BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

EFFICACY OF CHLORHEXIDINE MOUTHRINSE IN THE CONTROL OF DENTAL PLAQUE AND GINGIVITIS: A PRISMA-GUIDED SYSTEMATIC REVIEW OF SYSTEMATIC REVIEWS

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Doi: https://doi.org/10.5281/zenodo.23835545

Abstract

Background: Chlorhexidine (CHX) has been used as an adjunct to mechanical plaque control since the early 1970s, yet the size and clinical relevance of its effect, and its trade-offs against alternative antiseptics, remain debated. **Objective:** To synthesise evidence from published systematic reviews on the efficacy and adverse effects of CHX mouthrinses for dental plaque and gingivitis. **Methods:** A systematic review of systematic reviews was conducted following PRISMA 2020 principles. Targeted searches (October 2026) identified systematic reviews of randomised controlled trials (RCTs) evaluating CHX mouthrinses. Eight reviews published between 2006 and 2025 were included. Effect estimates and risk-of-bias judgements were extracted as reported, and a narrative synthesis was performed; no pooling was undertaken because of overlap among primary trials. **Results:** CHX mouthrinse consistently reduced plaque: the Cochrane review reported a standardised mean difference (SMD) of −1.45 (95% CI −1.90 to −1.00) at 4–6 weeks and −1.59 (−1.89 to −1.29) at 6 months. Gingival inflammation fell by 0.21 points (95% CI 0.11–0.31) on the 0–3 Gingival Index in mild gingivitis, a change the authors judged of limited clinical importance, with moderate reductions in bleeding. Extrinsic tooth staining increased (SMD 1.07; 0.80–1.34). No consistent advantage of 0.2% over 0.12% was shown. Compared with essential-oil rinses, CHX produced greater plaque reduction but no difference in gingival inflammation; compared with cetylpyridinium chloride, a small plaque advantage appeared only in non-brushing models. Most primary trials were at high risk of bias. **Conclusions:** CHX is a highly effective short-term anti-plaque adjunct, with a modest effect on gingival indices at low baseline inflammation and predictable local adverse effects. Long-term, low-risk-of-bias trials with standardised outcomes are needed.

Keywords: chlorhexidine; mouthwash; dental plaque; gingivitis; systematic review; PRISMA

1. Introduction

Plaque-induced gingivitis is a reversible inflammatory condition of the gingiva initiated by the accumulation of dental biofilm, in the absence of attachment loss [1]. The causal link was established in the experimental gingivitis model, in which withholding oral hygiene produced gingival inflammation that resolved once hygiene was resumed [2]. Because many individuals do

not achieve adequate biofilm control by mechanical cleaning alone, chemical agents have been investigated as adjuncts to toothbrushing and interdental cleaning.

Among antiseptics, chlorhexidine (CHX), a cationic bisbiguanide, has the longest research history. In a landmark study, rinsing with 0.2% CHX twice daily prevented plaque accumulation and the development of gingivitis [3]. Its effect is generally attributed to broad antimicrobial activity combined with substantivity, that is, retention on oral surfaces and gradual release. Since then, CHX has served as the reference compound against which newer agents are commonly compared.

Despite decades of use, several questions remain. How large is the benefit on plaque and on gingival indices, and is it clinically meaningful? Does concentration matter? How does CHX compare with essential oils (EO) and cetylpyridinium chloride (CPC)? And what is the burden of adverse effects, including newer concerns about oral microbiome disturbance? Primary trials are heterogeneous in design, duration and outcome indices, and several systematic reviews have addressed these questions with partly differing conclusions. This review therefore aimed to synthesise, in a structured and transparent manner, the evidence from systematic reviews on the efficacy and safety of CHX mouthrinses for the control of dental plaque and gingivitis.

2. Methods

2.1 Design and reporting

A systematic review of systematic reviews (overview of reviews) was conducted and reported following the PRISMA 2020 statement [4]. The protocol was not prospectively registered.

2.2 Eligibility criteria

We included systematic reviews, with or without meta-analysis, of RCTs that evaluated CHX mouthrinse (any concentration) as an adjunct to oral hygiene in children or adults with plaque-induced gingivitis or in experimental gingivitis models. Comparators were placebo, no rinse, or other antiseptic agents. Outcomes of interest were plaque indices, gingival inflammation (Gingival Index, GI), gingival bleeding, extrinsic tooth staining and other adverse effects. We excluded narrative reviews, reviews limited to CHX gels or dentifrices, and reviews restricted to periodontitis, surgical, peri-implant or fixed-orthodontic populations. Only English-language reports were considered.

2.3 Information sources and selection

Targeted searches of PubMed/MEDLINE-indexed records, the Cochrane Library and publisher or institutional repositories were run in October 2026 using combinations of “chlorhexidine”, “mouthrinse/mouthwash”, “plaque”, “gingivitis”, “systematic review” and “meta-analysis”, without date limits. Reference lists of retrieved reviews were screened. The search was purposive rather than exhaustive. One reviewer screened records and extracted data: review characteristics, comparisons, effect estimates with 95% confidence intervals, risk-of-bias judgements and adverse events, all as reported by the original authors.

2.4 Synthesis

Because the same primary trials recur across reviews, results were not pooled, and effect estimates were not recalculated. We compared the direction and magnitude of findings narratively and report the certainty of evidence as graded by the original review authors. Overlap was acknowledged but not quantified with a corrected covered area.

3. Results

3.1 Included reviews

Eight systematic reviews published between 2006 and 2025 met the criteria [5–12] (Table 1). They ranged from a six-month meta-analysis of antiplaque agents to a Cochrane review of 51 RCTs (5,345 participants) [9] and a network meta-analysis of six-month home-use trials [10]. Table 2 summarises the principal quantitative estimates.

Table 1. Characteristics and main findings of the included systematic reviews.

Review	Design and scope	Comparison	Principal findings (as reported)
Gunsolley 2006 [5]	Meta-analysis of six-month RCTs of antiplaque/antigingivitis agents	Mouthrinses and dentifrices vs control	Seven studies supported a strong antiplaque and antigingivitis effect of 0.12% CHX rinses; CPC results varied with formulation.
Berchier 2010 [6]	Systematic review of RCTs	0.12% vs 0.2% CHX	Small but statistically significant difference in plaque; no difference in gingivitis (as summarised in secondary appraisals).
Van Leeuwen 2011 [7]	Systematic review with meta-analysis (studies ≥4 weeks)	EO vs CHX rinse	CHX better for plaque (WMD 0.19; p = 0.0009); no difference in gingival inflammation (WMD 0.03; p = 0.58).
Van Strydonck 2012 [8]	30 publications (34 experiments); meta-analysis of 13 studies	CHX vs placebo/control, ≥4 weeks	Significant reductions in plaque and gingivitis (33% and 26%); increased staining.
James 2017 [9]	Cochrane review; 51 RCTs, 5,345 participants	CHX rinse vs placebo, control or no rinse, ≥4 weeks	High-certainty large plaque reduction; small GI reduction in mild gingivitis; increased staining; no concentration effect shown.
Figuero 2019 [10]	Network meta-analysis; 53 papers (19 mouthrinse); six-month RCTs	Multiple agents, GI outcome	CHX (≥0.10%), EO, triclosan–copolymer and CPC (>0.05%) showed the greatest effects; EO rinses ranked highest for GI.

Review	Design and scope	Comparison	Principal findings (as reported)
Figuero 2020 [11]	Meta-analysis; 70 studies of adjunctive antiseptics; six-month RCTs	Antiseptic rinses and dentifrices vs control	Significant reductions in gingival, bleeding and plaque indices; rinses reduced % plaque more than dentifrices.
[Authors] 2025 [12]	Systematic review and meta-analysis (PRISMA)	CPC vs CHX rinse	Moderate-certainty small advantage of CHX for plaque in non-brushing models; no difference in brushing situations.

3.2 Plaque

Every review that addressed plaque found a benefit of CHX over control. In the Cochrane review, plaque was lower in the CHX group at 4–6 weeks (SMD −1.45; 95% CI −1.90 to −1.00; 12 trials, 950 participants; high-certainty evidence), with a similarly large effect at six months (SMD −1.59; −1.89 to −1.29) [9]. Van Strydonck et al. reported weighted mean differences of −0.39 on the Silness–Löe index and −0.67 on the Quigley–Hein index, equivalent to a 33% relative reduction in plaque; restricting the analysis to studies at lower risk of bias left the Quigley–Hein estimate essentially unchanged (−0.68) [8].

Table 2. Summary of principal effect estimates for CHX mouthrinse.

Outcome	Source	Estimate (95% CI)	Comment
Plaque, 4–6 weeks	Cochrane [9]	SMD −1.45 (−1.90 to −1.00)	High certainty; 12 trials, 950 participants

Outcome	Source	Estimate (95% CI)	Comment
Plaque, 6 months	Cochrane [9]	SMD −1.59 (−1.89 to −1.29)	Similarly large effect
Plaque (Quigley–Hein)	Van Strydonck [8]	WMD −0.67 (−0.82 to −0.52)	−0.68 (−0.85 to −0.51) in lower-risk studies
Gingival Index, 4–6 weeks	Cochrane [9]	MD −0.21 (−0.31 to −0.11)	Mild gingivitis; judged of limited clinical importance
Gingival Index	Van Strydonck [8]	WMD −0.32 (−0.42 to −0.23)	Relative reduction 26%
Gingival bleeding	Cochrane [9]	SMD −0.56 (−0.79 to −0.33) at 4–6 wk; −0.72 (−1.02 to −0.42) at 6 mo	Moderate reduction
Extrinsic staining	Cochrane [9]	SMD 1.07 (0.80 to 1.34) at 4–6 wk	Moderate certainty; persists at 7–12 wk and 6 mo
Staining (Lobene)	Van Strydonck [8]	WMD 0.91 (0.12 to 1.70)	Increase with CHX

Outcome	Source	Estimate (95% CI)	Comment
CHX vs EO: plaque / GI	Van Leeuwen [7]	WMD 0.19 (p = 0.0009) / 0.03 (p = 0.58)	Favours CHX for plaque; no GI difference

3.3 Gingivitis and bleeding

The gingival effect was smaller and more nuanced than the plaque effect. In the Cochrane review, CHX lowered the GI (0–3 scale) by 0.21 points at 4–6 weeks in participants with mild baseline inflammation (mean GI about 1; 10 trials, 805 participants); the authors rated the evidence as high certainty but considered the reduction not clinically important at such a low baseline [9]. Data were insufficient to estimate the effect in moderate or severe gingival inflammation (GI 1.1–3) [9]. Bleeding outcomes showed moderate reductions at 4–6 weeks and six months (Table 2). The meta-analysis by Van Strydonck et al. yielded a somewhat larger pooled GI difference (−0.32) and a 26% relative reduction in gingivitis [8]. Six-month evidence syntheses likewise showed statistically significant reductions in gingival, bleeding and plaque indices with adjunctive antiseptics, including in patients with treated periodontitis and residual gingival inflammation [5,11].

3.4 Concentration

Berchier et al., comparing 0.12% and 0.2% CHX, reported a small but statistically significant difference in plaque, with no difference in gingivitis [6]. The Cochrane review, which examined concentration and rinsing frequency as effect modifiers, found no evidence that any one concentration was more effective than another [9]. The network meta-analysis grouped CHX at concentrations of 0.10% or higher as a single category and ranked it among the most effective rinse actives [10].

3.5 Comparison with other agents

In the meta-analysis of long-term studies (≥4 weeks), CHX provided significantly better plaque control than a standardised EO rinse, whereas gingival inflammation did not differ; EO was considered a reliable alternative with respect to gingival parameters [7]. The network meta-analysis found that, among rinses, EO, triclosan–copolymer, CHX (≥0.10%) and CPC (>0.05%) had the greatest effect on GI, with EO rinses ranking highest, although among active agents differences were not uniformly significant [10]. In a recent review comparing CPC with CHX, a meta-analysis in non-brushing models favoured CHX for plaque (mean difference 0.55; 95% CI 0.19–0.91; p = 0.003), whereas no difference was found for plaque or gingivitis when participants brushed [12]. Mouthrinses produced greater percentage plaque reductions than dentifrices (meta-regression coefficient 13.80%; 95% CI 2.40–25.10; p = 0.020) [11].

3.6 Adverse effects and ecological effects

The Cochrane review found a large increase in extrinsic tooth staining with CHX at 4–6 weeks, 7–12 weeks and six months (Table 2); evidence on calculus formation was inconclusive. Taste

disturbance (11 studies), oral mucosal soreness, irritation, desquamation or ulceration (13 studies) and burning sensations (9 studies) were the most frequently reported effects [9]. Beyond the trial literature, a non-randomised crossover study in 36 healthy adults found that seven days of CHX rinsing shifted the salivary microbiome toward more acidic conditions and lowered saliva and plasma nitrite, with a trend toward higher systolic blood pressure [13].

3.7 Risk of bias and certainty

Methodological quality of primary trials was a recurrent limitation. In the Cochrane review, 50 of 51 trials were at high risk of bias [9]; in the review by Van Strydonck et al., only a small number of studies were assessed as low risk [8]. Nonetheless, the main plaque finding was graded as high-certainty evidence, and effects were stable in lower-risk subsets where these were analysed [8,9].

4. Discussion

4.1 Principal findings

Across eight systematic reviews spanning nearly two decades, CHX mouthrinse used as an adjunct to oral hygiene consistently reduced plaque, with large standardised effects maintained to six months. The effect on gingival indices was statistically significant but modest in absolute terms, particularly when baseline inflammation was low. The principal cost was extrinsic staining, accompanied by taste disturbance and mucosal symptoms in a minority of trials.

4.2 Clinical interpretation

The contrast between a large plaque effect and a small GI effect is partly a matter of measurement. Trials in generally mild gingivitis leave limited room for improvement on a 0–3 index, and the Cochrane authors explicitly regarded the 0.21-point change as clinically unimportant despite high-certainty evidence [9]. Differences between the Cochrane estimate and the larger pooled GI difference of Van Strydonck et al. [8] probably reflect different eligibility rules, index selection and pooling strategies rather than contradictory findings. The absence of evidence in moderate or severe gingivitis [9] means that extrapolation to those patients remains uncertain. Together, these findings are consistent with CHX being most useful as a short-term adjunct, for example when mechanical cleaning is temporarily limited, rather than as a routine long-term substitute for effective brushing and interdental cleaning, a use the staining and taste profile does not favour.

4.3 CHX versus alternatives

CHX's advantage over EO and CPC is concentrated in plaque outcomes. For gingival inflammation, EO rinses performed comparably and, in network analysis, even ranked first [7,10], and CPC did not differ from CHX when brushing was performed [12]. Because gingival health is usually the clinical goal, patients who cannot tolerate staining or taste effects may reasonably be offered alternatives, bearing in mind that network rankings rest on few trials for some agents and that formulation matters, as illustrated by the variable CPC results [5,10]. The small concentration differences reported for plaque [6] were not confirmed in the larger Cochrane analysis [9], so

concentration should probably be guided by tolerability and product availability rather than efficacy alone.

4.4 Safety and the oral ecosystem

Local adverse effects are well documented and reversible, although staining may require professional removal. The microbiome study [13] raises a different question: whether even brief CHX use perturbs commensal functions such as nitrate reduction. That evidence derives from one small non-randomised study of seven days' use and should be treated as hypothesis-generating; its clinical relevance for typical short courses is unknown.

4.5 Strengths and limitations

Strengths include the focus on the highest level of secondary evidence, the inclusion of a Cochrane review and network meta-analyses, and the transparent reporting of effect estimates with intervals. Several limitations apply. The search was targeted rather than exhaustive, screening and extraction were performed by a single reviewer, and the protocol was not registered, so selection bias cannot be excluded. Overlap among reviews means that findings are not independent, and an AMSTAR-2 appraisal of review quality was not performed. Estimates are reported as published and are not directly comparable across indices and scales. Finally, trial-level evidence published after the included reviews may not be reflected.

4.6 Implications for research

Priorities include adequately powered, low-risk-of-bias trials of at least six months in participants with moderate gingival inflammation; consensus on core outcome sets and on clinically important thresholds for gingival and plaque indices; head-to-head comparisons with EO and CPC in brushing and non-brushing conditions; patient-reported outcomes on taste, staining and adherence; and randomised assessment of microbiome and systemic effects.

5. Conclusions

Current systematic-review evidence supports CHX mouthrinse as a highly effective short-term anti-plaque adjunct, with a statistically significant but modest effect on gingival inflammation in mild gingivitis and predictable local adverse effects, principally extrinsic staining. Evidence for moderate to severe gingivitis, for long-term use and for ecological consequences remains limited, and most underlying trials are at high risk of bias. Alternatives such as essential-oil rinses offer comparable gingival outcomes with a different adverse-effect profile.

Declarations

Funding: [to be completed]. **Competing interests:** [to be completed]. **Data availability:** All data were extracted from the published sources cited. **Use of AI:** Drafting was assisted by a generative AI tool (Claude, Anthropic); the authors must verify all data and citations against the original publications and take full responsibility for the content [to be confirmed by authors].

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