# Efficacy of periodontal risk communication on psychological outcomes and supragingival plaque control in anxious and/or depressed patients

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## ABSTRACT

**Introduction:** To evaluate, in a cohort of anxious/depressed patients (group A/D) and control patients (group C) undergoing motivational interviewing (MI) following the first periodontal visit: 1) the psychological profile and supragingival plaque control prior to the MI session; 2) the efficacy of periodontal risk communication, performed with or without the support of a validated tool for assessing the patient's periodontal prognosis (PerioRisk; Trombelli et al. 2009), on psychological outcome measures and supragingival plaque control.
**Materials and Methods:** Fifteen patients with scores ≥11 on the Hospital Anxiety and Depression Scale (group A/D) and 15 patients matched for age, sex, and periodontal status (group C), all presenting for their first periodontal visit, contributed to this retrospective study. At the periodontal visit, a single MI session, implemented with or without communication of periodontal risk level determined by PerioRisk (RISK and CTR treatments respectively), was administered by a trained operator in about 8 minutes. The psychological profile of the patient was assessed immediately before and after CTR/RISK using the Positive Affect Negative Affect Scale (PANAS) and the Protection Motivation Theory (PMT) questionnaire. Plaque Index (PII) was reassessed in patients returning after 8–12 weeks.
**Results:** Before receiving CTR/RISK, patients in the A/D group exhibited lower positive emotion scores and higher negative emotion scores compared to patients in group C. Both RISK and CTR treatments positively affected various domains in the PANAS and PMT questionnaires. However, among patients who returned at 8–12 weeks (9 A/D and 13 C patients), only RISK treatment was associated with a small decrease in PII.
**Conclusion:** An 8-minute motivational interview (MI), implemented with or without the support of a validated tool for periodontal prognosis evaluation (PerioRisk), positively influences certain psychological variables and attitudes towards disease in anxious/depressed patients.

**Keywords** Anxiety, Depression, Risk assessment, Periodontitis

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## INTRODUCTION

The main goal of primary and secondary prevention strategies in periodontology is the maintenance of periodontal health or stability. A key feature of both health and periodontal stability is the limited prevalence (<10%) of periodontal inflammation when assessed by bleeding on probing (BoP) (29, 9, 40, 53, 56). Biofilm control is currently the primary instrument to pursue this goal (7). It has been demonstrated that inadequate biofilm control combined with persistent exposure to other risk factors leads to treatment failure and disease recurrence (4, 57). Achieving and maintaining good oral hygiene over time is highly challenging (48) since it depends strongly on individual skills and dexterity, as well as motivation to maintain self-care (35) and on the individual's ability to seek adequate assistance (33, 53). Motivational interventions based on cognitive-behavioral theories can be more effective than unstructured interventions in changing oral hygiene habits and controlling risk factors related to periodontitis (1, 25), although their ability to produce additional clinical benefits in major preventive and therapeutic periodontal strategies is not uniformly recognized (8). These models, including cognitive-behavioral therapy, cognitive restructuring, verbal reinforcement, problem solving, and motivational interviewing (MI), share the premise that behavior is best understood by examining attitudes and beliefs (44, 45). Some randomized controlled studies have shown that in periodontitis patients, communication based on their individualized periodontal risk profile, processed through specific tools, can influence thoughts and emotions regarding periodontal disease itself (2), as well as psychological variables informing adherence to treatment. This translates into better patient performance in supragingival plaque control (3).

Anxiety and depression affect 322 million people worldwide (European Study on the Epidemiology of Mental Disorders (ESEMeD) – WHO) and are associated with poor quality of life (50), greater utilization of healthcare, and severe functional limitations (30). Anxiety and depression are known to complicate treatment of many diseases: depressed individuals often exhibit health risk behaviors such as smoking, alcohol consumption, and poor home oral hygiene (20, 18, 37, 59), and present overall poorer oral health (27). Although the role of stress and depression in modulating host response in periodontitis is well documented (5), these disorders are also strongly linked with weakened cognitive control (19, 31, 51), a set of processes crucial to motivated, goal-directed behavior that enables flexible adaptation of cognition and consequent actions to pursue a set goal (6, 17, 49). Anxiety and depression profoundly influence the way information is processed and how individuals think about themselves, others, and the surrounding world: anxious and depressed individuals take longer to manage negative information and experience difficulty suppressing irrelevant thoughts or constructing action pathways toward goals. This complicates emotion regulation and adaptation to fast-changing environments (10, 23), as well as the modification of ingrained habits. A study among young police recruits revealed that poor (OR 1.25) or nonexistent (OR 1.31) anxiety and stress coping were statistically significant predictors ($p < 0.05$) of ineffective home biofilm control (42), while anxious-depressive traits are significant risk indicators for clinical attachment loss in periodontitis (36).

This study, conducted on a cohort of anxious/depressed patients (group A/D) and matched controls for age, sex, and periodontal status (group C), was designed to comparatively evaluate in A/D and C patients:

1. psychological profile and supragingival plaque control level at the time of first periodontal visit;
2. efficacy of periodontal risk communication, performed with or without the support of a validated tool for periodontal prognosis evaluation (PerioRisk, 54), on psychological outcome measures and supragingival plaque control following motivational interviewing (MI).

## MATERIALS AND METHODS

### Experimental design, ethical aspects, and funding

This study consisted of a retrospective analysis of data derived from a single-blind randomized controlled trial (16) aimed to evaluate efficacy of periodontal risk communication (evaluated via PerioRisk) (54) on psychological profile and supragingival plaque control in patients who participated in MI during the first visit.

The experimental protocol was approved by the Ethics Committee of Area Vasta - Emilia Centro (CE-AVEC) protocol number 935/2021/Sper/AUSLFe, approval date 18/11/2021, and was registered on ClinicalTrials.gov (ID: NCT05078411). All patients provided written informed consent before participation and were given additional explanations as requested.

### Study population

For this study, patients were retrospectively selected from the participants in Farina et al. (16). All participants were recruited at the Interdepartmental Research Centre for the Study of Periodontal and Peri-Implant Diseases, University of Ferrara, and the Complex Operational Unit of Dentistry of Ferrara Local Health Authority, in accordance with criteria detailed in Farina et al. (16). Briefly, patients were adults, fully or partially dentate, scheduled for a first periodontal visit. Exclusion criteria included inability to comprehend Italian, previous periodontal diagnosis, psychiatric comorbidities that could influence comprehension and questionnaire completion, HADS score ≥ 11 indicating clinical anxiety and/or depression (60), medications well documented to affect cognition necessary for questionnaire completion, alcohol or drug dependence, absence of a recent radiograph (OPT, max 24 months old) or contraindications to radiographic exam (e.g., pregnancy). Patients who did not adhere to protocol procedures, missed two consecutive appointments, failed to complete questionnaires, or withdrew from the study were excluded.

For this retrospective analysis, two groups were considered:

- anxious/depressed patients (group A/D), comprising all who had been previously excluded from Farina et al. (2024) due to HADS ≥ 11 but who still completed questionnaires and evaluations relevant to this study;
- control patients (group C), identified among Farina et al. (16) participants by matching for age, sex, and periodontal status to A/D patients.

Pre-experimental procedures

Operators participated in calibration sessions to guarantee homogeneous administration of the two interventions discussed here (see "Treatments" for details).

### Experimental procedures

Outlined by observation times in Figure 1.

At screening visit (t0), selection criteria were verified.

Within three months after t0 (t1), anamnesis, smoker status, diabetic status, number of fully erupted permanent teeth, number of teeth lost to periodontitis or judged with poor prognosis due to severe periodontal support loss (46), and Plaque Index (PII) were recorded. The PII was calculated as the percentage of sites with supragingival plaque visible after plaque disclosing (16).

Periodontal diagnosis was made according to definitions of periodontal health, plaque-associated gingivitis, and periodontitis (9, 40, 53, 56), with staging, grading, extent, and stability determined in periodontitis cases (40, 53).

Periodontal risk level (numeric scale 1–5; 1 = low risk, 5 = high risk) was determined by PerioRisk (54).

A reevaluation visit was scheduled within 8–12 weeks after t1 (t2), when periodontal parameters including PII were reassessed.

### Experimental treatments

Randomized assignment to test (RISK) or control (CTR) was computer-generated and conserved in sealed envelopes.

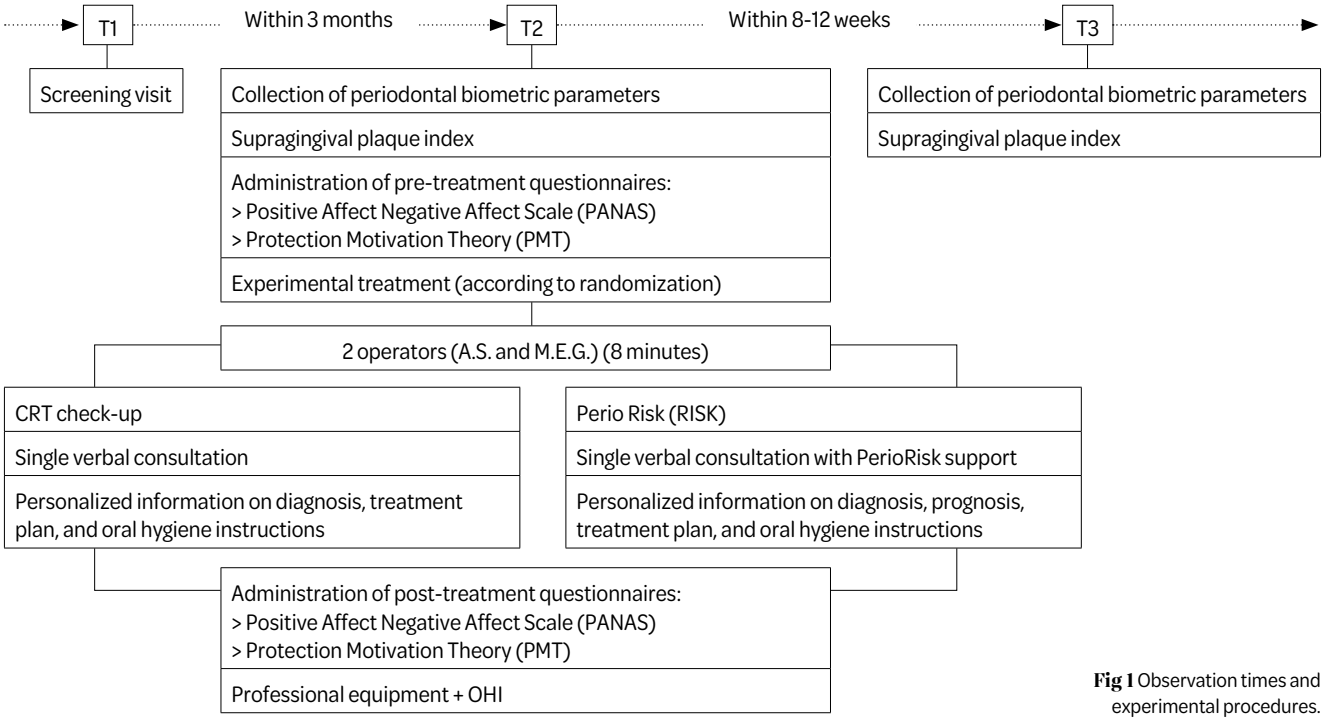


**Fig 1** Observation times and experimental procedures.

At baseline, after periodontal clinical assessment and questionnaire administration, patients were assigned to RISK or CTR treatment by clinicians administering the interventions only.
Both groups received a single structured MI intervention. Training sessions pre-study defined topics and average time (~8 minutes) per MI session, allowing additional time if participants requested clarification.
The intervention was delivered privately with only operator and patient present.
Both groups were informed of diagnosis, treatment plan, and oral hygiene instructions.
In CTR, the general concept of risk of periodontitis incidence/progression was explained, emphasizing relevance of risk factors (e.g., smoking, diabetes) and indicators (pockets, bleeding) from clinical data, without explicit mention of the PerioRisk-calculated risk level or any other tool.
This CTR strategy aligned with previous studies (2,3), where participants engaged in a 5–10-minute Q&A session without discussing disease risk.
RISK patients received their individual PerioRisk-generated risk level and profile information, with emphasis on treatment goals based on PerioRisk results during consultation. RISK patients were also given a PerioRisk brochure outlining individual risk, profile, and therapeutic recommendations to reduce risk.
Due to study nature/design, blinding of operators was not maintained.

## Outcome measures: Psychological assessments

At t1, participants underwent psychological evaluation with Italian versions of the Positive Affect Negative Affect Scale (PANAS) (58), translated by Terracciano et al. (52) to evaluate emotional reaction during treatment, and Protection Motivation Theory questionnaire (PMT) (11) to assess beliefs on periodontal disease, with items from Asimakopoulou et al. (2).
PANAS is a 20-item Likert scale (5-point agreement: "not at all or very slightly," "little," "moderately," "quite a bit," "extremely") with excellent psychometric properties.
PMT is a 7-item Likert scale (10-point agreement from 1 "not at all" to 10 "extremely") exploring participant awareness of severity, susceptibility, treatment efficacy, self-efficacy, barriers, fears, and intention to adhere.
After CTR or RISK administration, patients repeated PANAS and PMT questionnaires.

## Outcome measures: Plaque Index

Immediately before intervention and at reevaluation visit, PII was calculated as percentage of sites with visually detectable supragingival plaque after application of a disclosing agent (Mira-2-Ton®, Hager & Werken GmbH, Germany).

## Statistical analysis

Data expressed as mean ± standard deviation.
This study was a retrospective sub-analysis of Farina et al. (16). The original study's sample size powered to test superiority of RISK vs. CTR; thus, this analysis was descriptive only.

# RESULTS

## Study population

Fifteen patients (age 55.7 ± 17.5 years; 1 male, 14 female) excluded from Farina et al. (16) for HADS ≥ 11 formed

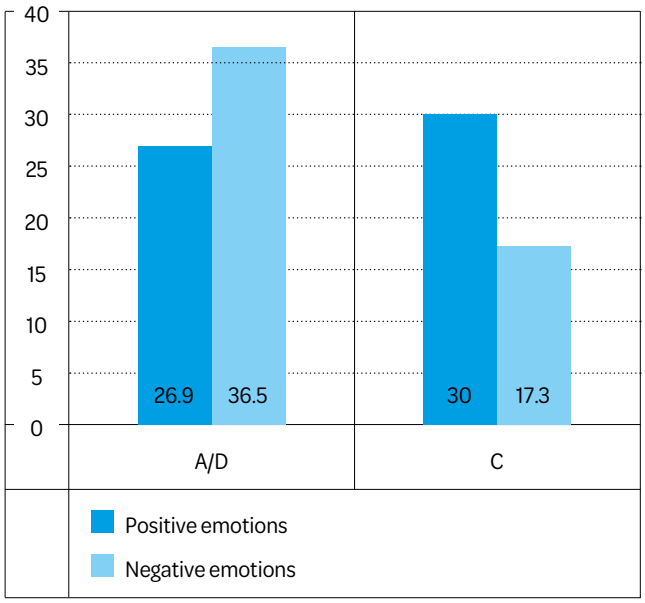


**Fig 2** Pre-treatment scores on the PANAS questionnaire for positive and negative emotions.

group A/D. Of these, 13 scored ≥11 (range 11–16) for anxiety; 3 scored ≥11 (range 11–16) for depression.
Fifteen Farina participants (age 55.9 ± 14.5 years; 1 male, 14 female), matched for sex, age, and periodontal diagnosis to A/D patients, formed group C.
In both groups, 4 had gingivitis diagnosis; 3 had stage II, III, or IV grade B periodontitis; 8 had stage III or IV grade C periodontitis. Both groups had 6 smokers and 1 ex-smoker; 4 A/D had diabetes mellitus.
8 patients per group were assigned CTR; 7 per group were assigned RISK. 6 A/D patients assigned CTR and 2 C patients assigned RISK missed t2 and did not contribute PII data to this analysis.

## Treatment administration time

For nearly all patients in both groups, treatment duration was between 8:00 and 9:30 minutes.

## Baseline psychological (PANAS, PMT) and clinical (PII) profiles

At t1, before treatment, group A/D had lower PANAS positive emotion scores (26.9) than group C (30), and higher PANAS negative emotion scores (36.5 vs. 17.3) (Figure 2).
At t1, group A/D had lower PMT scores than group C across all domains: awareness (6.3 vs. 7.3), susceptibility (7.7 vs. 7.9), treatment efficacy (8.3 vs. 9.1), self-efficacy (7.9 vs. 9.5), fear/worry (6.8 vs. 8.2), intention to adhere (8.3 vs. 9.3). Group A/D perceived higher treatment costs/barriers (+1.9) than controls (Figure 3).
PII% was comparable (80.8%) between groups at t1 (Figure 4).

## Response to CTR treatment in groups A/D and C

Following CTR, positive emotion increased by +0.5 in A/D and +0.9 in C (Figure 5).
Negative emotion decreased by −4.3 in A/D and −1.5 in C (Figure 5).
In A/D, CTR increased PMT scores for awareness (+2.62), susceptibility (+0.37), treatment efficacy (+1.5), self-efficacy (+0.12), fear/worry (+1.00), intention to adhere (+0.5), and perceived costs/barriers (+1.5) (Figure 6).
Similarly, CTR increased awareness (+1.75), susceptibility (+1.75), treatment efficacy (+0.38), self-efficacy (+0.5), intention (+0.37), costs/barriers (+2.75), and fear/worry (+0.5) in C (Figure 6).
CTR reduced PII by −11.2% in controls but produced no change in A/D patients (Figure 7).

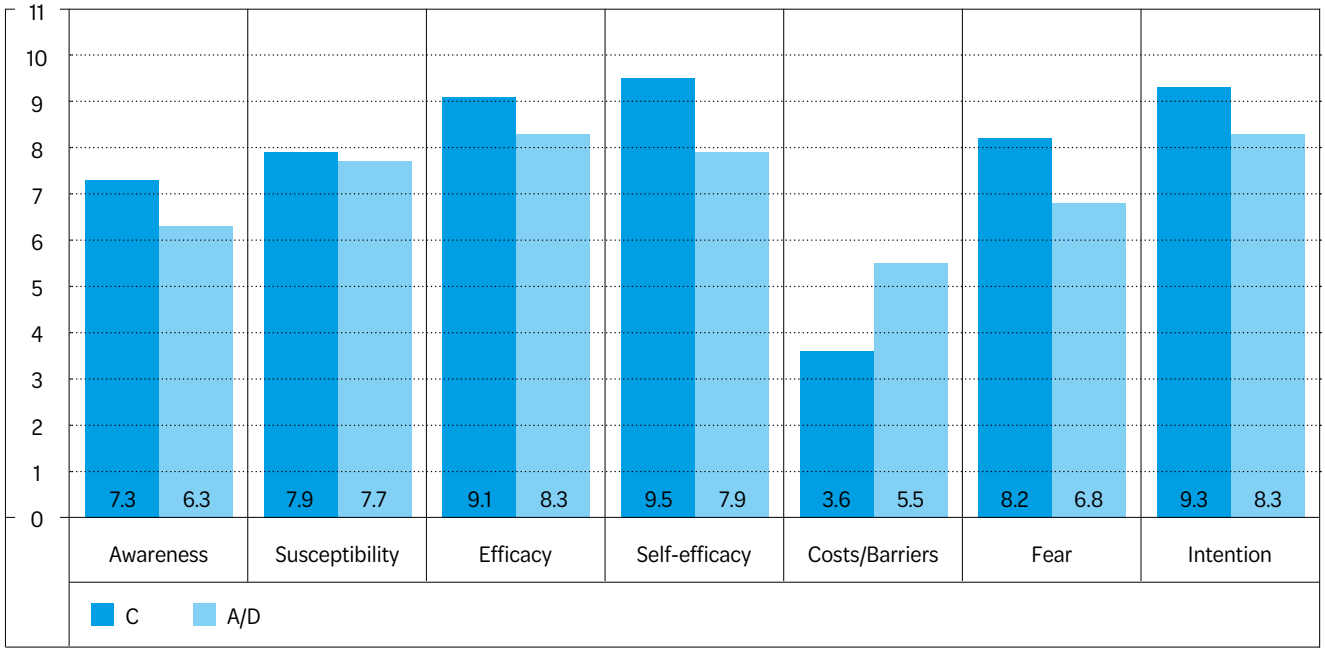


**Fig 3** Pre-treatment PMT questionnaire scores for group C and group A/D.

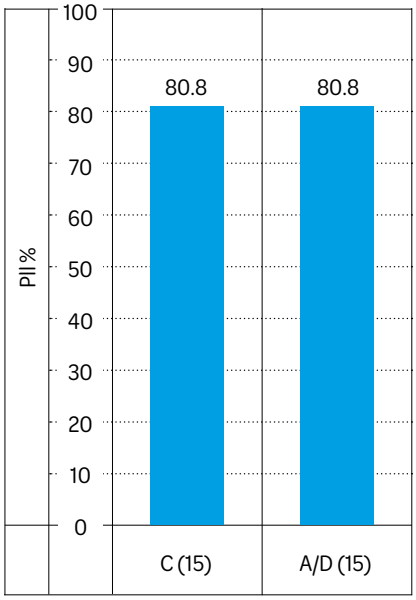


**Fig 4** Pre-treatment plaque index groups C and A/D.

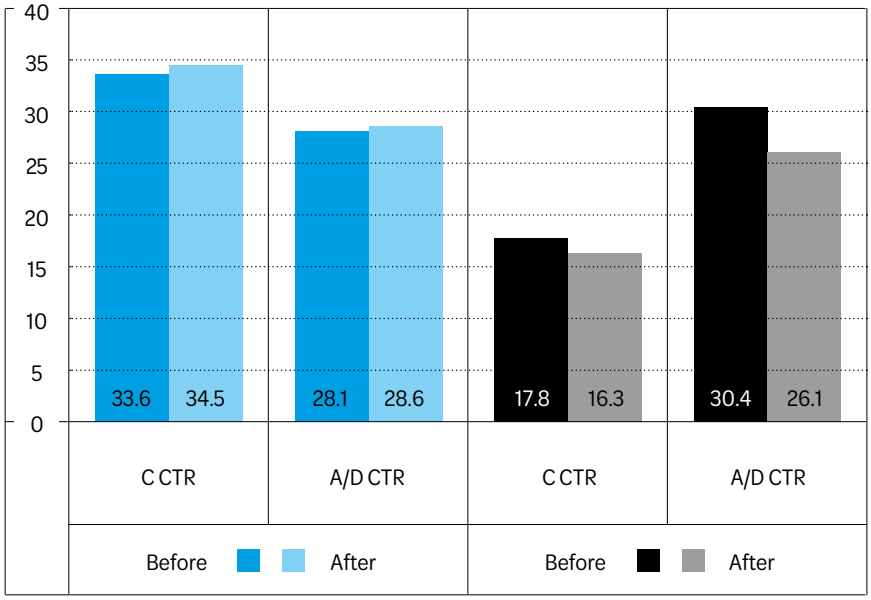


**Fig 5** PANAS questionnaire scores for positive emotions pre- and post-treatment CTR; PANAS questionnaire scores for negative emotions pre- and post-treatment CTR.

## Response to RISK treatment in groups A/D and C

Following RISK, both groups showed reductions in positive emotion (−0.5 A/D and −0.8 C) (Figure 8).
Negative emotion decreased by −6.5 in A/D but increased by +2.9 in controls (Figure 8).
In controls, RISK increased pre-post values in most PMT domains: awareness (+0.58), susceptibility (+1.28), treatment efficacy (+0.86), costs/barriers (+0.43), fear (+0.86), intention (+0.42). Self-efficacy did not change (Figure 9).
In A/D patients, most PMT domains started lower than controls except for costs/barriers (5.29 A/D vs. 4.71 controls), and had a mixed post-treatment pattern: awareness (+2.00), fear (+1.00), intention (+0.29) increased; susceptibility (−0.29), treatment efficacy (−1.14), and self-efficacy (−1) decreased; costs/barriers decreased from 5.29 to 4.43 (Figure 9).
RISK reduced PII by −4.1% in controls and −5.1% in A/D (Figure 10).

## DISCUSSION

Successful primary and secondary periodontal prevention requires patient awareness of disease severity, treatment nature and aims, and willingness to adhere to home biofilm control, lifestyle changes, and professional interventions (43).
Anxiety and depression correlate with poor medical compliance; depressed patients are three times more likely to be non-adherent (OR 3.03, 95% CI) and show association

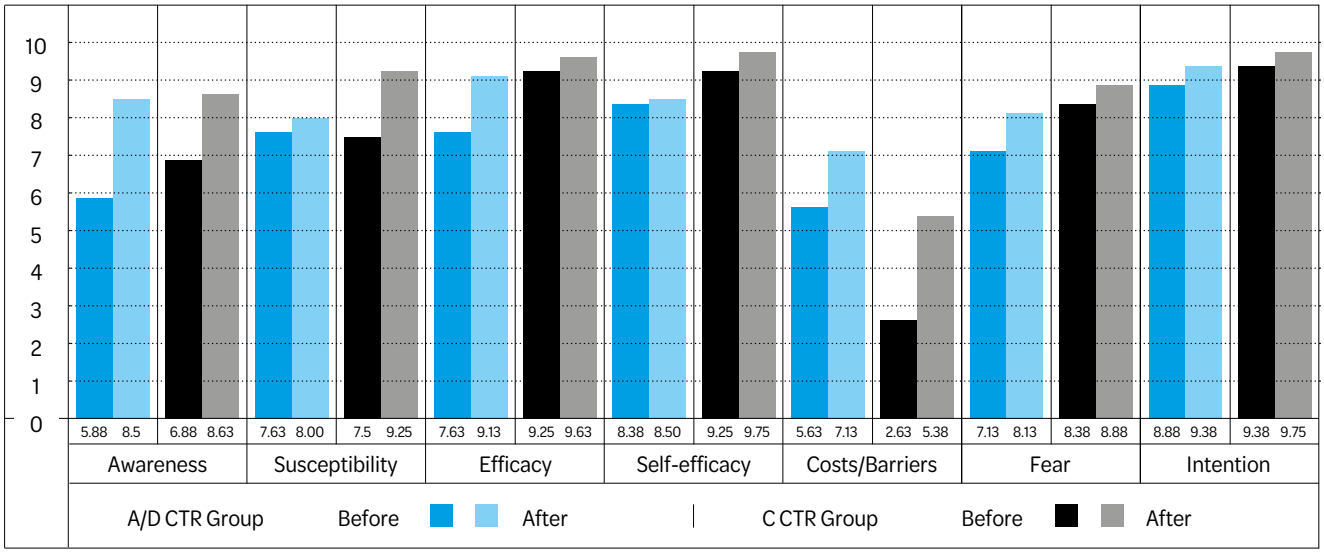


**Fig 6** Pre- and post-treatment PMT questionnaire scores for CTR group A/D; Pre- and post-treatment PMT questionnaire scores for CTR group C.

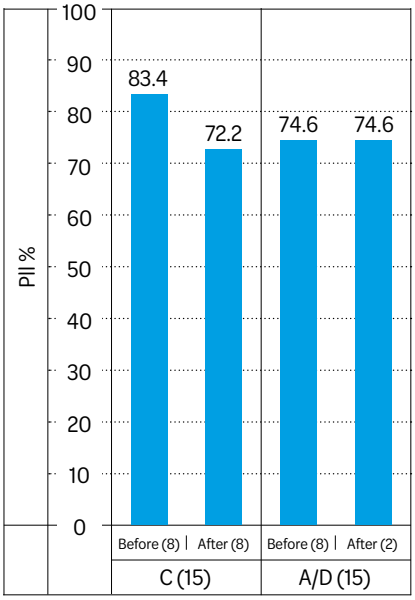


**Fig 7** Post-treatment plaque index CTR groups C and A/D.

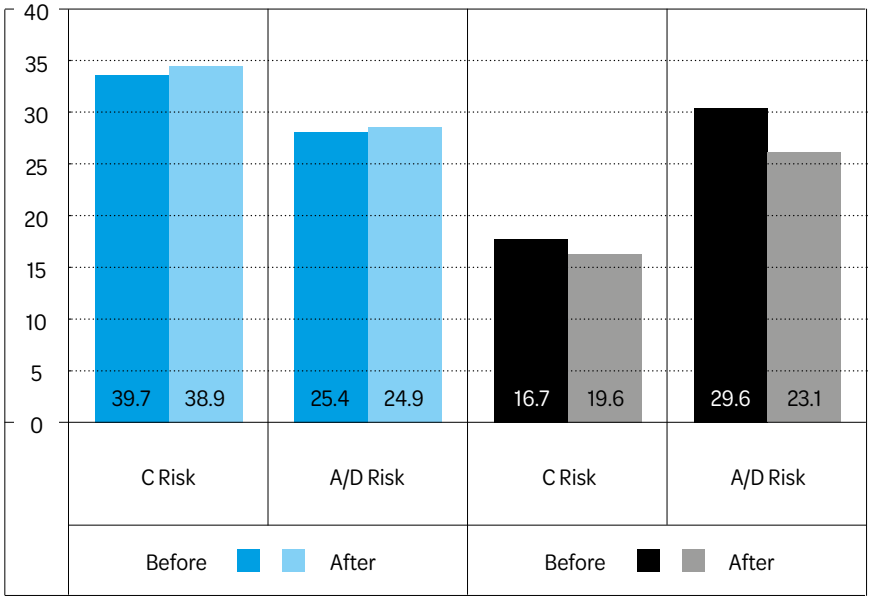


**Fig 8** PANAS questionnaire scores for positive emotions pre- and post-treatment RISK; PANAS questionnaire scores for negative emotions pre- and post-treatment RISK.

between stress, anxious depressive disorders, periodontitis prevalence/severity, and sometimes worse treatment outcomes (14, 24, 26).

This well-documented biological association (5, 21) likely reflects anxiety/depression impairing pro-active behaviors critical for effective oral hygiene (42).

This work assessed the impact on psychological profile and supragingival plaque control of periodontal risk communication with or without PerioRisk support (54) in anxious/depressed patients (A/D) compared to matched controls (C).

Recent data show psychological interventions based on cognitive-behavioral theories in periodontitis patients without anxiety or depression do not demonstrate added clinical benefit over conventional motivation (8). Nonetheless, goal-setting and self-monitoring effectively promote behavioral change (35), presenting a challenge for anxious/depressed patients who take longer to digest health information and struggle to plan therapeutic goal-directed behavior (6, 17, 49).

Understanding benefits of behavioral change and disease severity awareness via periodontal risk communication (with Periodontal Risk Calculator) predicts behavioral change and improved plaque control in healthy periodontitis patients (2, 3). However, the efficacy of these methods in anxious/depressed patients has not yet been well elucidated.

In this study, patients with higher HADS (≥11) scores exhibited at baseline greater negative and fewer positive emotions (PANAS) than non-anxious/depressed controls (Figure 2), validating HADS psychometric performance. Baseline PMT scores were lower across all domains in A/D patients, consistent with their higher perceived barriers

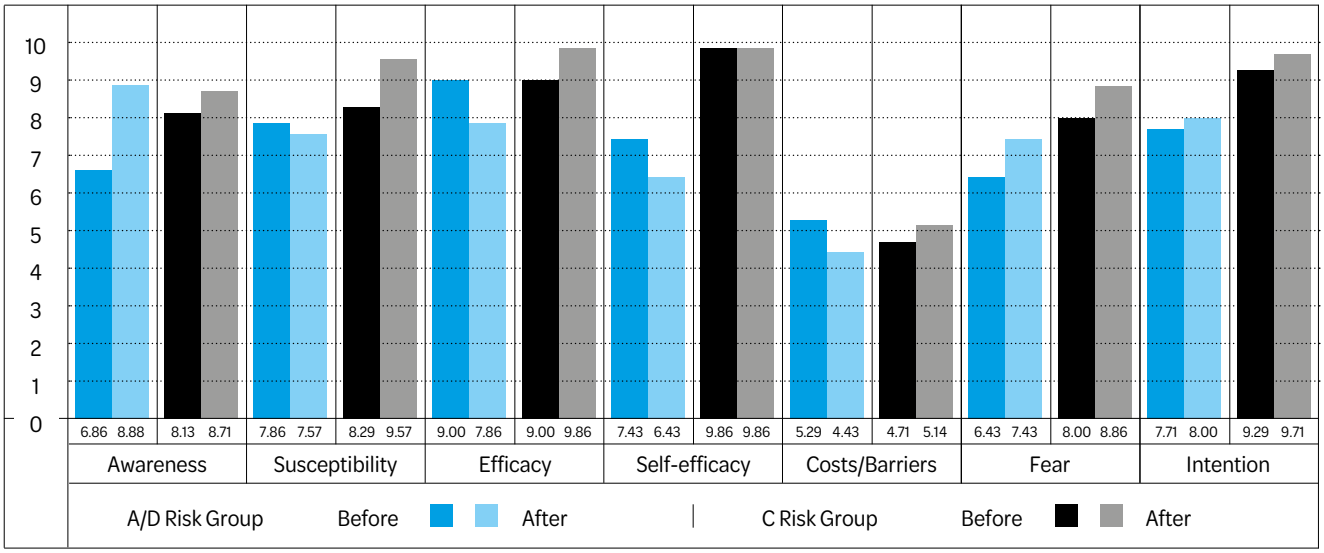


**Fig 9** Pre- and post-treatment PMT questionnaire scores for RISK group A/D; Pre- and post-treatment PMT questionnaire scores for RISK group C.

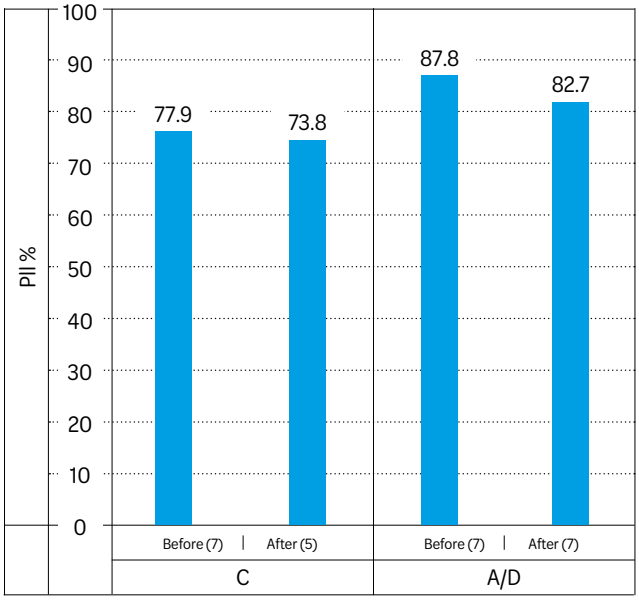


**Fig 10** Post-treatment plaque index RISK groups C and A/D.

(Figure 3). Therefore, validated tools to easily detect anxious/depressed traits can assist clinicians in tailoring realistic periodontal therapy plans and are encouraged (22, 41).
Both CTR and RISK treatments minimally affected positive emotions in healthy controls but strongly reduced negative emotions in anxious/depressed patients (Figure 5).
CTR comprised a single structured MI lasting about 8 minutes, targeting diagnosis, treatment plan, and oral hygiene education. Similar MI in prior studies improved patient beliefs on seriousness and intention, indirectly improving plaque control at 8–12 weeks (2,3).
CTR increased PMT domains (awareness, intention, perceived treatment efficacy and self-efficacy) but also increased perceived costs/barriers, fear, and worry (Figure 6). A high dropout rate among A/D patients receiving CTR (n=6) may limit its efficacy in this population.
RISK integrated MI with PerioRisk risk level and profile, providing printed information on individual risk and therapeutic guidelines. Patients in control group receiving RISK showed small pre-post PMT improvements, whereas anxious/depressed patients exhibited mixed PMT responses: increased awareness, fear, and intention; decreased susceptibility, perceived efficacy, and self-efficacy; decreased cost/barrier perception (Figure 9).
Reduced barrier perception indicates treatment success. Anxiety disorders paired with depression vary widely from panic attacks to obsessive-compulsive behavior, which might paradoxically improve periodontal treatment adherence (32). RISK might support motivation in certain anxious/depressed patients; further studies are needed.
Clinically, both groups had high baseline PII levels (Figure 4). Neither treatment reduced biofilm sufficiently for periodontal stability in either group. Small A/D sample completing CTR might explain no PII change at t2 (Figure 7).
RISK-treated A/D patients (one dropout) exhibited modest PII decrease (–5.1%, Figure 10) similar to controls. A two-year study on compliance showed depressed patients learned and applied new oral hygiene more slowly but could follow professional advice equally, suggesting anxious/depressed patients may need more frequent motivational reinforcement and recall visits to build therapeutic alliance (22). Repeated MI sessions with periodontal risk evaluation tools might provide useful clinical support for anxious/depressed patients.

## CONCLUSIONS

An 8-minute motivational interview (MI), with or without PerioRisk support, positively influences psychological variables and attitudes towards disease in anxious/depressed patients. Given limitations including retrospective design, small sample size, and lack of inferential statistics, PerioRisk may be a useful adjunct to enhance MI effects on psychological profile and supragingival biofilm control in this population, warranting further investigation.

## Acknowledgments

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