University of Rio Grande do Sul, Rua Ramiro Barcelos, 2492 – 3° andar, Porto Alegre, Rio Grande do Sul, 90035-003, Brazil.
Email: beatrizccolvara@gmail.com

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Abstract

Objectives: This systematic review with meta-analysis was performed to assess whether motivational interviewing (MI) is effective in the prevention of early childhood caries (ECC) and to examine potential sources of heterogeneity.

Methods: Interventions based on motivational interviewing were considered eligible. The main outcome was new caries lesions (some studies included white-spot lesions in total count), and secondary outcomes included caregivers' oral health knowledge, home-care behaviours, plaque index, gingival index and fluoride varnish applications. Controls were any type of oral health education or negative controls without any specific intervention.

Results: From a total of 1498 studies identified in the databases search, 1078 were assessed for eligibility by reading titles and abstracts, after removal of duplicates. Full-text screening was performed in 61 articles, with 18 reporting on 14 different studies included in the qualitative synthesis and 8 in the quantitative synthesis (four studies included new white-spot lesions in total count). Subgroup analysis was performed by the control group dmft/dmfs and the test for subgroup differences suggests that there is a subgroup effect ($P = .06$), so population caries experience modifies the effect of MI-based intervention. In populations with high caries experience, the MI-based approach proved preventing an average of 3.15 (95% CI: −6.14, −0.17) dmfs in young children. In samples with low caries experience, differences were smaller, since the caries levels were already lower (−0.31; 95% CI: −0.63, 0.00).

Conclusion: Motivational interviewing has the potential to modify knowledge and behaviours and reduce ECC with a more significant impact on children with high caries experience.

KEYWORDS
dental caries, early childhood caries, motivational interviewing, preschool child, review

1 | INTRODUCTION

Dental caries in children has declined in the past few decades, although many children still carry significant disease levels.[1] In 2010, untreated caries in primary teeth was the 10th most prevalent condition, affecting 621 million people globally,[2] but the effectiveness of individual interventions for disease prevention is unclear.[3] While dental health education seems to improve knowledge, its effects on

behaviour and clinical outcomes are limited, showing that health education alone may not promote short- and long-term improvements in oral health.[4,5]

Nevertheless, new approaches have shown to reduce the incidence of the disease, especially in socio-economically disadvantaged populations.[6-8] One approach to behavioural change, motivational interviewing (MI), seems to stand out among school, community and family-based approaches.[9] MI is a collaborative communication style, person-centred, that aims to improve health behaviours. It is more than a set of techniques, and it is a form of profession-patient interaction. MI considers individual autonomy and sociocultural context, evoking intrinsic motivation to make long-term behavioural changes.[10,11] On the other hand, traditional health education is based on prescriptive, standardized guidelines, which does not take into account the individual's interpersonal context and subjectivities. Previously, systematic reviews that assessed the effectiveness of MI in dental settings showed mixed findings[12,13] and included few studies. However, after these publications new studies were published, mainly in the approach of early childhood caries. Therefore, an update in the synthesis of current evidence is needed, as well as a throughout examination of potential sources of heterogeneity, something that has not been done previously. This systematic review with meta-analysis aimed to assess whether motivational interviewing is effective in the prevention of early childhood caries (ECC).

2 | METHODS

2.1 | Protocol registration and review reporting

The protocol was registered in Prospero (PROSPERO 2019 CRD42019128819), and this review is reported following Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[14]

2.2 | Eligibility criteria

Interventions based on motivational interviewing or indicating that a counselling technique based on the principles developed by Miller and Rollnick[11] were considered eligible. The main outcome was new caries lesions (some studies included white-spot lesions in total count), and secondary outcomes included caregivers' oral health knowledge, home-care behaviours, plaque index, gingival index and fluoride varnish applications. Controls were any type of oral health education or negative controls without any specific intervention. Participants were children with 0-6 years with deciduous dentition, although pregnant woman or children's mothers could be considered as the main population, since they received the intervention. PICO strategy was applied to develop a search strategy; however, to gain sensitivity, the search strategy was developed using terms only for intervention and outcome description.

Randomized controlled trials, cluster randomized controlled trials and community-based randomized controlled trials, which included motivational interviewing as an approach, were included. There were no restrictions in terms of language or publication date.

2.3 | Information sources and search strategy

The following databases were searched for relevant studies: PubMed, EMBASE, Virtual Health Library, Scopus, Cochrane Central Register of Controlled Trials, Web of Science, LILACS and Google Scholar. The search strategy was developed for PubMed and adapted for other databases. Potentially relevant reports were retrieved through combinations of medical subject headings (MeSH) and keywords (Appendix 1).

"Stages of change", "transtheoretical model" and "readiness to change" keywords (Appendix 1) were included since these terms were often used exchangeably with motivational interviewing, although there are differences between these theories.[15] Published protocols were identified by searches, and attempted contact was performed. Electronic searches were last updated in September 2019.

2.4 | Data collection and risk of bias assessment

A database with the search results was generated using Mendeley Desktop version 1.19.4. All papers were screened independently by title and abstract by two reviewers (BCC and JBH). Disagreements were resolved by discussions. Potentially eligible full texts were obtained and carefully assessed for eligibility by two reviewers (BCC and DDFS). Disagreements were resolved by a third reviewer (JBH). Articles that met all inclusion criteria were carefully read for data extraction by a standardized and pretested spreadsheet.

Risk of bias was assessed following the Cochrane Handbook for Systematic Reviews of Interventions version 5.1.0.[16] Seven domains were made up of risk of bias assessment, six of them were part of the Cochrane Handbook (random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data and selective report) and a seventh domain was added for intervention-related bias assessment. Bias was investigated using the Funnel plot graph and Egger's and Begg's test of bias.

2.5 | Data analysis

Studies that met any inclusion criteria were considered for qualitative analysis. Only studies that evaluated the main outcome were included in the meta-analysis. A summary of the characteristics of each study included (eg study population, intervention characteristics, who delivered the intervention) was done using a descriptive

synthesis. Different publications that comprised the same study were summarized together.

For quantitative synthesis, the combined estimate of intervention's effects was calculated from the mean difference in each included study. Meta-analysis was performed using the final follow-up per group, the final dmfs or dmft and standard deviation (or confidence intervals). Heterogeneity was assessed by the chi-square test ($P < .05$) and I-square index, and the meta-analysis was performed using a random-effects model. In order to investigate sources of heterogeneity, subgroup analysis was performed. When data were missing, sensitivity analysis or data imputation was performed to estimate extreme scenarios and standard deviation. All analyses were performed using Review Manager version 5.3 and Stata Statistical Software.

## 3 | RESULTS

3.1 | Study selection and characteristics

From a total of 1498 studies identified in the database search, 1078 were assessed for eligibility by reading titles and abstracts, after removal of duplicates. Full-text screening was performed in 61 articles, with 18 reporting on 14 different studies included in the qualitative synthesis and 8 in the quantitative synthesis. A study was included in the qualitative synthesis, due to the lack of data on mean caries

values and standard deviation (or confidence interval) per group, even after contact attempts, but not in the meta-analysis.[17] The reasons for exclusions after full-text screening are listed in Figure 1.

Included studies were performed in seven different countries: Australia, Brazil, Canada, India, Iran, Thailand and the United States. The effect of motivational interviewing in early childhood caries was studied in different populations, including Australian Aboriginal children,[18,19] low-income African Americans[7] and children from the Cree Group of First Nations in Canada.[20] Two studies were carried out in pregnant woman,[18,19,21] ten after gestation[6,7,17,22-31] and two were conducted with pregnant woman and mothers of young children simultaneously.[8,20] Most studies used motivational interviewing alone as a test intervention, but two associated motivational interviewing with at least one other intervention.[17,18] The longest follow-up period was of 3 years[6,19,24] and the shortest was of 4 weeks,[22] although most studies had a follow-up period of 1 year or less. Detailed study characteristics can be found in Appendix 2.

3.2 | Risk of bias

Risk of bias assessment is summarized in Figure 2 and was generated by Review Manager (v. 5.3). Only two studies fulfilled all domains with low risk of bias.[27] Allocation concealment was unclear in most studies, while several studies have not provided data for proper risk assessment. Three studies presented high bias in the quality of
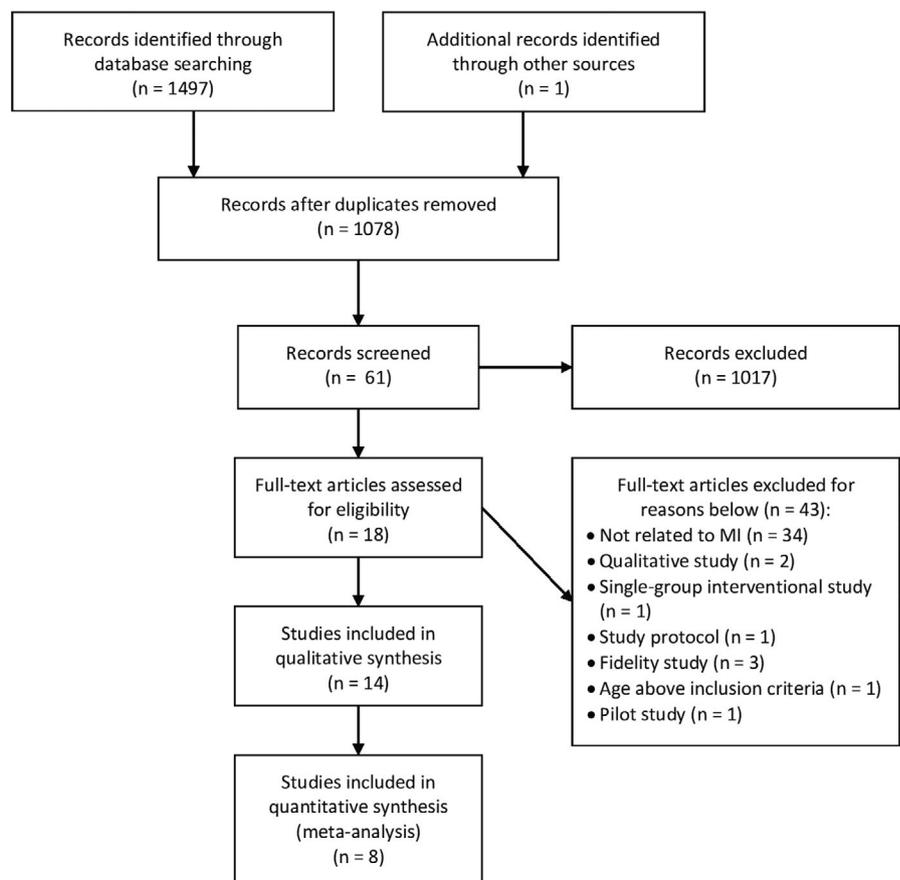
FIGURE 1 Flow diagram of studies selection

motivational interviewing training.[20,23,30] This domain evaluated the theoretical foundation that underpinned the training and intervention. Discrepancies were found between the intervention employed and the one advocated. In many studies, there was a difference not only qualitatively in what was performed to each group, but also in the number of interventions performed to each group (Appendix 2).

Funnel plot inspection identified an asymmetry caused by the two studies from Harisson (2007, 2012), and bias was confirmed in Egger's ($P = .05$) and Begg's ($P = .03$) tests.

3.3 | Qualitative synthesis

Motivational interviewing had a protective effect for caries in four studies,[18,20,23,24] and this effect may be greater in children of mothers who prechew children's food and were raised in a rural environment and with higher family income.[23] The number needed to treat

was estimated at 25, ranging from 8.9, in mothers who self-reported their oral health as fair or poor, to 99 when in children living in metropolitan areas.[18] Two studies additionally evaluated oral hygiene[17,30] and observed children with healthier gum and lower plaque index in the test group when compared to the control group.

Of the fourteen studies included, four did not evaluate caries as the main outcome.[21,22,29,31] Variables related to knowledge, practices and attitudes were assessed, and higher frequency of brushing, knowledge of toothpaste quantity and supervised position were observed in the groups that received the MI-based intervention.[22,31] More favourable attitudes towards cleaning the child's teeth and higher perceived control scores were found.[29]

3.4 | Meta-analysis

Figure 3 shows the Forest plot of the overall mean difference in dmft/dmfs among any control and MI groups. Eight studies were included in the quantitative analysis, with 3298 patients completing the studies. The subgroup analysis was performed by the control group dmft/dmfs, because the control population is closer to the profile of the populations from the original samples. Three studies with the highest mean dmft/dmfs values composed a subgroup, and the other five studies composed the subgroup with the lowest mean dmft/dmfs values. The test for subgroup differences suggests that there is a subgroup effect ($P = .06$), meaning that population caries experience modifies the effect of MI-based intervention. In populations with high caries experience, the MI-based approach proved preventing an average of 3.15 (95% CI: −6.14, −0.17) dmfs in young children. In samples with low caries experience, differences were smaller, since the caries levels were already lower (−0.31; 95% CI: −0.63, 0.00).

There was no heterogeneity among results from the trials within the subgroup formed by the lowest dmft/dmfs values ($P = .55$). However, there is moderate unexplained heterogeneity among trials reporting data for the highest dmft/dmfs value subgroup ($I^2 = 62\%$; $P = .07$). Four other subgroup analyses were performed in order to determine potential sources of heterogeneity, but did not explain it and there were no differences in the effect measures: number of MI sessions and menu use (list of dietary and nondietary recommendations presented to caregivers) were collinear, ≤4 MI sessions without menu use vs >4 MI sessions with menu use (chi-square test for subgroup differences = 0.72, $P = .40$), mixed dentition vs deciduous dentition ($\chi^2 = 0.85$, $P = .36$), ICDAS for caries' diagnosis vs any other ($\chi^2 = 0.17$, $P = .68$) and with white spots vs without white spots ($\chi^2 = 0.05$, $P = .83$).

3.5 | Additional analysis

In two studies, even after attempts to contact the authors, data were still missing. In a study that originated three publications,[23,25,26] the number of losses per group was not identified. As the attrition data were available, a sensitivity analysis was performed to estimate the most extreme scenarios and the same number of losses was

FIGURE 2 Risk of bias summary. +, low risk of bias; ?, unclear risk of bias; -, high risk of bias

Study or Subgroup	MI Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
1.1.1 Higher levels of caries among controls								
Batliner2018	10	16	237	10.4	16.2	253	3.9%	-0.40 [-3.25, 2.45]
Harrison 2007	3.52	8	105	7.91	14.2	100	3.2%	-4.39 [-7.57, -1.21]
Harrison 2012	9.2	12.4	110	14.3	16.4	131	2.5%	-5.10 [-8.74, -1.46]
Subtotal (95% CI)			**452**			**484**	**9.6%**	**-3.15 [-6.14, -0.17]**

Heterogeneity: Tau² = 4.28; Chi² = 5.20, df = 2 (P = 0.07); I² = 62%
Test for overall effect: Z = 2.07 (P = 0.04)

1.1.2 Lower levels of caries among controls								
Colvara 2018	0.86	2.34	175	1.91	5.53	145	16.5%	-1.05 [-2.01, -0.09]
Henshaw2018	3.1	8	310	3.1	8.1	596	14.6%	0.00 [-1.10, 1.10]
Ismail 2011	4	4.75	299	4.1	4.75	300	19.6%	-0.10 [-0.86, 0.66]
Jamieson 2018	0.64	1.57	159	0.89	2.27	165	24.9%	-0.25 [-0.67, 0.17]
Mohammadi 2015	4.55	3.94	108	5.05	4.07	105	14.9%	-0.50 [-1.58, 0.58]
Subtotal (95% CI)			**1051**			**1311**	**90.4%**	**-0.31 [-0.63, 0.00]**

Heterogeneity: Tau² = 0.00; Chi² = 3.05, df = 4 (P = 0.55); I² = 0%
Test for overall effect: Z = 1.93 (P = 0.05)

Total (95% CI)			**1503**			**1795**	**100.0%**	**-0.61 [-1.22, -0.01]**

Heterogeneity: Tau² = 0.34; Chi² = 15.82, df = 7 (P = 0.03); I² = 56%
Test for overall effect: Z = 1.99 (P = 0.05)
Test for subgroup differences: Chi² = 3.44, df = 1 (P = 0.06), I² = 71.0%
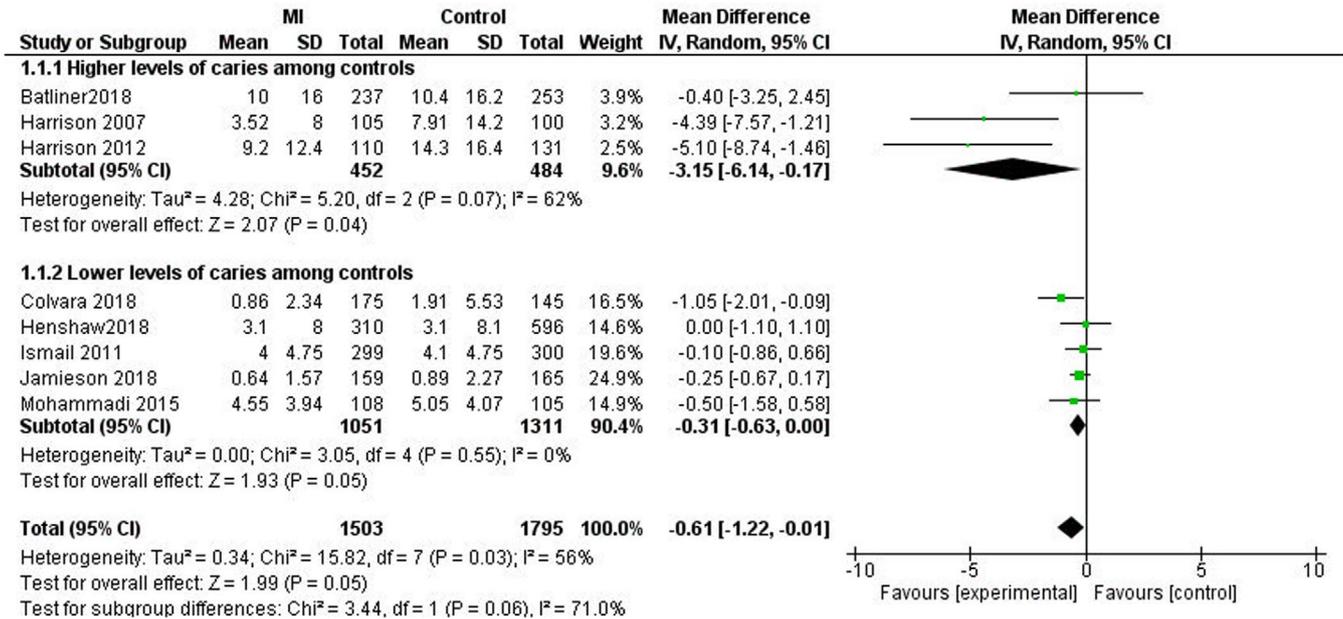

FIGURE 3 Forest plot of comparison by baseline caries level

maintained for both groups. In other study,[7] data from a similar study with the same population, with similar means, and children at the same age range, were used as a basis to estimate standard deviation.[32]

4 | DISCUSSION

This systematic review investigated whether MI is effective in preventing ECC when compared to any control, and potential sources of heterogeneity. This is a novel approach to meta-analysis in the field of MI in dental settings, and it showed that children experiencing more caries at the baseline will benefit the most experience from it in terms of prevention. Population caries experience is partially capable to account for heterogeneity, and MI was shown to be effective in preventing caries in young children.

New evidence on caries prevention through MI has been published in recent years, which is understandable, as caries risk is reduced by the adoption of healthy behaviours. Also, MI seems to be a good option to promote behaviour changes.[33] Many lifestyle changes can be beneficial to people in general, but especially to patients with chronic diseases, and MI has shown to be an effective alternative for the treatment and prevention of many of these health conditions, such as ECC,[33] type 2 diabetes[34] and chronic pain.[35] Nevertheless, inconclusive findings for many other health outcomes point to a wide methodological variety regarding the approach, accentuating heterogeneity and posing problems for reviews.[36] This methodological variety was evident in the present review. The design and implementation of the intervention varied greatly among studies, the number of sessions ranged from one to nine,[8] and the duration of each session ranged from 15 to 90 minutes.[17-19] Additionally, certain concessions were offered to families that received the intervention, such as accelerated access to dental care through privilege cards[20]

and a much larger number of interventions than the control group. It is not clear whether the findings came out of a well-performed and monitored MI-based approach or by excessive contact with the families of the intervention group through numerous one-to-one sessions, postcards or phone calls.

Another important source of variation among studies was counsellor training and counsellor background. Of the 14 studies included, only three reported that the counsellor was an oral health professional,[6,17,24,31] and the other professionals ranged from laypeople who lived in the communities[8,23] to master-level therapists.[7] This wide variety of professionals and the conceptual differences in the training may have modified the findings obtained from the ability of these counsellors to deal with issues related to oral health itself and the principles of MI, such as development of discrepancy, empathy and evocation. The duration of the training ranged from 8 hours to 3 days, but five studies did not report it.[21,22,28-30] Also, bases quite different from the postulated have resulted in interventions that are not compatible with MI,[15] focusing excessively on stages of change[23,25,26] or incorporating more than one intervention to the same group.[18,19] It remains unclear how MI effect may differ among these options.

Caries prevention through MI has not been established for different age groups and target behaviours should be investigated in order to explain the mechanism of change. It is not yet known which behaviours benefit from a MI-based approach, but behaviours as correct weekly brushing frequency, as well as knowledge about correct amount of toothpaste and period when fluoride varnish should be administered, appear to be impacted by an MI-based intervention.[31] The timing of intervention delivery can also be an important variable to explain the success of the approach in cases of caries in young children. Ismail et al[7] carried out the approach with 4-year-old children, when habits are already established and the disease may already be installed, which might have contributed

to changes in behaviours, but which did not impact clinical outcomes. Prenatal and postnatal periods have their particularities, and it is still unclear which is the best period to deliver MI-based approaches focused on the prevention of ECC.[37]

The interventions delivered in the studies' control groups were extremely diverse. Some groups did not receive any type of intervention, and others received conventional oral health education, watched videos or even received pamphlets. Oral health advices and conventional oral health education aim to improve people's oral health condition through improving knowledge, attitudes and behaviours. This is often not reflected in positive clinical results, as knowledge is not necessarily reflected in practices. Recent reviews point to the low quality of the evidence available in this field[38] and for the lack of long-term evidence about the effectiveness of these oral health education interventions in preventing plaque accumulation, gingivitis and dental caries in schoolchildren populations.[5] Thus, this review brings together comparisons with various types of control, and even though many of them are part of what is called conventional oral health education, there was significant variation in what was actually delivered to the control groups.

Identifying populations that can benefit from this sort of approach is essential, since in childhood different behaviours are established and practiced that can impact the individual's overall health. Restorative dental care is extremely costly to families and health systems, while risk factors for ECC are modifiable. Associating risk assessment tools[39] with preventive approaches is a way to optimize the use of MI. Early diagnosis, control of risk factors, arresting carious lesions, health education, community engagement and involvement of primary care teams are the steps cited by the World Health Organization to ending ECC.[40]

Heterogeneity found seems compatible with an effect modification or publication bias. Both explanations pointed to a couple of small studies with large effects in favour of the intervention among high-risk groups. Based on a previous study,[6] which also suggests larger effects among groups with higher dmf index, it seems more plausible that such results are due to an effect modification. In addition, we had very few studies (n = 8), and the chance of a false significant result in Egger's test is relatively high. However, there is a clear need for more studies among high-risk groups to confirm this. Limitations of this review included that some studies were excluded because there was a relevant difference between the intervention delivered and what is currently postulated by MI's idealizers. Studies included in the meta-analysis used different criteria for caries' diagnosis, in addition to not all of them considered white-spot lesions as caries lesions. Finally, one study included in the meta-analysis used the average index of decayed, missing and filled teeth (dmft), while the other studies used surface level (dmfs).

5 | CONCLUSION

Preventive approaches based on MI were effective in the prevention of ECC and may be recommended as part of preventive approaches, especially for populations with a high disease burden. The studies produced in this field have a wide methodological variety and there is a need to evaluate this approach in populations at high risk of caries, seeking to clarify the effect modification identified in the present review.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

BCC designed the protocol, reviewed the article, collected the data, analysed the data and drafted the manuscript. DDFS designed the protocol, collected the data and drafted the manuscript. EM designed the protocol and critically reviewed the manuscript. FNH designed the protocol and critically reviewed the manuscript. RKC designed the protocol, analysed the data and critically reviewed the manuscript. JBH designed the protocol, collected the data and critically reviewed the manuscript.

ORCID

Beatriz Carriconde Colvara https://orcid.org/0000-0002-8836-6909
Daniel Demétrio Faustino-Silva https://orcid.org/0000-0001-6876-6537
Elisabeth Meyer https://orcid.org/0000-0001-8642-037X
Fernando Neves Hugo https://orcid.org/0000-0003-2222-7719
Roger Keller Celeste https://orcid.org/0000-0002-2468-6655
Juliana Balbinot Hilgert https://orcid.org/0000-0002-2204-1634

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