

Promoting behavioural changes to improve oral hygiene in patients with periodontal diseases: A systematic review

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Abstract

Aim: This systematic review investigates the impact of specific interventions aiming at promoting behavioural changes to improve oral hygiene (OH) in patients with periodontal diseases.

Methods: A literature search was performed on different databases up to March 2019. Randomized and non-randomized controlled trials evaluating the effects of behavioural interventions on plaque and bleeding scores in patients with gingivitis or periodontitis were considered. Pooled data analysis was conducted by estimating standardized mean difference between groups.

Results: Of 288 articles screened, 14 were included as follows: 4 studies evaluated the effect of motivational interviewing (MI) associated with OH instructions, 7 the impact of oral health educational programmes based on cognitive behavioural therapies, and 3 the use of self-inspections/videotapes. Studies were heterogeneous and reported contrasting results. Meta-analyses for psychological interventions showed no significant group difference for both plaque and bleeding scores. No effect was observed in studies applying self-inspection/videotapes.

Conclusions: Within the limitations of the current evidence, OH may be reinforced in patients with periodontal diseases by psychological interventions based on cognitive constructs and MI principles provided by oral health professionals. However, no conclusion can be drawn on their specific clinical efficacy as measured by reduction of plaque and bleeding scores over time.

KEYWORDS

behavioural changes, motivational interviewing, oral hygiene, periodontal diseases, psychological intervention

1 | INTRODUCTION

The main goal of periodontal therapy is to restore periodontal health. A prerequisite to achieve this objective is a low level of clinical periodontal inflammation (<10% of bleeding on probing) on either an anatomically intact periodontium or a reduced periodontium (Lang & Bartold, 2018b). Plaque control is at the forefront of the proximal

risk factors leading to periodontitis (Bouchard, Carra, Boillot, Mora, & Range, 2017). Thus, among the known determinants of periodontal diseases, including predisposing local and systemic factors (e.g. dental restoration, uncontrolled diabetes) and environmental determinants (e.g. smoking, medications, stress, nutrition), oral hygiene (OH) appears as a key factor strongly linked to periodontal inflammation (Bouchard et al., 2017; Chapple et al., 2018; Lang & Bartold, 2018b).

It has been shown that poor OH, together with the persistence of uncontrolled periodontal risk factors, leads to further disease progression, treatment failure, and disease recurrence (Axelsson, Nystrom, & Lindhe, 2004; Han & Park, 2017; Lertpimonchai, Rattanasiri, Arj-Ong Vallibhakara, Attia, & Thakkestian, 2017; van der Weijden & Slot, 2011). As for the management of other long-term medical conditions, oral health professionals have a growing need to motivate their patients to lifestyle changes that modify risk factors and optimize adherence to medical advice (Lundahl et al., 2013). Among these lifestyle modifications, promoting behavioural changes to achieve and maintain a good OH over time remains highly challenging (Shamani & Jansson, 2012).

Oral hygiene depends on the patients' skills and dexterity but also on their motivation in performing effective self-care on a long-term basis (Newton & Asimakopoulou, 2015). Indeed, effective daily OH may be technically demanding and time-consuming, especially in patients with periodontal diseases for whom inter-dental cleaning is more difficult (Morris, Steele, & White, 2001; van der Weijden & Hioe, 2005).

Oral hygiene instructions (OHI) are part of the therapeutic patient education and are keystone interventions during all stages of periodontal treatment (Tonetti et al., 2015). The objectives of OHI are (a) to inform about the importance of OH in periodontal therapy, (b) to identify patient-tailored OH techniques, (c) to assess patient's ability to adequately perform these techniques, and (d) to ensure adherence to OHI over time. Various approaches based on behavioural sciences and communication skills have been proposed to improve and maintain individual plaque control over time (Sanz & Meyle, 2010). Indeed, it has been suggested that the adoption of specific psychological interventions based on theories of health-related behaviour and motivational interviewing (MI) may contribute to improve patient's adherence to OHI compared to non-specific educational interventions (Jarvinen, Stolt, Honkala, Leino-Kilpi, & Pollanen, 2018; Kopp, Ramseier, Ratka-Kruger, & Woelber, 2017; Newton & Asimakopoulou, 2015; Renz & Newton, 2009; Werner et al., 2016).

The present systematic review investigates the impact of specific interventions based on behavioural sciences and/or communication skills on OH behaviours of patients with periodontal diseases and the consequent improvement in plaque and/or gingival inflammation indices. The review question was as follows: In patients with periodontal diseases (gingivitis/periodontitis), which is the efficacy of behavioural interventions, aimed to promote OH, in terms of plaque and bleeding indices improvement?

2 | METHODS

2.1 | Protocol development and registration

A systematic review of studies focusing on interventions aiming at promoting behavioural changes to improve OH in patients with periodontal diseases was undertaken. As currently recommended,

Clinical Relevance

Scientific rationale for the study: Patients' adherence to oral hygiene (OH) instructions remains challenging. Oral health professionals should promote behavioural changes to improve OH and ensure long-term adherence.

Principal findings: The available evidence suggests that OH in patients with periodontal diseases may be improved by a therapeutic patient education based on behavioural interventions, cognitive constructs, and motivational interviewing delivered by trained oral health professionals or psychologists. However, there is insufficient evidence to assess their clinical efficacy and support one approach over the others.

Practical implications: Behavioural approaches can be implemented to promote risk factor control in patients with periodontal diseases.

we followed the PRISMA statements' checklist for reporting a systematic review (Moher, Liberati, Tetzlaff, & Altman, 2009). The systematic review protocol was registered in PROSPERO (temporary registration number: 142317).

2.2 | Eligibility criteria

For the purpose of conducting a systematic review, we searched for all the studies in which the primary objective was to evaluate the impact of any type of behavioural intervention on plaque index and/or gingival inflammation indices in patients with gingivitis or periodontitis. Hereafter, the criteria applied for the consideration of studies for the present systematic review, according to the following PICOS format:

2.2.1 | Participants

Non-institutionalized adult patients with gingivitis or periodontitis without comorbidity (e.g. diabetes, hypertension) and without ongoing orthodontic treatment. No restriction was applied for the definition, extent, and severity of the periodontal disease.

2.2.2 | Interventions

Any kind of interventions associated or not to periodontal therapies such as scaling and root planing, delivered by oral health professionals and/or psychologist/counsellor, and aimed to improve OH. These include the following: individually tailored patient's education, MI, psychological interventions, cognitive behavioural therapy (CBT),

feedback, use of videotape, text messaging, mobile applications, and combined techniques.

2.2.3 | Comparison

Standard OHI delivered by oral health professionals or no OHI.

2.2.4 | Outcome measures

Any validated index to assess the full-mouth amount of plaque and inflammation (bleeding) before and after the intervention.

2.2.5 | Study design

Randomized (RCTs) and non-randomized controlled clinical trials (NRCTs) with a follow-up of at least 3 months.

2.3 | Definition of interventions

Psychological interventions are based upon the evidence that several psychological factors (e.g. oral health beliefs, locus of control, sense of coherence, dental anxiety) are related to oral health behaviours (e.g. compliance to medical advice, attending professional dental care visits over time). These interventions refer to several psychological theories, such as health belief model, theory of planned behaviour, self-regulatory model, and social learning, which can all be used to promote behavioural changes (Christensen, Petersen, & Hede, 2010; Werner et al., 2016).

Principles of CBT can be applied to reinforce OHI, including cognitive restructuring, verbal reinforcement, use of cues to facilitate behaviour, and problem solving to address barriers to behaviour change. These strategies are based on psychological, contextual, and physiological individual factors that are related to the health outcome of interest and derived from individual assessments (Renz & Newton, 2009).

Motivational interviewing comprises all evidence-based communication methods, centred on the individual and individually tailored, aiming at supporting health behaviour changes such as weight loss, smoking cessation, and reduction of alcohol consumption (Miller & Moyers, 2002). Motivational interviewing has been defined as a collaborative, goal-oriented style of communication with particular attention to the language of change. It is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion (Miller & Rollnick, 2014). Motivational interviewing can focus on a variety of problem behaviours—typically one at a time—and can be delivered in a single session or through multiple sessions, sometimes integrated with other treatments (e.g. cognitive behavioural

therapy), or as a stand-alone intervention (Lundahl et al., 2013). Motivational interviewing can be used as a tool to facilitate the counselling process between the oral health professional and the patient.

2.4 | Information sources and search

Electronic literature search was performed on March 2019 and updated in May 2019 using the following online databases: MEDLINE (through PubMed), EMBASE, Cochrane Oral Health Group Specialized Register, Google Scholar, and ProQuest Dissertations and Theses Database. Additionally, a grey literature search was performed by using the OpenGrey database. A specific research equation was formulated for each different database, using the following key words and MeSH terms: periodontal disease(s), periodontitis, gingivitis, motivational interviewing, oral hygiene instruction, therapeutic patient education, behavioural change, behavioural medicine, text messaging, and mobile app. In addition, reference lists from eligible studies and previously published review articles were cross-checked to identify additional studies. Only English literature was reviewed.

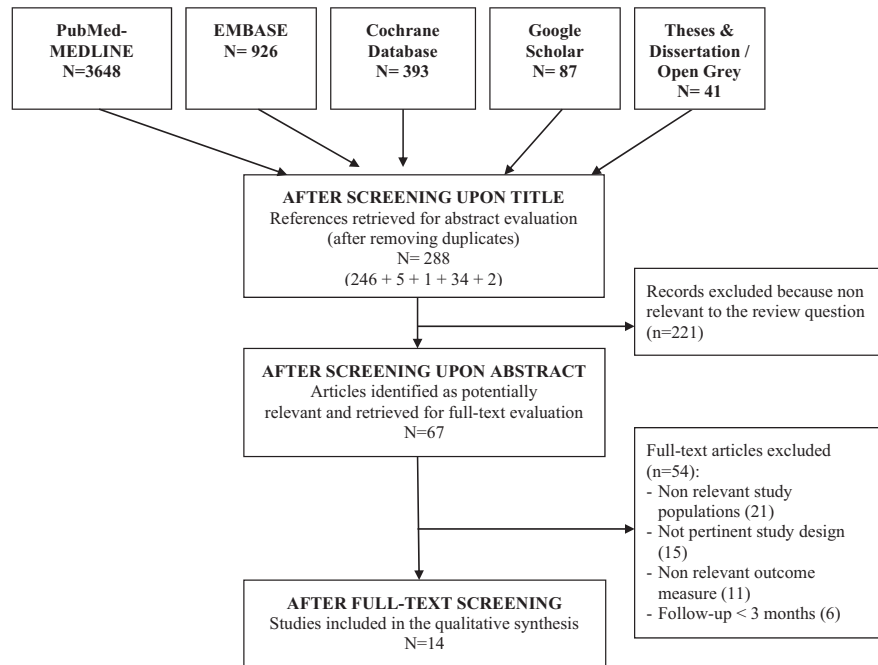
2.5 | Study selection and data extraction

Titles and abstracts of the retrieved studies were independently screened for relevance by two reviewers (MCC and LD) using Covidence software being one of Cochrane's recommended tools to support the reviewers in all different stages of the systematic review (<https://www.covidence.org>). Records were first screened at the title and abstract level. Any disagreement was resolved by consensus or discussion with a third author (PhB). Subsequently, both reviewers performed a full-text evaluation of the pre-selected articles that consisted in a full article reading to assess eligibility according to the PICOS criteria. This evaluation was performed by the two reviewers independently to reach a perfect agreement on the final selection of articles. During the full-text analysis, study characteristics and main findings were collected in a Microsoft Excel spreadsheet and summarized in tables to be processed for qualitative and, possibly, quantitative analyses. Outcome measures for plaque and bleeding scores were extracted for both experimental and control groups before and after receiving the intervention, marking whether a significant group difference was observed in each selected study.

2.6 | Risk of bias

Once completed the full-text article assessment, both reviewers proceeded to data extraction and risk-of-bias evaluation. Study quality and risk of bias were assessed by using appropriate tools according to the study design. Specifically for RCTs, the revised Cochrane risk-of-bias

FIGURE 1 Flow chart of literature search and study selection



PubMed equation:

(((((interview[MeSH Terms]) OR patient education as topic[MeSH Terms]) OR oral hygiene[MeSH Terms]) OR dental model[MeSH Terms]) OR text messaging[MeSH Terms]) OR mobile applications[MeSH Terms]) OR advertising as topic[MeSH Terms]) OR motivational interview*[Title/Abstract]) OR motivation intervention*[Title/Abstract]) OR oral hygiene instruction*[Title/Abstract]) OR oral hygiene education*[Title/Abstract]) OR patient education[Title/Abstract]) OR oral health education[Title/Abstract]) OR behavioural change*[Title/Abstract]) OR oral health behavior*[Title/Abstract]) OR oral hygiene behaviour[Title/Abstract]) OR behavioural medicine[Title/Abstract]) OR dental health education[Title/Abstract]) OR behavioral medicine[MeSH Terms]) OR mobile app*[Title/Abstract]) OR text message[Title/Abstract]) OR smartphone[Title/Abstract]) AND Humans[Mesh] AND English[lang])) AND (((((((plaque index[Title/Abstract]) OR dental plaque index[MeSH Terms]) OR periodontal index[MeSH Terms]) OR periodontal disease[MeSH Terms]) OR gingivitis[MeSH Terms]) OR periodontitis[MeSH Terms]) OR bleeding on probing[Title/Abstract]) OR BOP[Title/Abstract]) OR gingival inflammation[Title/Abstract]) OR periodontal inflammation[Title/Abstract]) AND Humans[Mesh] AND English[lang])) AND adult[MeSH Terms]

tool for randomized trials (RoB-2) was used (Higgins et al., 2016) while for NRCTs, the ROBINS-I was applied (Sterne et al., 2016).

2.7 | Summary measures and synthesis of results

Data from the studies included in the systematic review were processed for qualitative and, possibly, quantitative analyses. Outcome measures of any validated full-mouth plaque and bleeding score were extracted as mean values and standard deviation (SD) for both the test group (i.e. patients with periodontal diseases receiving the OHI with a specific psychological intervention or communication technique) and the control group (i.e. patients with periodontal diseases receiving the conventional OHI). If necessary and possible, outcome variables were calculated by the authors based on the data available in the individual selected studies. To express the size of the intervention effect in each study, standardized mean difference (SMD) and 95% confidence intervals (CI) were calculated

as the difference in the mean outcome between groups/SD of outcome among participants. Random effects models were used to take into account potential inter-study heterogeneity and to adopt a more conservative approach. The pooled effect was considered significant if $p < .05$. Heterogeneity was assessed using I^2 statistics (Harbour & Miller, 2001). Meta-analysis was conducted by using Review Manager (RevMan, version 5.1, by Cochrane Collaboration, Copenhagen, Denmark).

3 | RESULTS

3.1 | Study selection

Overall, the literature search yielded a total of 288 articles that were screened on the abstract level. Of these, 67 underwent a full-text evaluation which allowed removing 47 articles due to a non-relevant study design or an inclusion of non-eligible type of patients. Of the

TABLE 1 Summary of the included interventional studies assessing the impact of behavioural changes on oral hygiene of patients with periodontal diseases

First author, year, and country	Study design, study setting, and source of funding	Sample size (n)	Test group (n)	Control group (n)	Study duration	Definition of periodontal disease
<i>Studies on motivational interviewing (MI) associated to oral hygiene instructions (OHI)</i>						
Stenman et al. (2018) Sweden	RCT Setting: specialist clinic in periodontics Funding: TUA-Research Funding, and The foundation Swedish Patent Revenue Fund for Research in Preventive Odontology	26	Single session of MI by psychologist prior to non-surgical periodontal therapy (including conventional education and mechanical instrumentation) (13)	Conventional OHI and patient education by dental hygienist prior to non-surgical periodontal therapy (13)	3 years	Chronic periodontitis
Woelber et al. (2016) Germany	RCT Setting: University Funding: Institutional funding and a grant of the Neue Arbeitsgruppe Parodontologie e.V.	155	4–5 sessions of MI delivered by dental students trained in MI prior to periodontal therapy (73)	Periodontal therapy by students without training in MI (99)	6 months	Patients with a CPITN \geq 3 of at least two sextants
Brand et al. (2013) USA	RCT Setting: University Funding: Industry	56	Brief MI by trained counsellor + OHI prior to periodontal therapy (27)	Standard OHI prior to periodontal therapy (27)	3 months	Patients in periodontal maintenance for at least one year, and with a BOP \geq 40% or at least two teeth with interproximal PD \geq 5 mm
Stenman et al. (2012) Sweden	RCT Setting: specialist clinic in periodontics Funding: TUA-Research Funding, and The foundation Swedish Patent Revenue Fund for Research in Preventive Odontology	44	Single session of MI by psychologist prior to non-surgical periodontal therapy (22)	Conventional OHI and patient education by hygienist prior to non-surgical periodontal therapy (22)	6 months	Chronic periodontitis

Outcome measures	Impact on plaque score [mean (SD)]	Impact on bleeding score [mean (SD)]	Additional findings
PI (O'Leary) Marginal gingival bleeding (MBI) (%)	NS-D between groups TEST GROUP Baseline: 49.6% (23.7) At 6 months: 25.2% (15.3) At 3 years: 42.1% (30.6) CONTROL GROUP Baseline: 38.4% (15.3) At 6 months: 15.7% (10.4) At 3 years: 41.9% (30.3)	NS-D between groups TEST GROUP Baseline: 37.8% (19.7) At 6 months: 17.1% (8.6) At 3 years: 14.7% (9.2) CONTROL GROUP Baseline: 32.1% (12.3) At 6 months: 16.3% (8.9) At 3 years: 15.4% (17.6)	<ul style="list-style-type: none"> - Both groups showed a desirable mean MBI of 15%. - A single MI session as an adjunct to conventional periodontal therapy could not be proven to be of long-term beneficial additive effect with regard to prevention of relapse in oral hygiene behaviour.
PI (Silness and Loe) GI BOP (%) PPD CAL	NS-D between groups TEST GROUP Baseline: 0.56 (0.3) At 6 months: 0.72 (0.32) CONTROL GROUP Baseline: 0.43 (0.30) At 6 months: 0.54 (0.32)	NS-D between groups TEST GROUP Baseline: 51.87% (23.18) At 6 months: 46.65% (25.07) CONTROL GROUP Baseline: 53.65% (23.86) At 6 months: 51.82% (27.32)	<ul style="list-style-type: none"> - Patients in the experimental group showed significantly higher inter-dental cleaning self-efficacy than control group
PI (Quigley-Hein) BOP (%) PPD	NS-D between groups TEST GROUP Baseline: 2.4 (0.6) At 6 weeks: 1.9 (0.6) At 3 months: 2.1 (0.7) CONTROL GROUP Baseline: 2.6 (0.5) At 6 weeks: 2.2 (0.4) At 3 months: 2.3 (0.7)	NS-D between groups TEST GROUP Baseline: 50% (18) At 6 weeks: 31% (14) At 3 months: 33% (15) CONTROL GROUP Baseline: 55% (18) At 6 weeks: 40% (19) At 3 months: 36% (20)	<ul style="list-style-type: none"> - The intervention did not produce differential increases in motivation, autonomy, or knowledge.
PI (O'Leary) Marginal gingival bleeding (MBI) (Ainamo & Bay 1975).	NS-D between groups TEST GROUP Baseline: 50.2% (21.5) At 3 months: 27.1% (15.2) At 6 months: 25.2% (15.4) CONTROL GROUP Baseline: 43.1% (19.2) At 3 months: 19% (13.3) At 6 months: 18.6% (13.2)	NS-D between groups TEST GROUP Baseline: 36.6% (17.1) At 3 months: 21% (12.5) At 6 months: 18.8% (10.9) CONTROL GROUP Baseline: 33% (12.4) At 3 months: 16.2% (13.4) At 6 months: 18.4% (14.1)	<ul style="list-style-type: none"> - MI is not a predictor of achieving a MBI \leq 20%

(Continues)

TABLE 1 (Continued)

First author, year, and country	Study design, study setting, and source of funding	Sample size (n)	Test group (n)	Control group (n)	Study duration	Definition of periodontal disease
<i>Studies on individually tailored oral health educational programmes, cognitive behavioural therapy (CBT), and combined techniques including MI</i>						
Ramsay et al. (2018) UK	RCT Setting: 63 urban and rural general dental practices Funding: NIHS	1,237	Personalized OHI based on social cognitive theory and implementation intervention theory	Routine OHI	3 years	Periodontal health, gingivitis, and moderate periodontitis (basic periodontal examination score 0 to 3; Two-thirds of participants had BPE scores of ≤ 2)
Araujo et al. (2016) Portugal	RCT Setting: Private dental clinics Funding: Industry	78	Reinforcement, goal setting and feedback + intra-oral camera used during supportive periodontal therapy (40)	Reinforcement, goal setting and feedback during supportive periodontal therapy (38)	4 months	Gingivitis
Jönsson et al. (2010) Sweden	RCT Setting: specialist clinic in periodontics Funding: Swedish Research Council, Uppsala County Council, Swedish Patent Revenue Fund for Research in Preventive Odontology, and authors' institutions	113	Individually tailored oral health educational programme based on cognitive behavioural principles (including MI) delivered by trained dental hygienist + periodontal therapy (57)	Standard treatment for periodontal therapy (56)	12 months	Chronic periodontitis
Jönsson et al. (2009) Sweden	RCT Setting: Department of Periodontology in a Swedish county Funding: Swedish Research Council, Uppsala County Council, Swedish Patent Revenue Fund for Research in Preventive Odontology, Pfizer Oral Care Award, and authors' institutions	113	Individually tailored oral health educational programme based on cognitive behavioural principles (including MI) delivered by trained dental hygienist + periodontal therapy (57)	Standard treatment for periodontal therapy (56)	12 months	Chronic periodontitis

Outcome measures	Impact on plaque score [mean (SD)]	Impact on bleeding score [mean (SD)]	Additional findings
GI BOP (%)	Not reported	NS-D between groups TEST GROUP Baseline: 34.3% (23.2) At 3 years: Not reported CONTROL GROUP Baseline: 31.0% (23.7) At 3 years: Not reported	<ul style="list-style-type: none"> - Bleeding increased from baseline to 3-year follow-up for both groups - There was also little evidence of a difference between participants randomized to personalized OHI or routine OHI (difference -2.5%, 95% CI -8.3% to 3.3%; $p = .393$) - No difference between OHI delivery for GI/BOP also in the subgroup analysis considering periodontal patients versus. non-periodontal patients (PPD < 4 mm)
BOMP (Bleeding on Marginal Probing)	Not reported	↓significantly in the experimental group than control group TEST GROUP Baseline: 1.20 (0.29) At 4 months: 0.61 (0.28) CONTROL GROUP Baseline: 1.14 (0.33) At 4 months: 0.81 (0.33)	<ul style="list-style-type: none"> - Self-reported flossing and self-efficacy were also significantly improved in the experimental group
PI (Silness and Loe, expressed as % >1) BOP (%) PPD	↓significantly in the experimental group TEST GROUP Baseline: 59% (18) At 3 months: 17% (10) At 12 months: 14% (12) CONTROL GROUP Baseline: 57% (17) At 3 months: 28% (17) At 12 months: 28% (13)	↓significantly in the experimental group TEST GROUP Baseline: 70% (20) At 3 months: 24% (12) At 12 months: 19% (13) CONTROL GROUP Baseline: 75% (18) At 3 months: 33% (15) At 12 months: 29% (14)	<ul style="list-style-type: none"> - Mean differences between groups for full-mouth BOP = 8.24% (CI: 3.5–12.9) - No group difference for the mean proportion of sites reaching the treatment endpoint of “pocket closure,” i.e. a PPD ≤ 4 mm - More patients in the experimental group reached a level of non-surgical periodontal treatment success.
PI (Silness and Loe) GI (Loe and Silness)	↓significantly in the experimental group TEST GROUP Baseline: 0.74 (0.34) At 3 months: 0.17 (0.11) At 12 months: 0.14 (0.13) CONTROL GROUP Baseline: 0.73 (0.31) At 3 months: 0.32 (0.22) At 12 month: 0.31 (0.16)	↓significantly in the experimental group TEST GROUP Baseline: 0.92 (0.28) At 3 months: 0.27 (0.14) At 12 months: 0.21 (0.16) CONTROL GROUP Baseline: 0.92 (0.23) At 3 months: 0.52 (0.20) At 12 months: 0.50 (0.17)	<ul style="list-style-type: none"> - Mean gain PI score difference between groups at 12 months: 0.16 (CI: 0.03–0.30)] - Mean gain GI score difference between groups at 12 months: 0.27 (0.16–0.39)] - Patients in the experimental group reported higher frequency of daily inter-dental cleaning and were more certain that they could maintain the attained level of behaviour change.

(Continues)

TABLE 1 (Continued)

First author, year, and country	Study design, study setting, and source of funding	Sample size (n)	Test group (n)	Control group (n)	Study duration	Definition of periodontal disease
Jönsson et al. (2006) Sweden	RCT Setting: Department of Periodontology in a Swedish county of Uppsala Funding: Not reported	35	Client Self-care Commitment Model (CSCCM) over 3 sessions by hygienist + conventional OHI (19)	Conventional OHI by hygienist (16)	3 months	Periodontal patients with insufficient compliance and progress of their periodontal disease
Little et al. (1997) USA	RCT Setting: 12 large dental clinics Funding: National Institute of Dental Research	107	Behavioural intervention consisting in 5 group sessions (90 min) based on social learning principles performed once a week by hygienist (54)	Usual periodontal cares (53)	4 months	Mild to moderate periodontal disease
Tedesco et al. (1992) USA	RCT Setting: University Funding: NIH-NIDR grant	167	Traditional OHI with psychological and social assessment instruments + phase contrast slide of their own subgingival plaque on a videomonitor + feedback by hygienist (111)	Traditional OHI with psychological and social assessment instruments + feedback by hygienist (56)	9 months	Mild to moderate gingivitis (least 55% of oral sites with gingival bleeding on probing)

Abbreviations: BOP, bleeding on probing; CAL, clinical attachment level; CBT, cognitive behavioural therapy; CI, confidence interval; GI, gingival index; MBI, marginal gingival bleeding; MI, motivational interviewing; NRCT, non-randomized controlled trial; NS-D, non-significant difference; OH, oral hygiene; OHI, oral hygiene instructions; PD, pocket depth; PPD, probing pocket depth; PI, plaque index; RCT, randomized controlled trial.

remaining 20 articles, 6 were excluded because the study follow-up was <3 months. Finally, 14 articles were selected and included in the present systematic review. The PRISMA flow chart of the study identification and inclusion/exclusion process is shown in Figure 1. The excluded studies and the reasons for exclusion are reported in Table S1.

During the study selection process, the inter-examiner agreement was 0.82 for title and abstract screening and 0.98 for the full-text evaluation (Cohen's kappa test).

3.2 | Study characteristics

Overall, the selected studies were published between 1981 and 2018. They included 12 RCTs (Araujo, Alvarez, Godinho, & Pereira, 2016; Baab & Weinstein, 1986; Brand, Bray, MacNeill,

Catley, & Williams, 2013; Jönsson, Lindberg, Oscarson, & Ohrn, 2006; Jönsson, Ohrn, Lindberg, & Oscarson, 2010; Jönsson, Ohrn, Oscarson, & Lindberg, 2009; Little et al., 1997; Ramsay et al., 2018; Stenman, Lundgren, Wennstrom, Ericsson, & Abrahamsson, 2012; Stenman, Wennstrom, & Abrahamsson, 2018; Tedesco, Keffer, Davis, & Christersson, 1992; Woelber et al., 2016) and 2 NRCTs (Glavind, Zeuner, & Attstrom, 1981, 1984). Four studies (28.6%) evaluated the effect of MI associated with OHI, seven studies (50%) assessed the impact of an individually tailored oral health educational programme including principles of CBT and MI (combined techniques), and in three studies (21.4%), the effects of self-inspections and/or videotapes were investigated. No study applied and evaluated media communication methods, text messaging, or smartphone applications in patients with gingivitis or periodontitis. The articles by Jönsson and co-workers published in

Outcome measures	Impact on plaque score [mean (SD)]	Impact on bleeding score [mean (SD)]	Additional findings
PI (Silness and Loe) BOP (%) PPD	↓significantly in the experimental group TEST GROUP Baseline: 0.59 (0.17) At 3 months: 0.25 (0.11) CONTROL GROUP Baseline: 0.59 (0.29) At 3 months: 0.33 (0.11)	NS-D between groups TEST GROUP Baseline: 46.8%(13.8) At 3 months: 18.7% (8.3) CONTROL GROUP Baseline: 39% (16.0) At 3 months: 16.3% (5.7)	<ul style="list-style-type: none"> - Patients in the experimental group increased their interdental cleaning and reduced the number of periodontal pockets > 4 mm compared to the control group. - The majority of the patients in the experimental group reported that the written commitment had influenced on their oral self-care habits in a positive direction.
PI (O'Leary) GI BOP (%) PPD CAL	↓significantly in the experimental group TEST GROUP Baseline: 82% At 4 months: 76% CONTROL GROUP Baseline: 80% At 4 months: 80%	↓significantly in the experimental group TEST GROUP Baseline: 24% At 4 months: 15% CONTROL GROUP Baseline: 26% At 4 months: 21%	<ul style="list-style-type: none"> - Patients in the experimental group increased significantly their skills and frequency of tooth brushing and flossing - No group difference for PPD and CAL changes over time
PI (Loe and Silness) GI (Loe and Silness)	NS-D between groups TEST GROUP Baseline: 1.35 At 9 months: 0.9 CONTROL GROUP Baseline: 1.26 At 9 months: 0.99	NS-D between groups TEST GROUP Baseline: 1.61 At 9 months: 0.96 CONTROL GROUP Baseline: 1.61 At 9 months: 0.97	<ul style="list-style-type: none"> - A slower relapse rate was noted for the experimental group. - No significant differences were found between groups for oral health cognitions or behaviour reports over time.

2009 and 2010 appeared to evaluate the same population but presenting different outcomes, whereas the articles by Stenman and co-workers published in 2012 and 2018 are the consecutive publications of short- and long-term results of the same study. Overall, a total of 2,160 patients with periodontal diseases were studied, including gingivitis and periodontitis at different degrees of severity. Study characteristics are displayed in Tables 1 and 2, according to the type of behavioural intervention applied.

3.3 | Synthesis of the results

3.3.1 | Impact of psychological interventions

Within the 4 studies dealing with MI as a stand-alone intervention to reinforce OHI, MI was provided in a single session or multiple

sessions by either a psychologist or trained counsellors/dental students (Brand et al., 2013; Stenman et al., 2012, 2018; Woelber et al., 2016). Oral hygiene instructions were delivered along with the MI interventions and prior to conventional non-surgical periodontal therapy. At the re-evaluation examinations performed at 3 months, 6 months, and 3 years after MI, all studies found no significant difference between the experimental and control groups for both plaque index and bleeding scores (i.e. bleeding on probing, BOP, and marginal gingival bleeding index, MBI). The only long-term study by Stenman and co-workers concluded on a sample of 26 patients that a single MI session could not be proven to have any long-term (namely 3 years) beneficial additive effect to conventional periodontal therapy with regard to prevention of relapse in OH behaviours (Stenman et al., 2018) (Table 1).

In the 7 studies applying combined psychological interventions, personalized OHI were delivered in conjunction with reinforcement,

TABLE 2 Summary of the included interventional studies assessing the impact of self-inspection and videotape on oral hygiene of patients with periodontal diseases

First author, year, and country	Study design, study setting, and source of funding	Sample size (n)	Test group (n)	Control group (n)	Study duration
<i>Studies on self-inspection and videotapes</i>					
Baab and Weinstein (1986) USA	RCT Setting: University Funding: National Institutes of Health	31	Oral self-inspection manual and OHI (15)	No intervention (16)	6 months
Glavind et al. (1984) Denmark	NRCT (age- and number of teeth-matched case-control) Setting: University Funding: Danish Dental Association	74	Periodontal self-examination + OHI (self-instructional manual) prior to periodontal treatment (23)	OHI prior to periodontal treatment (27) and OHI 6 week after the periodontal treatment (24)	7 months
Glavind et al. (1981) Denmark	NRCT (matched case-control) Setting: University Funding: A/S L. Goof	37	Self-instructional manual (12)	Individual OHI by dental hygienists (13) or no OHI (12)	6 months

Abbreviations: BOP, bleeding on probing; NRCT, non-randomized controlled trial; NS-D, non-significant difference; OH, oral hygiene; OHI, oral hygiene instructions; PI, plaque index; RCT, randomized controlled trial.

goal setting, feedback, counselling, CBT, social learning principles, and MI. Overall, interventional protocols were heterogeneous being performed over single or multiple sessions by different trained oral health professionals. For example, Jönsson and co-workers applied a protocol that comprised an individually tailored oral health educational programme based on cognitive behavioural principles delivered by a dental hygienist who received a specific training of three 8-hr sessions covering education in MI techniques and the philosophy behind the use of cognitive behavioural strategies (Jönsson et al., 2010, 2009). Two studies evaluated the impact of using of an intra-oral camera (Araujo et al., 2016) or a phase contrast slide of the patient's subgingival plaque on a videomonitor (Tedesco et al., 1992) to provide a visual feedback reinforcing OHI delivered together with the psychological intervention.

Five RCTs reported outcomes for both plaque and bleeding scores (Jönsson et al., 2006, 2010, 2009; Little et al., 1997; Tedesco et al., 1992). In 2 studies, both indices were significantly modified by the behavioural interventions leading to a statistically significant reduction for the experimental group compared to the control group at 3 months, 4 months, and 1 year after the intervention (Jönsson et al., 2010, 2009; Little et al., 1997). Conversely, the study by Tedesco et al. (1992) found no significant impact on plaque and bleeding scores (i.e. GI) at 9-month follow-up, and Jönsson et al. (2006) observed a significant reduction in plaque index but not in the bleeding score (as assessed by BOP and GI) at 3 months (Jönsson et al., 2006; Tedesco et al., 1992). The remaining two studies (Araujo et al., 2016; Ramsay et al., 2018) evaluated only the bleeding score. Araujo and co-workers found a significant reduction in bleeding on

Definition of periodontal disease	Outcome measures	Impact on plaque score [mean (SD)]	Impact on bleeding score [mean (SD)]	Additional findings
Patients having completed active periodontal treatment, including surgery	PI BOP	NS-D between groups (detailed mean values not reported)	NS-D between groups (detailed mean values not reported)	- Visual feedback may be of minor importance in plaque control programmes
Patients seeking for dental treatments and with only few pockets >5 mm	PI (O'Leary) BOP (%)	NS-D between groups TEST GROUP Baseline: 61.8% (15.7) At 7 months: 23.7% (16.8) CONTROL GROUP 1 Baseline: 59.4% (17) At 7 months: 23.5% (14.9) CONTROL GROUP 2 Baseline: 60.3% (17) At 7 months: 23.5% (14.9)	NS-D between groups TEST GROUP Baseline: 55.4% (14.4) At 7 months: 20.4% (11.8) CONTROL GROUP 1 Baseline: 52.6% (179.2) At 7 months: 21.9% (13.9) CONTROL GROUP 2 Baseline: 56.3% (21.2) At 7 months: 18% (17.1)	- Most patients expressed that they were satisfied with the treatment procedures , although 8 indicated that they disliked the use of disclosing tablets.
Patients seeking for periodontal treatment with few pockets >5 mm	PI (O'Leary) BOP (%)	NS-D between groups TEST GROUP Baseline: 66.2% (19.7) At 6 months: 20.4% (15.9) CONTROL GROUP 1 Baseline: 61.4% (19.3) At 6 months: 22.1% (19.2) CONTROL GROUP 2 Baseline: 66.1% (16.7) At 6 months: 19.7% (15.9)	NS-D between groups TEST GROUP Baseline: 39.5% (24.4) At 6 months: 13.1% (14.8) CONTROL GROUP 1 Baseline: 39.6% (26.9) At 6 months: 13.1% (10.6) CONTROL GROUP 2 Baseline: 39.6% (20.9) At 6 months: 15.9% (12.9)	- Improvement in PI was maintained for 6 months but without group differences

marginal probing at 4 months in the group of 40 patients with gingivitis receiving OHI associated with reinforcement, goal-setting, and feedback interventions with an intra-oral camera compared to 38 gingivitis patients receiving the same intervention except for the use of intra-oral camera (Araujo et al., 2016). The authors concluded that the use of an intra-oral camera may be an effective strategy to boost patient's motivation in OH adherence, enabling patients to better understand the information provided in the interview with the oral health professional (Araujo et al., 2016). In contrast, the study with the greater sample size ($n = 1,237$) and longer follow-up (3 years) reported no difference in bleeding scores between participants randomized to personalized OHI based on social cognitive theory and implementation intervention theory or routine

OHI (difference = -2.5% , 95% confidence interval CI $[-8.3\%; 3.3\%]$; $p = .393$) (Ramsay et al., 2018),

Overall, an improvement in the sense of the patients' self-efficacy and their reported frequency of tooth brushing and inter-dental cleaning was observed in 4 studies (Araujo et al., 2016; Jönsson et al., 2006, 2009; Little et al., 1997).

3.3.2 | Impact of self-inspection and videotapes

Concerning the 3 studies evaluating the effectiveness of self-inspection and the use of videotapes (summarized in Table 2), 2 out of 3 were NRCTs published more than 20 years ago. Protocols included

patient's self-inspection and examination of the oral cavity as well as details on how performing OHI by providing specific manuals or videotapes in absence of any associated psychological intervention. At re-evaluation 6–7 months later, no significant impact on plaque and bleeding scores was observed (Baab & Weinstein, 1986; Glavind, Zeuner, & Attstrom, 1981, 1984).

3.4 | Quantitative analyses of the results

Pooled data analyses of interventional studies applying psychological interventions to improve OH behaviours are presented in Figures 2 and 3. No significant difference in both plaque and bleeding scores was found between the test group receiving OHI associated with MI or combined psychological techniques and control groups receiving conventional OHI (Brand et al., 2013; Jönsson et al., 2006, 2010, 2009; Stenman et al., 2012, 2018; Woelber et al., 2016). No significant group differences were also observed for the two studies (Araujo et al., 2016; Tedesco et al., 1992) evaluating the impact on BOP of psychological interventions and feedback by using an intra-oral camera or videomonitor (SMD: -0.31 [95% CI: $-0.95, 0.32$], $p = .33$; I^2 : 78%, $n = 120$ patients in the test group versus 76 patients in the control group).

3.5 | Risk of bias of individual studies

Two reviewers (LD and MCC) scored the methodological qualities of the included studies. Eleven out of the 12 RCTs were found at high risk of bias (Table S2). With the NRCTs, all studies were found at moderate-to-high risk of bias (Table S3).

4 | DISCUSSION

Several different psychological interventions based on social cognitive theories, behavioural principles, and MI have been applied to improve OHI adherence in patients with periodontal diseases. These approaches appear to positively impact on patient's behaviours and add a potential benefit in the periodontal treatment, which may also impact on the patients' sense of self-efficacy and reported frequency of tooth brushing and inter-dental cleaning. However, pooled data analysis showed no significant clinical benefits (improved plaque and bleeding scores) for patients receiving the psychological interventions compared to the control group, at short term (3 months) and overall (any follow-up duration). Evidence on the effectiveness of other communication methods, such as self-inspection and use of videotapes, to improve OH is yet inconclusive.

According to the World Health Organization, hygiene refers to conditions and practices that help maintaining health and preventing the spread of diseases (Allegranzi et al., 2013). Daily hygiene belongs to individual behaviours that are associated with lifestyle and

cultural habits. In developed countries, OH does not differ from general practice and attitude regarding personal hygiene and is strongly linked to the level of education (Bashirian et al., 2018; Newton & Asimakopoulou, 2015). Hygiene, in general, and OH, in particular, are sensitive to health information, knowledge, and attitudes, which may change the behaviours of the individuals over time. As for other chronic diseases such as diabetes mellitus (Swiatoniowska, Sarzynska, Szymanska-Chabowska, & Jankowska-Polanska, 2019), treatment goals can be met only if the patient is motivated to comply with the therapeutic recommendations. Therapeutic patient education, which aims to enable people with chronic diseases to manage their illness and yield benefits in both health and financial terms (WHO, 1998), is the starting point of patient care. Oral health professional must provide both knowledge and skills in order to establish a therapeutic relationship within the treatment process and change the patient's OH behaviours if necessary (Renz, Ide, Newton, Robinson, & Smith, 2007; Sanz & Meyle, 2010). This process is affected by a number of socio-economic and environmental factors, primarily the patient's psychological characteristics, as well as educator-related variables. Thus, the consensus report of the 11th European Workshop on effective prevention of periodontal and peri-implant diseases in 2015 recommended the use of psychological interventions (e.g. goal setting, self-monitoring, planning) to improve OH-related behaviours in patients with periodontal diseases (Newton & Asimakopoulou, 2015; Tonetti et al., 2015). This appears necessary because promoting OH behavioural changes and consolidating the new behaviours over time to prevent relapse is not a straightforward process; thus, any specific intervention that can enhance patient's motivation and adherence to OHI could be crucial for successful long-term outcomes in periodontal prevention and treatments.

To assess OH behavioural changes, plaque and bleeding scores can be used as quantitative surrogate metrics reflecting patient's improvements: the lower the index, the better the OH (Lang, 2014; Lang & Bartold, 2018a; Lertpimonchai et al., 2017). Plaque scores reflect the patient's ability to adequately perform OH, with a significant reduction being expected if plaque control is routinely implemented. Moreover, as a consequence of plaque score improvement, a reduction in bleeding scores should be observed, mirroring a decrease in clinical inflammation. This indicates that the patient has maintained a sufficient self-performed infection control over an extended period of time (Chapple et al., 2018; Lang & Bartold, 2018b; Lee et al., 2009). Thus, by measuring the reduction in both plaque and bleeding scores, it is possible to estimate the impact of a specific psychological intervention on patients' OH behaviours. Although the meta-analytic approach showed no significant additive effect on plaque and bleeding score, the current literature suggests that combined psychological interventions based on individually tailored oral health educational programmes, social cognition models, and MI may lead to an improvement in OH as measured by decreased plaque scores (Jönsson et al., 2006, 2010; Little et al., 1997). This is less evident for bleeding scores because of conflicting results among the studies included in this systematic review. A significant

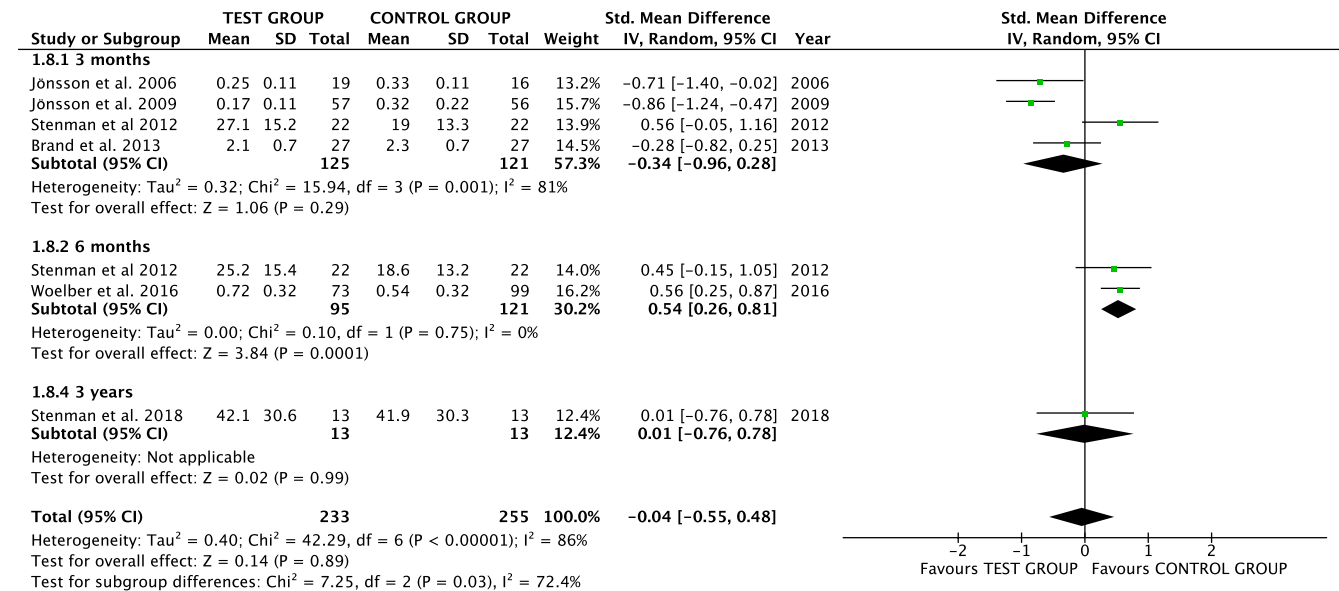


FIGURE 2 Forest plot for psychological intervention effect on plaque score [Colour figure can be viewed at wileyonlinelibrary.com]

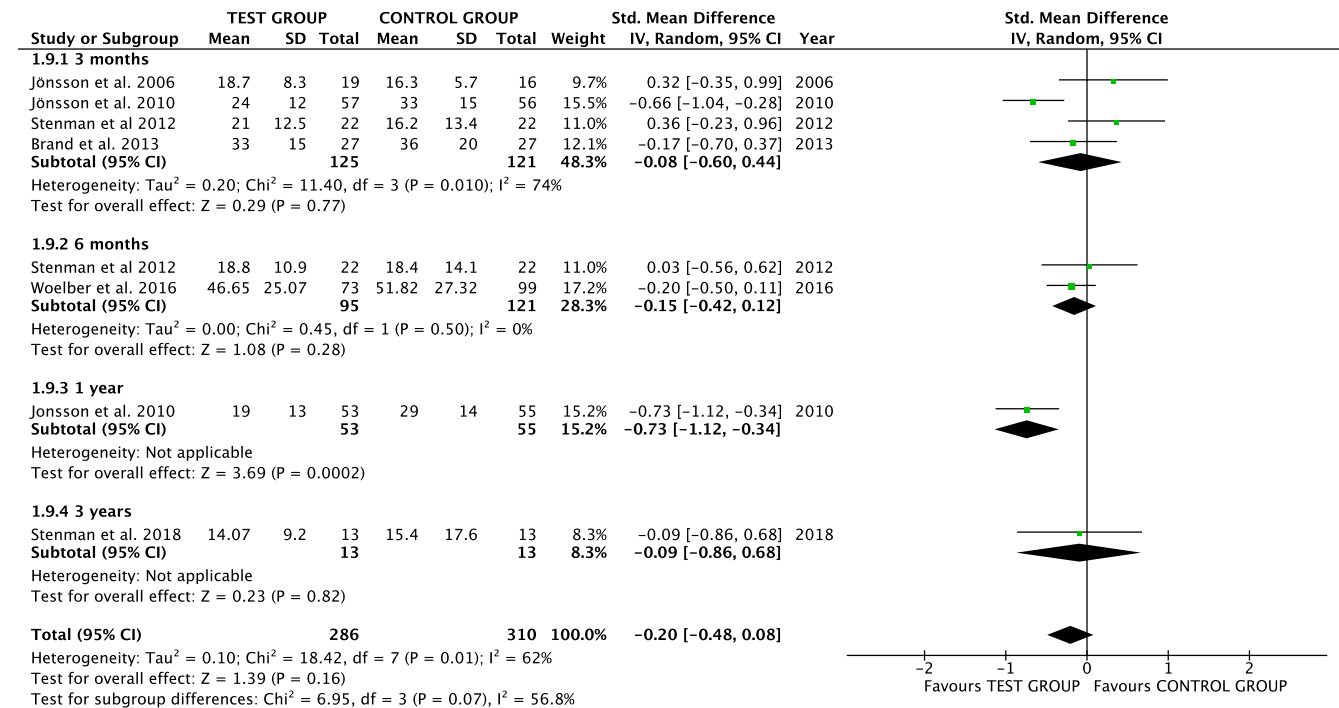


FIGURE 3 Forest plot for psychological intervention effect on bleeding score [Colour figure can be viewed at wileyonlinelibrary.com]

between-group difference was reported by 3 RCTs (Araujo et al., 2016; Jönsson et al., 2010; Little et al., 1997) whereas the other 3 included RCTs failed to conclude to any difference (Jönsson et al., 2006; Ramsay et al., 2018; Tedesco et al., 1992). The lack of evidence regarding the impact of these interventions on bleeding scores must be carefully interpreted. Whenever a significant reduction in the amount of plaque was observed, also a consistent reduction in the evaluated bleeding score was reported (Jönsson et al., 2010, 2009; Little et al., 1997). Only one study found contrasting results with a significant between-group difference in the amount

of plaque that was not mirrored with a significant difference in the bleeding score (Jönsson et al., 2006). However, the small sample size and the short follow-up (3 months), together with many missing co-factors (e.g. diet, smoking), hamper a full interpretation of this outcome. Similarly, the study with the greater sample size and longer follow-up reported no difference in bleeding scores, but it should be noted that this was not the primary outcome of the study and only two-thirds of the participants had a gingivitis or moderate periodontitis (based on basic periodontal examination score) (Ramsay et al., 2018).

In parallel, the majority of these studies found a sensitive improvement in the patient's sense of self-efficacy in performing OHI, as well as in the frequency of brushing and inter-dental cleaning (Araujo et al., 2016; Jönsson et al., 2006, 2010, 2009; Little et al., 1997). These secondary outcomes corroborate the significance of providing specific interventions that address patient's knowledge, attitude, motivation, and behaviours rather than providing un-specific information or unstructured education.

On the other hand, the studies included in the present systematic review are inconclusive concerning the effectiveness of MI alone, as an adjunct to standard periodontal therapy, to reinforce OH and thus improve plaque score or bleeding index (Brand et al., 2013; Ramsay et al., 2018; Stenman et al., 2012; Woelber et al., 2016). These scores were similar for the test and control groups independently to the type of MI applied (e.g. single or multiple MI sessions) and the duration of the study follow-up (ranging from 3 months to 3 years). The lack of significant additive effects of MI in the evaluated studies should be carefully interpreted in light of the type of patient populations examined and the professional delivering the intervention (e.g. trained oral health professionals vs. psychologists). It appears that the impact of MI, as well as other psychological interventions, depends on the patient's own motivation to treatment and readiness to change before the intervention. Thus, MI may be particularly useful in patients less motivated for change, and slightly useful to fruitless in highly compliant and motivated patients who have already passed the stage of ambivalence for a behavioural change (Jönsson et al., 2009; Kopp et al., 2017; Lundahl et al., 2013; Stenman et al., 2012). It is however difficult to precisely assess the degree of patient's motivation and readiness to change in the different studies, making direct comparisons and comprehensive conclusions impossible. Moreover, a high heterogeneity was noted for the type of MI; indeed, the effect of MI results from a causal chain model in which the statements of the patient have a mediating effect between the language of the counsellor and the treatment outcome (Miller & Rose, 2009). A recent study investigated the relationship between the language of dental counsellors leading the MI and their patients in periodontal therapy and suggested that specific verbal expressions in the context of MI may have a significant impact on subsequent patients' statements (Kitzmann, Ratka-Krueger, Vach, & Woelber, 2019). Consequently, open-ended questions, reflections, and affirmations to evoke motivational statements in favour of change should be preferred, whereas directive and confronting behaviours should be avoided in order to minimize resistant verbal reactions (Kitzmann et al., 2019). With regard to the causal chain model of MI and the outcome of this study, implying its existence in the periodontal field of application, it is necessary to assure the quality and integrity of the delivered MI by using validated and reliable coding instruments (Miller & Rollnick, 2014). Only Woelber and co-workers (Woelber et al., 2016) and Stenman and co-workers (Stenman et al., 2012, 2018) evaluated the quality of the MI delivered. None of the studies assured the efficacy of the method by also capturing the statements of the patients, which seem to play an important role according to the definition of MI and earlier research

about the causal chain model from other fields of application (Magill et al., 2018; Magill & Hallgren, 2018). Therefore, it is quite difficult to know how successfully the oral health professionals or counsellors were trained in performing an effective MI and if the main principles of MI have been applied in all studies.

Finally, the use of self-inspection and videotape communication methods seems to have a weak to negligible effect to improve OH, as measured by plaque and bleeding scores, in patients with periodontal diseases.

4.1 | Methodological implications

It must be noted that the selected studies used a variety of different validated scores to measure the amount of plaque and severity of gingival inflammation. This led to calculation of standardized mean differences to summarize the results and to use random effect models to account for the clinical and methodological heterogeneity. Moreover, different follow-up durations, varying from 3 months to 3 years, were found. This represents a drawback in the interpretation and comparison of the results. Indeed, it is expected that behavioural interventions may require long follow-up to have a significant impact on plaque score modifications, but, on the other hand, their efficacy may progressively decrease overtime if a reinforcement is not administered by a professional, for example during supportive periodontal therapy. What is still missing to date are consensus guidelines on standardized protocols or frameworks that would guide on the type of psychological interventions, number of sessions, and reinforcements that should be administered to patients with periodontal diseases in order to ensure long-term compliance. Literature is also lacking concerning specific indications on the health professional that should be in charge of this mission: the dentist, the dental hygienist, a counsellor, or a psychologist. No study demonstrated a superiority of one over the others but it has become evident that specific training and knowledge are required in order to perform an effective psychological intervention for OH (Kitzmann et al., 2019; Newton, 2010; Newton & Asimakopoulou, 2015; Woelber et al., 2016). It is likely that the combination of multiple behavioural interventions and MI, as shown in the study of Jönsson et al. (2010), has a better chance to be effective in leading to persistent behavioural changes in patients with periodontal diseases possibly because multiple intervention types will target the multiple patient-related aspects that strongly influence OH behaviours (e.g. knowledge, education, attitudes, or habits) (Jönsson et al., 2010). Moreover, psychological interventions may be applied to a broader risk factor control purpose including tobacco cessation, diabetes control, weight loss, or diet modifications (Swiatoniowska et al., 2019; Tonetti et al., 2015). However, no studies compared different psychological interventional protocols to assess which one may be more efficacious in conjunction with OHI and periodontal therapy to obtain a satisfactory plaque control and a reduction of gingival inflammation (i.e. bleeding) that can be considered compatible with periodontal health (e.g. BOP < 10%).

4.2 | Strengths and limitations

The major strength of the present study is the systematic approach used to search the literature on multiple databases to perform the most exhaustive selection of RCTs and NRCTs dealing with interventions aimed to improve OH in patients with periodontal diseases. The selection was restricted to this specific population in order to describe the effectiveness and impact of promoted behavioural changes in a subset of patients who particularly benefits from the adherence to therapeutic OHI. Moreover, only studies with a follow-up duration of at least 3 months were selected, in order to avoid spurious effects that may be observed in ultra short-term studies. Two reviewers performed the study search and selection, and data extraction, with a high inter-reviewer agreement. However, the high level of heterogeneity observed in the study designs, interventional protocols, study duration (ranging from 3 months to 3 years), and types and definitions of periodontal diseases limits the interpretation of the results.

In this scenario, we must also highlight that a statistically significant difference between the groups observed in the individual studies does not automatically translate into a clinically significant difference (Wasserstein & Lazar, 2016), particularly when almost all patients in both test and control groups gained the objective of optimal plaque control or low inflammation. Further, it is noteworthy that the overall quality of evidence is low with a high risk of bias. Although the majority are RCTs, they represent small-sized studies with randomization issues that must be taken into account when interpreting the study outcomes.

4.3 | Implications for future research

Future research directions may consider the following:

- To develop standardized psychological intervention protocols that address OH specifically in patients with periodontal diseases. It must be clearly defined the type of intervention, the number of sessions needed, and the type of training the oral health professional must follow to perform effective psychological interventions while delivering personalized OHI.
- To improve study design by including larger sample size and longer follow-up (> 6 months), with outcome assessment at multiple short and long-term time points, in order to indentify the eventual need of reinforcements and their optimal interval.
- To perform randomized controlled trials comparing different types of behavioural interventions to promote OH in patients with gingivitis and periodontitis.
- To investigate alternative methods and communication techniques to induce OH-related behavioural changes and increase adherence to therapeutic OHI in patients with gingivitis and periodontitis, possibly including text messaging and smartphone applications that are widely studied, for example, in orthodontic populations while largely disregarded in patients with periodontal diseases.

4.4 | Implications for clinical practice

- Promote training programmes for oral health professionals in order to implement behavioural approaches in OHI.

5 | CONCLUSIONS

Within the limitations of the available evidence, OH may be reinforced in patients with periodontal diseases by psychological interventions based on cognitive constructs and MI principles provided by oral health professionals. However, no conclusion can be drawn on their specific clinical efficacy as measured by the reduction of plaque and bleeding scores over time. Moreover, it remains difficult to assess the superiority of one psychological intervention over the others. Future research studies should apply standardized psychological intervention protocols to assess their efficacy in strengthening long-term adherence to OHI in patients with periodontal diseases. Finally, no evidence supports the effectiveness of the sole self-inspection and use of videotape communication techniques to improve OH parameters. Further RCTs are awaited to assess the role of mobile applications and other communication strategies to improve patients' adherence to OHI.

CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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