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Review article

The prevalence of gingival recession among miswak (*Salvadora persica* L.) chewing stick users: a systematic review

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ABSTRACT

Background: Miswak, a natural chewing stick from *Salvadora persica L., is traditionally used for oral hygiene in Africa, Asia, and the Middle East. Despite evidence of its effectiveness in plaque reduction and periodontal health improvement, its relationship with gingival recession remains understudied.*
Aim of the study: This systematic review evaluates existing literature to determine whether miswak use is associated with gingival recession compared to conventional toothbrush use.
Materials and methods: Literature was retrieved from Web of Science, Scopus, PubMed, Ovid MEDLINE, Ovid Emcare, CINAHL, and LILACS to analyse studies evaluating gingival recession prevalence among miswak users from 1983 to 2024. The Joanna Briggs Institute Critical Appraisal tool was used for quality assessment.
Results: Analysis of studies including 6 315 individuals showed varying results. Seven studies reported higher gingival recession prevalence (9.88–67.85%) among miswak users compared to conventional toothbrush users, while two studies reported no recession. Additional findings included increased anterior tooth wear, clinical attachment loss, and tooth loss. Usage frequency, technique, fibre texture, and user age influenced outcomes.
Conclusion: The lack of standardised miswak usage techniques contributed to variable outcomes across studies. Some studies suggest increased tooth wear, gingival recession, and abrasion with miswak use, while others report no difference or positive effects on oral health. Miswak's overall impact on periodontal health remains inconclusive, requiring standardised methods and controlled studies to better understand miswak's long-term effects and develop evidence-based usage recommendations.

Introduction

Miswak is a traditional chewing stick derived from the *Salvadora persica* L. plant and has been an integral natural method for oral hygiene among many countries in Asia, Africa, South America, and the Middle East (Haque and Alsareii, 2015). The miswak stick is chewed until frayed and is held using a pen-like grip with bristles along the handle's long axis (Haque and Alsareii, 2015). Unlike conventional toothbrushes, miswak has limited access to lingual and interdental surfaces (Haque and Alsareii, 2015). The chewing stick is believed to have cleansing effects, mainly through the release of antibacterial chemicals and the mechanical effects of its fibres (Haque and Alsareii, 2015).

Among oral health issues, gingival recession has received comparatively less research attention, particularly regarding prevention and management strategies (Mythri et al., 2015). Gingival recession is characterised by the apical migration of the gingival margin, exposing the root surface of the tooth (Yadav et al., 2023). The prevalence of gingival recession varies globally, with studies reporting 50% of the population being affected regardless of poor or high standards of oral hygiene (Kassab and Cohen, 2003; Yadav et al., 2023). The aetiology of gingival recession is multifactorial, involving both predisposing and precipitating factors such as chronic inflammation, thin gingival biotype, and bony dehiscence (Mythri et al., 2015; Jati et al., 2016). Neglect of this condition can lead to dentine hypersensitivity, aesthetic concerns, and increased risk of root caries, which may lead to tooth loss

Abbreviations: CAL, Clinical attachment loss; JBI, Joanna Briggs Institute

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and significant impact on oral health-related quality of life (Mythri et al., 2015). Despite its widespread occurrence, there is a need for more comprehensive research on effective prevention and treatment modalities for gingival recession.

Poor oral hygiene is a contributing factor to gingival recession and periodontal disease, emphasising the importance of maintaining adequate oral hygiene (Janakiram and Dye, 2020). The most common effective method for plaque control is through toothbrushing and the use of fluoridated dentifrices (Ramli et al., 2021). However, these hygiene tools may not always be available or chosen, especially in developing countries and some cultural communities (Nordin et al., 2020). Natural tooth-cleaning methods like chewing sticks remain prevalent in many developing countries due to availability, cost, and cultural significance (Nordin et al., 2020).

There are approximately 182 species of plants that are used as chewing sticks across the globe (Nordin et al., 2020). *S. persica* is the most commonly used plant for this practice (Nordin et al., 2020). It is known by many names (such as miswak, miswaki, sewak, babool, pilu) due to its extensive cultural, geographic, linguistic, historical, and religious significance (Halawany, 2012; Nordin et al., 2020; Ramli et al., 2021, 2022). For the purpose of this systematic review, the term miswak will be used as it is the most common name reported across various literature (Halawany, 2012; Nordin et al., 2020; Ramli et al., 2021, 2022). The accepted scientific name of *S. persica* was checked in 'The World Flora Online' (http://www.worldfloraonline.org) on June 15, 2024.

Miswak (*S. persica*) contains several bioactive components, including inorganic and organic compounds (silica), alkaloids, flavonoids, tannins, glycosides, saponins, benzyl derivatives, phenol compounds, sulphate, chloride, fluoride thiocyanate, and nitrates (Halawany, 2012; Nordin et al., 2020; Ramli et al., 2021, 2022). Additionally, silica is responsible for removing staining and plaque (Ramli et al., 2021). Interestingly, studies have shown that miswak can provide better control during toothbrushing, allowing easier access to posterior teeth (Nordin et al., 2020; Ramli et al., 2021). Other studies have reported its benefit in reducing halitosis and contributing to the appearance of brighter teeth (Nordin et al., 2020; Ramli et al., 2021). However, to date, there is limited evidence-based literature evaluating the drawbacks of miswak use (Ramli et al., 2021). Understanding this relationship could lead to developing evidence-based guidelines and recommendations for proper miswak oral hygiene practices, ensuring optimal dental care. Therefore, this systematic review examines whether the use of miswak (*S. persica*), is associated with increased gingival recession compared to non-users.

Materials and methods

The review protocol and registration

The study protocol was developed following the guidelines outlined in the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA, 2020) framework. This systematic review was registered at PROSPERO (CRD42024569969).

Research question

Following the PICO framework (Population, Intervention, Comparison, Outcome), this study investigates the following research question: *Does the use of the miswak (S. persica) chewing stick (I) increase the prevalence of gingival recession (O) in individuals who use miswak (P) compared to individuals who do not use the miswak chewing stick (C)?*

Databases

This search was conducted in Web of Science, Scopus, PubMed, Ovid Medline, Ovid Emcare, CINAHL, and LILACS, using the specified keywords in titles, abstracts, and MeSH terms, up to the 9th of June 2024. Detailed search strategies are provided in Appendix A: Supplementary Materials. In summary, keywords and synonyms for miswak and periodontal health were derived from a list of terms found in previous articles during a scoping search and through professional or expert recommendations. With the aid of an experienced librarian, the developed search strategy strings employed the Boolean operators 'OR' and 'AND' to combine the keywords: Salvadoraceae OR Miswak OR Siwak OR Sewak OR Miswaak OR Miswaki OR Meswak OR Siwaki OR '*S. persica*' OR 'chewing stick' OR 'teeth cleaning twig' OR 'toothbrush tree' OR Arak OR 'mustard tree' OR Mastic OR Datun OR Neem OR Babool OR '*Galenia asiatica*' OR Peelu OR Pilu OR 'Natural toothbrush' OR Koyoji OR Qesam OR Qisa AND Dentistry OR 'Oral Health' OR 'Oral Hygiene' OR Periodontitis OR Periodontium OR 'Periodontal Index' OR 'Periodontal Diseases' OR 'Gingival Recession' OR 'Gum recession' OR 'Receding gums' OR 'Periodontal Attachment Loss' OR 'Tooth wear'. In addition to electronic searches, reference lists of the included articles were manually reviewed to uncover any eligible studies that may have been overlooked. Furthermore, articles that were heavily cited yet not accessible electronically were sourced via soft copies at the James Cook University Library and were scanned and copied for further analysis.

Eligibility criteria

The inclusion and exclusion criteria were determined during the scoping of the literature and are delineated as follows:

Inclusion:

- Miswak users of any age and gender worldwide.
- All study designs Randomized clinical trials, cohort, case-control, and observational studies).
- English language publications.
- Studies evaluating gingival recession as primary outcome.
- Any method of miswak use.

Exclusion:

- Non-miswak users.
- Studies not measuring gingival recession.
- Non-English publications.
- Review articles (systematic, literature, or scoping).
- Editorial, conference, and opinion papers.

Data screening

The screening process involved two reviewers (NS and MS) who searched the databases independently. All the references were imported into Endnote version 20 and grouped according to the respective databases. All duplicates were removed, and each study was categorised by grading as 'suitable', 'unsuitable', or 'may be suitable', based on the titles and abstracts. Subsequently, the full-text articles were retrieved and reviewed to shortlist the eligible studies to be included in this review. Any reviewer uncertainty and disagreements were resolved via consensus in the presence of a third reviewer (BB).

Data extraction

One author (NS) initially extracted the data, and a second author (MS) independently reviewed the data to verify its accuracy and suitability. Discrepancies were resolved by a third author (BB). A data extraction table was constructed to include the first author, publication year, study design, sample size, participant description, type of miswak, intervention group, comparator group, practice of miswak use (including frequency, duration, and method of use), method of gingival recession measured, and outcome of the study.

Risk of bias assessment

The present review used the Joanna Briggs Institute (JBI) tool known as the 'JBI Critical Appraisal Checklist' to assess the included studies (JBI, 2017), and analyse all based on the overall appraisal criteria scheme. For the included studies, a risk of bias assessment was done by two independent reviewers (NS and MS), after which the assessors discussed outcomes for mutual consensus to resolve any disagreements with the third reviewer (BB). Each study was assessed on nine domains. Each domain was assessed as having either 'yes', 'no', 'unclear', or 'not applicable', and a final judgement was made to either include, exclude, or seek further information. The final risk of bias assessment for each study was a combination of assessments on each domain as per the instructions given in the 2017 JBI checklist for systematic reviews and research synthesis.

Data synthesis

Due to heterogeneity in study designs and outcome measures, data synthesis involved a descriptive and narrative synthesis of study findings. Subgroup analyses were planned to explore variations in miswak use, clinical evaluation of recession, factors influencing its prevalence, and its oral health effects.

Results

The search strategy retrieved 49 potentially eligible articles published between 1983 and 2024 with no geographical limit or date limit to ensure a comprehensive understanding of the topic, a depiction of the evolution of the research, and to avoid bias. Out of the 49 articles, 14 articles could not be assessed due to lack of access to full texts and despite attempts to contact the authors via email, no responses were received. The full text of 35 articles was reviewed and assessed based on the inclusion criteria. Twenty four articles were excluded for the following reasons (1) not relevant to the topic (n = 12), (2) systematic review/literature/scoping review (n = 2), (3) academic report/discussion (n = 6), (4) incomplete study (n = 1) and (5) alternative outcome to gingival recession were included such as an oral lesion, pigmentation, and gingival trauma (n = 3). Overall, 13 articles were included in this systematic review. Figure 1 shows the screening process.

Study designs and sample characteristics

Out of the 13 studies included in this systematic review, 12 are cross-sectional (Younes and El Angbawi, 1983; Eid et al., 1990, 1991; Johansson et al., 1991; Darout et al., 2000; Mumghamba and Fabian,

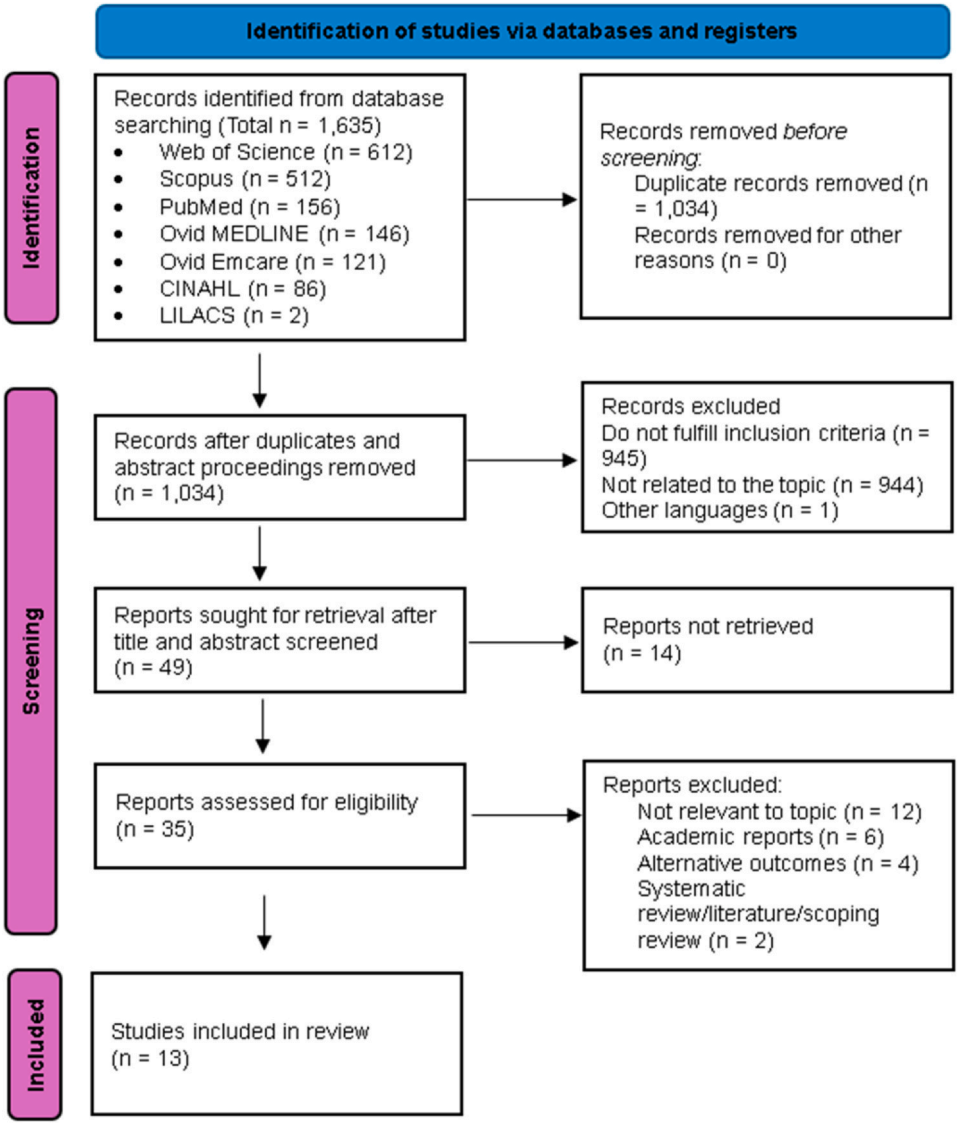

Fig. 1. PRISMA (2024) flow diagram. Two articles by Eid et al. (1990, 1991) were manually searched at the James Cook Univeristy (JCU) Library database and added.

2005; Saha et al., 2012; Saleh Muhammad et al., 2017; Savage et al., 2018; Shah et al., 2018; Ramadan and Alshenqiti, 2021; Yasmin et al., 2024). One study by Rifaey et al. is a single-blind, randomised controlled trial with a crossover design. A total number of 6 315 individuals were included in the reviewed studies. Sample sizes varied widely, ranging from 20 participants (Rifaey et al., 2021) to 2 124 participants (Shah et al., 2018). The age ranges of participants also varied significantly. Some studies focused on younger populations, such as 10–15 years old (Younes and El Angbawi, 1983), while others included adult populations, such as 20–65 years old (Darout et al., 2000). Mumghamba and Fabian (2005) had specific age criteria, such as individuals over 40 years old. The study populations included individuals of different nationalities, including Nigerian (Savage et al., 2018), Saudi (Younes and El Angbawi, 1983; Eid et al., 1990, 1991; Johansson et al., 1991), Sudanese (Darout et al., 2000), Tanzanian (Mumghamba and Fabian, 2005) and Indonesian groups (Saleh Muhammad et al., 2017). Some studies focused on specific populations, such as only male participants (Darout et al., 2000), individuals with mild to moderate gingivitis (Rifaey et al., 2021), and generally healthy adults (Yasmin et al., 2024). Notably, one study by Saha et al. (2012) focused on adolescents aged 12–15 years. Overall, the studies provided a comprehensive view of oral health outcomes associated with miswak use across different demographic and cultural settings. Table 1 details the characteristics of included studies.

Quality assessment

Thirteen of the studies included were assessed in the risk of bias assessment as depicted in Tables 2 and 3. Assessment of included studies revealed that the most common issues across the studies were related to the criteria of the relationship between researcher and participants, ethical issues, and data analysis sufficiently rigorous, where 'unclear' or 'no' responses were prevalent. Despite these challenges, all studies were included in the final analysis, indicating that the identified issues did not warrant exclusion from the overall appraisal.

In summary, eight studies (Younes and El Angbawi, 1983; Eid et al., 1990, 1991; Saha et al., 2012; Saleh Muhammad et al., 2017; Shah et al., 2018; Ramadan and Alshenqiti, 2021; Yasmin et al., 2024) received predominantly positive ('yes') responses across all the criteria. However, the remaining five studies had some criteria with 'unclear' or 'negative' ('no') responses. Specifically, Savage et al. (2018) had an unclear response on the criterion relationship between researcher and participants considered, and Rifaey et al. (2021) received a 'no' on the criterion. The data analysis was sufficiently rigorous. Mumghamba and Fabian (2005) had unclear responses on ethical issues considered and data analysis sufficiently rigorous; Johansson et al. (1991) had unclear responses on appropriate recruitment strategy and relationships between researchers and participants considered, and a 'no' on ethical issues considered; and Darout et al. (2000) had 'unclear' responses on criteria such as appropriate methodology, appropriate recruitment strategy, and relationships between researchers and participants considered, and a 'no' on criterion 'data analysis sufficiently rigorous'. The findings across the studies have been categorised into themes, framing the following analysis of results.

Thematic analysis of results

Common types of miswak

The reviewed studies mention various types of miswak, with *S. persica* being the most frequently specified. This species is explicitly cited in at least six studies (Eid et al., 1990, 1991; Darout et al., 2000; Saleh Muhammad et al., 2017; Ramadan and Alshenqiti, 2021; Rifaey et al., 2021). Many studies did not specify the exact type of miswak used, as seen in the works of Savage et al. (2018), Johansson et al. (1991) and Younes and El Angbawi (1983). Additionally, one study by Shah et al. (2018) mentioned the use of chewing sticks made from the bark of different trees, including neem and babool, alongside miswak sticks. Despite the frequent mention of *S. persica*, the lack of specificity in many studies made it challenging to determine if other types of miswak were commonly used but not identified. Nonetheless, *S. persica* stood out as the most frequently mentioned and likely the most common type of miswak used in the studies included in this systematic review.

Clinical parameters used to assess gingival recession and related oral health outcomes

Researchers employed diverse methods to measure gingival recession. For instance, studies utilised clinical attachment loss (CAL), assessed using the Clavind and Löe method (Ramadan and Alshenqiti, 2021) and by quantifying sextants with more than 4 mm attachment loss (Darout et al., 2000). Other methods included measuring the distance between the cementoenamel junction and the gingival margin (Yasmin et al., 2024), employing a graded scale to categorise recession severity (Shah et al., 2018), and using the Williams Probe to assess crown length and recession depth (Younes and El Angbawi, 1983).

Tooth wear was another critical parameter examined in relation to miswak use, assessed using the Tooth Wear Index by Smith and Knight (Shah et al., 2018) and specifically focusing on anterior tooth wear on canines and incisors (Johansson et al., 1991). Additional factors such as crown length measurements from the incisal edge to the deepest part of the labial gingival margin (Younes and El Angbawi, 1983), the mean number of teeth lost (Mumghamba and Fabian, 2005) and signs of tooth wear attributed to local cleaning agents (Savage et al., 2018) were also considered. Qualitative assessments provided further insights, including observations on the presence or absence of gingival recession (Saha et al., 2012) and the prevalence of gingival recession among regular miswak users (Rifaey et al., 2021).

Prevalence of gingival recession among miswak and toothbrush users

Eid et al. (1990) reported a significantly higher prevalence of gingival recession in miswak users (67.85%) compared to toothbrush users (41.67%) with a statistically significant difference ($P < 0.001$). In a follow-up study, Eid et al. (1991) found that 35.4% of miswak users, 28.6% of toothbrush users, and 36.1% of users who combined miswak and toothbrushing, experienced gingival recession. Conversely, Younes and El Angbawi (1983) reported gingival recession in only 9.88% of miswak users. Saleh Muhammad et al. (2017) found that 13 participants who used miswak for over 1 year had gingival recession. However, Saha et al. (2012) observed no gingival recession among their study subjects, and Yasmin et al. (2024) found no statistical or clinical evidence of gingival recession differences between miswak and toothbrush users.

Frequency of miswak use and its effects on oral health

Miswak usage patterns ranged from once a day to multiple times daily, reflecting diverse oral hygiene practices among participants (Darout et al., 2000; Mumghamba and Fabian, 2005; Savage et al., 2018). Savage et al. (2018) reported that on average participants used chewing sticks three times a day. The duration of miswak use also varied significantly; Saleh Muhammad et al. (2017) found that a substantial proportion of users continued its use for periods ranging from 6 months to over 1 year. Darout et al. (2000) noted that miswak sticks were typically used for 3–5 minutes several times a day, primarily targeting the buccal and occlusal surfaces of teeth.

Gingival recession and oral health effects

Ramadan and Alshenqiti (2012) found that gingival recession was more significant in toothbrush users compared to miswak users, with miswak reported to be effective in reducing plaque and resulting in less gingival recession. Johansson et al. (1991) noted significantly higher anterior tooth wear on canines and incisors among daily miswak users. Younes and El Angbawi (1983) measured gingival recession using a

Table 1
The characteristics of included studies.

References (Year)	Study design	Sample size (n)	Participants	Type of miswak	Intervention	Comparator	Practice of miswak use	Methods	Main findings
Younes and El Angbawi (1983)	Cross-sectional study	1 336 (male/female distribution unspecified)	Saudi school children aged 10–15 Y old	Not specified	Miswak	Not specified	-Traditional practice use miswak at age 7–10 Y,-Frequency of use not specified.	- Gingival recession and crown length measured with Williams Periodontal Probe.- Crown length measured from the incisal edge to the deepest part of the labial gingival margin of anterior teeth.- Gingival recession defined as a migration of epithelium attachment in the direction of root apex.	- Gingival recession reported in 9.88% of participants.
Eid et al. (1990) (manually searched)	Cross-sectional study	236 Saudi patients (male/female distribution unspecified)	Not Reported	*Salvadora persica*	Miswak users	Conventional toothbrush	Not specified	- Pocket depth, attachment loss, and gingival recession measured with a calibrated Williams' round No. 14 probe.	- Miswak users (67.85%) higher prevalence of gingival recession compared to toothbrush users (41.67%), statistically significant ($P < 0.001$). - Miswak users had higher mean gingival recession scores (0.93 ± 0.92).
Eid et al. (1991) (manually searched)	Cross-sectional study	238 Saudi patients (male/female distribution unspecified)	Not Reported	*Salvadora persica*	Miswak users	Conventional toothbrush	Not specified	- Patients were divided into three groups: miswak group, toothbrush group, and miswak/toothbrush group.- Maxillary and mandibular anterior teeth and both premolars were selected for examination.- Gingival recession measured with a calibrated Williams' round No. 14 probe and recorded as present when 1 mm or more of the cementum was exposed.	- Miswak users (20.9%) had higher gingival recession than toothbrush users and severity of 1.11 ± 0.80 mm. - Gingival recession for miswak users is 35.4%, toothbrush users 28.6% and miswak/toothbrush users 36.1%.- Significant differences in recession severity observed in the premolar and central incisor regions between miswak and toothbrush groups.
Johansson et al. (1991)	Cross-sectional study	90 (50 males and 40 males)	19–25 Y old (mean age 22 Y) Saudi population	Not specified	Miswak	Non-miswak users	Miswak used once a day.	- The use of miswak reported in (n = 26) where subjects (n = 7) reported daily miswak use- 'Anterior subindex' to describe anterior tooth wear on canines and incisors.	- Daily miswak use showed a significantly higher anterior subindex compared to those that did not use miswak.

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Table 1 (*continued*)

References (Year)	Study design	Sample size (n)	Participants	Type of miswak	Intervention	Comparator	Practice of miswak use	Methods	Main findings
Darout et al. (2000)	Cross-sectional study	213 (only males)	20–65 Y old (mean age 36.6 Y) Sudanese population	*Salvadora persica*	Miswak users	Toothbrush users	Sticks used for 3–5 Min, several times a day, often on the buccal and occlusal surfaces of teeth. An optimal technique of miswak use has not been investigated.	- Attachment loss defined as the distance from the CEJ to the bottom of a pocket/sulcus.- The following cut-off points for scoring attachment loss were used: 0–3 mm, 4–5 mm, ≥6 mm.	- Higher number of sextants with > 4 mm attachment loss found among miswak users compared to toothbrush users.
Mumghamba and Fabian (2005)	Cross-sectional study	206 (115 males and 91 females)	Adults ≥40 Y old (mean age of 55.24 ± 11.87 Y)	Not specified	Chewing stick, 53 (25.7%)	Plastic toothbrush, 106 (51.5%), Combination of plastic toothbrush and chewing stick (35 (17.0% other unspecified means of tooth cleaning, 12 (5.8%).	The tooth brushing frequency practised by study participants was once per day (35.4%), two to three times per day (56.8%) and 5.3% were not specific regarding the frequency of brushing.	- Individuals interviewed on oral hygiene practices using a structured questionnaire, and tooth loss was assessed using a Community Periodontal Index (CPI) probe.	- The mean number of teeth lost was significantly higher among users of chewing sticks (12.04 ± 8.35) compared to habitual users of plastic toothbrushes (8.73 ± 7.00, *P* 1/4 0.015)
Saha et al. (2012)	Cross-sectional study	297 (only males)	Age 12–15 Y	*Salvadora persica*	115 subjects were miswak users only	93 subjects were conventional toothbrush/ toothpaste users 79 were using both miswak & toothbrush	Not specified	- All individuals were interviewed regarding their oral hygiene habits and practices.- Clinical examinations using gingival index and plaque index.	None of the study subjects in the present study reported gingival recession.
Saleh et al. (2017)	Cross-sectional study	292 people in Indonesia but after sampling n = 20 included (16 males, 4 females)	30–55 Y old	*Salvadora persica*	Miswak users	Manual toothbrush	Not specified	- Toothbrushing using miswak was inspected to know the technique and periodontal tissues were examined.	- 40% of participants used miswak for 6 mo −1 Y, while 60% used miswak for greater than 1 Y.- 13 out of 20 people (65%) that used miswak for over 1 Y had gum/gingival recession. - Miswak use found to cause tooth abrasion and trauma to oral soft tissue due to incorrect brushing technique and hard texture of miswak fibres.
Savage et al. (2018)	Cross-sectional clinical- based survey	1 349 (male/ female distribution unspecified)	Adults 18–35 Y Nigerian population	Not specified	Chewing stick	Not specified	Brushing frequency of three times a day, using horizontal motions and brushing after breakfast.	- Cervical, facial, and palatal/lingual surfaces of teeth were scored using the basic erosive wear examination index.	- 60% of participants showed signs of tooth wear due to local cleaning agents such as salt, chewing sticks, grounded charcoal and broken ceramic plates.

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Table 1 (*continued*)

References (Year)	Study design	Sample size (n)	Participants	Type of miswak	Intervention	Comparator	Practice of miswak use	Methods	Main findings
Shah et al. (2018)	Cross-sectional study	2 124 (1 062 participants included in each of the study and control groups)	Individuals using traditional oral hygiene methods	Bark of a tree (neem, babool, or miswak sticks)	Chewing stick (neem, babool, or miswak sticks)	Conventional toothbrush and toothpaste	Not specified	- Tooth wear index by Smith and Knight to measure tooth wear. - Gingival recession measured from the cementoenamel junction using a calibrated probe. - Recession grading as follows:• 0 = No recession• 1 = Recession < 3 mm• 2 ≥ 3 mm but < 6 mm• 3 ≥ 6 mm• X = Excluded• 9 = Not recorded	- Gingival recession was greater in the intervention group compared to the control group.- Tooth wear significantly higher on all surfaces: buccal, lingual, cervical, and occlusal in the intervention group
Ramadan and Alshenqiti (2021)	Cross-sectional study	150 (115 males, 35 females)	17–63 Y old (mean 30 ± 12.1 Y)	*Salvadora persica*	Group II (miswak users)	Group I (toothbrush users) and Group III (toothbrush and miswak users)	Not specified	- Individuals divided in 3 groups: Group I (toothbrush users), Group II (miswak users), Group III (toothbrush and miswak users). - Probing depth and clinical attachment loss (CAL) measured as per Clavind and Löe, 1967.- Gingival recession was measured Jahne, 1991.	-Miswak user group had a significantly higher percentage of the mean probing pocket depth between 3 and 5 mm (52.4%), followed by the toothbrush group at 42.9%- CAL and degree of gingival recession were more significant among exclusive toothbrush users in comparison to the combined use of toothbrush and miswak. - Toothbrush users had a greater degree of gingival recession than the exclusive miswak users. - Miswak demonstrated to be effective in reducing plaque and has resulted in less gingival recession.
Rifaey et al. (2021)	Single-blind (examiner), randomised controlled trial, crossover	20 (8 males, 12 females)	Adult patients with mild or moderate gingivitis. Mean age of 24 ± 3.0 Y	*Salvadora persica*	Group 1 (miswak and toothbrush users)	Group 2 (only toothbrush users)	Not specifically stated - participants were given instructions on how to use miswak (twice daily) and toothbrush (twice daily using the modified Bass technique) by a single investigator.	- Measuring gingival recession was not the primary aim of the study.	- The prevalence of gingival recession was higher among regular miswak users.
Yasmin et al. (2024)	Cross-sectional study (male/female distribution unspecified)	36 (male/female distribution unspecified)	Adult individuals of both genders who were generally healthy	Not specified	Siwak users	Toothbrush users	Not specified	- Gingival recession measured as the distance between the cementoenamel junction and the gingival margin.	- No statistical or clinical evidence of gingival recession between the groups.

Table 2
Quality assessment of cross-sectional studies using Joanna Briggs Institute critical appraisal tool.

Study (First authors name, year)	1. Inclusion criteria clearly defined	2. Study subjects and setting described in detail	3. Valid and reliable measurement of exposure	4. Objective, standard criteria used for measurement of condition	5. Confounding factors identified	6. Strategies for dealing with confounding factors stated	7. Valid and reliable measurement of outcomes	8. Appropriate statistical analysis	9. Overall appraisal include/exclude/ seek further information
Savage et al. (2018)	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Mughamba and Fabian (2005)	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Include
Shah et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Saha et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Yasmin et al. (2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Ramadan and Alshenqiti (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Johansson et al. (1991)	Yes	Yes	Unclear	Yes	Unclear	No	Yes	Yes	Include
Younes and El Angbawi (1983)	Yes	Yes	Yes	Yes	Yes	No	Unclear	Yes	Include
Darout et al. (2000)	Yes	Unclear	Unclear	Yes	Unclear	Yes	No	Yes	Include
Saleh et al. (2017)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Include
Eid et al. (1990)	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes	Include
Eid et al. (1991)	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes	Include

Table 3
Quality assessment of randomised controlled study using Joanna Briggs Institute critical appraisal tool.

Study (First author name, year)	1. True randomisation used for assignment of participants to treatment groups?	2. Allocation to treatment groups concealed	3. Treatment groups similar at the baseline	4. Participants blind to treatment assignment	5. Were those delivering treatment blind to treatment assignment?	6. Were outcomes assessors blind to treatment assignment?	7. Were treatment groups treated identically other than the intervention of interest?	8. Follow up complete	9. Participants analysed in the groups to which they were randomised	10. Were outcomes measured in the same way for treatment groups?	11. Were outcomes measured in a reliable way?	12. Was appropriate statistical analysis used?	13. Was the trial design appropriate?
Rifaey et al. (2021)	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Include

Williams Probe, but did not provide specific findings on recession. Savage et al. (2018) found that 60% of participants showed signs of tooth wear due to local cleaning agents, including chewing sticks. Rifaey et al. (2021) commented that the prevalence of gingival recession was higher among regular miswak users. Mumghamba and Fabian (2005) found significantly higher tooth wear on all surfaces in the miswak group compared to the control group. Saha et al. (2012) reported no gingival recession among study subjects. Yasmin et al. (2024) found no statistical or clinical evidence of gingival recession between miswak users and toothbrush users. Younes and El Angbawi (1983) reported gingival recession in 9.88% of participants but did not specify differences between groups. Darout et al. (2000) found a higher number of sextants with > 4 mm attachment loss in miswak users compared to toothbrush users. Saleh Muhammad et al. (2017) attributed gingival recession in 13 miswak users to incorrect brushing techniques and the hard texture of miswak fibres. Shah et al. (2018) found that gingival recession was greater in the chewing stick (including miswak) group compared to the conventional toothbrush and toothpaste group.

Effects of miswak on tooth abrasion

Regarding tooth abrasion, several studies indicate that miswak use is associated with increased tooth wear compared to conventional toothbrush use. Johansson et al. (1991) reported significantly higher anterior tooth wear on canines and incisors among daily miswak users compared to non-users. Shah et al. (2018) also found higher tooth wear across all tooth surfaces in participants using chewing sticks, including miswak, compared to those using toothbrushes. Moreover, Mumghamba and Fabian (2005) noted a higher mean number of teeth lost in chewing stick users compared to plastic toothbrush users. Saleh Muhammad et al. (2017) highlighted miswak's abrasive nature and its potential to cause tooth abrasion, particularly when used with incorrect brushing techniques. However, Yasmin et al. (2024) did not observe significant clinical evidence of tooth wear differences between the two groups.

Discussion

This systematic review evaluated whether miswak (*S. persica*) chewing stick use increases gingival recession prevalence compared to conventional toothbrush use. Results varied widely across 13 studies, with gingival recession prevalence ranging from 9.88% to 67.85% among miswak users (Younes and El Angbawi, 1983; Eid et al., 1990). Some studies found no significant differences between miswak and toothbrush users (Yasmin et al., 2024), while others reported higher rates of tooth wear and abrasion among miswak users (Johansson et al., 1991). Heterogeneity of the results can be attributed to differences in study populations, methodologies, interpretations of the aetiology of gingival recession, frequency of use, environmental/cultural factors and that gingival recession can progress overtime regardless of oral hygiene (Kassab and Cohen, 2003; Mythri et al., 2015).

Factors contributing to a higher gingival recession among miswak users

Common factors among participants who showed higher gingival recession included miswak or chewing stick use, frequency and duration of use, brushing technique, texture of miswak fibres, and age. Several studies reported higher gingival recession or tooth wear among miswak or chewing stick users compared to toothbrush users (Eid et al., 1990, 1991). For example, Eid et al. (1990) and Shah et al. (2018) found greater gingival recession in the chewing stick group compared to the conventional toothbrush group. Other studies noted that long-term or more frequent use of miswak was associated with increased gingival recession. For instance, Saleh Muhammad et al. (2017) reported that 13 people who used miswak for over a year had gingival recession. Incorrect brushing technique was cited as a potential cause of gingival recession and tooth abrasion in miswak users, suggesting that

improper technique plays a role in the development of recession (Saleh Muhammad et al., 2017). However, the study conducted by Rifaey et al. (2021) provided specific instructions to participants on how to use both miswak and a toothbrush, yet the results still showed high levels of gingival recession. This could be attributed to the natural fibres of the miswak stick, even when used correctly, which may still be more abrasive than the bristles of a conventional toothbrush (Ramli et al., 2022). Despite the participants being instructed on proper usage, the inherent roughness of the miswak could lead to mechanical trauma, and over time, repeated trauma can lead to the apical migration of the gingival margin, resulting in gingival recession (Halawany, 2012). This reinforces the idea that the biology and proper technique of miswak use play crucial roles in determining its impact on gingival health.

Furthermore, some studies focused on adult populations, particularly those over 30 or 40 years old (Darout et al., 2000; Mumghamba and Fabian, 2005; Saleh Muhammad et al., 2017; Savage et al., 2018), which showed higher rates of gingival recession, suggesting that age might be a factor, although it was not clear if this was directly related to miswak use or a general declining trend in oral health.

Factors contributing to a lower gingival recession among miswak users

Some studies showed lower levels among certain study populations and cultural practices. Ramadan and Alshenqiti (2021) conducted their research in Al-Madinah Al-Munawara, Saudi Arabia, a region where miswak use is deeply ingrained within cultural and religious practices (Ramadan and Alshenqiti, 2021; Ramli et al., 2022). According to various literature, the use of miswak is passed down through generations and likely includes proper technique use and cultural familiarity, which may play a protective role, accounting for the lower prevalence of gingival recession noted (Halawany, 2012). In contrast, Saha et al. (2012) reported no gingival recession in children aged 12–15 years, who might not have been using miswak long enough to yield significant gingival recession. Moreover, children's oral tissues are more resilient and may respond differently to mechanical stimuli compared to adults (Nwhator, 2014). Furthermore, literature suggests gingival recession is uncommon in children and if so, it would depend on multiple factors such as plaque and frenum attachment, rather than exclusive use or improper use of miswak (Nwhator, 2014).

While the use of miswak in culturally and religiously significant contexts may contribute to lower gingival recession due to proper technique, the absence of gingival recession in children using miswak suggests that age, resilience of oral tissues, and other factors like plaque and frenum attachment may also play crucial roles. Thus, the impact of miswak on gingival recession might be influenced by a complex interplay of cultural practices and biological factors.

Methodological differences

Another critical factor that has contributed to the heterogenous results is the methodological differences across the studies. Twelve out of the 13 studies were cross-sectional studies which may not have captured details of individual miswak use, such as frequency, technique, and pressure applied during use. This methodological limitation may indicate why some of the studies did not find a significant association between miswak use and gingival recession (Halawany, 2012). Furthermore, the lack of detailed clinical assessments may have limited the ability to accurately determine the extent and causes of gingival recession. The assessment of clinical attachment loss was measured differently across literature using variety of scales such as Clavind and Lōe (Ramadan and Alshenqiti, 2021) while other studies quantified sextants with more than 4 mm attachment loss (Darout et al., 2000). Similarly, gingival recession was evaluated using different methods: by measuring the distance between the cementoenamel junction and the gingival margin (Yasmin et al., 2024), using a graded scale to categorise the severity of recession (Saha et al., 2012), and employing the Williams Periodontal Probe to assess both crown length and recession depth (Younes and El Angbawi, 1983). These inconsistencies complicated the interpretation of data, making it difficult to draw definitive conclusions. Consequently, the different measurement techniques employed may potentially underestimate or overestimate the prevalence or severity of gingival recession.

Cultural and environmental factors

Cultural and environmental factors also play a significant role in the varying outcomes of these studies. In regions where miswak use is deeply ingrained in cultural practices, such as in Saudi Arabia or Sudan (Halawany, 2012), individuals may use miswak more frequently and with less attention to technique, potentially leading to higher rates of gingival recession. This is evident in the studies by Younes and El Angbawi (1983) and Johansson et al. (1991) which found that traditional oral hygiene practices, including miswak use, were associated with higher rates of gingival recession in young Saudi populations. These findings suggest that cultural norms around miswak use, including the belief in its superiority over modern toothbrushes, may lead to its overuse and consequent damage to gingival tissues.

Conversely, studies conducted in environments where miswak use is less common or where it is used alongside modern dental care practices may report different results. For example, the study by Shah et al. (2018) in India found that traditional oral hygiene methods, including miswak, were associated with lower levels of gingival recession compared to toothbrush use. This difference could be due to the less frequent and more controlled use of miswak in this population, as well as the concurrent use of modern dental care practices that mitigate the risks associated with traditional methods.

Clinical implications

This systematic review both supports and challenges existing theories regarding miswak's effects on oral health. Ramadan and Alshenqiti (2012) support existing theories about the effectiveness of miswak in reducing plaque and improving periodontal health. This aligns with previous research highlighting the anti-bacterial properties of *S. persica* (Halawany, 2012; Ramli et al., 2021, 2022). The findings of the review support the understanding that miswak, as a mechanical cleaning tool, can effectively remove plaque, which is consistent with traditional beliefs about its oral hygiene benefits. This review also provides new insights into the influence of certain factors, such as age and duration of miswak use on oral health, which were otherwise not extensively considered in previous theories.

The importance of this study lies in its potential to inform evidence-based recommendations for oral hygiene practices in communities where miswak use is prevalent. As global health initiatives increasingly recognise the value of integrating traditional practices with modern healthcare, understanding the effects of miswak on gingival health becomes crucial. This review challenges the assumption that natural oral hygiene methods are universally beneficial, highlighting the need for a more balanced approach that considers both the advantages and potential drawbacks of miswak use.

Furthermore, the findings of this review have the potential to profoundly impact the field of periodontal health by stimulating new research directions. The contradictory results regarding gingival recession underscore the need for more rigorous, standardised studies that can definitively establish the long-term effects of miswak use on periodontal tissues. This could lead to the development of improved methodologies for assessing traditional oral hygiene practices and their impact on oral health outcomes.

The practical implications of this study are multifaceted and significant for both clinical practice and public health initiatives. Firstly, the results of this study could potentially inform dental professionals about the potential effects of miswak on gingival health, enabling tailored patient education and advice (Al-Otaibi et al., 2003). Secondly,

the review outcomes may influence the development of oral health policies and guidelines in regions using traditional methods (World Health Organisation, 2024). Public health officials and policymakers may need to consider incorporating guidance on proper miswak use into broader oral health promotion strategies (Haque and Alsareii, 2015). Thirdly, this study underscores the need for more comprehensive, long-term research on the effects of miswak use (Dahiya et al., 2012). Indeed, the inconsistencies in the study outcomes and the lack of standardised usage techniques of miswak point to the necessity of developing standardised protocols (Azizan et al., 2023).

Strengths and limitations

A significant strength of this review is its comprehensive search strategy, which encompassed a broad spectrum of studies across diverse populations, age groups, and geographical regions. Including studies employing different methodologies offers various perspectives on the subject and adds depth to the analysis. While previous reviews have consistently highlighted the anti-bacterial and anti-plaque properties of miswak, the direct impact on gingival recession has remained less clear.

Albeit the strengths of this study, limitations of this systematic review included studies with small sample sizes, heterogeneous study designs, and inconsistent periodontal assessment methods. The predominance of cross-sectional studies restricted causality inference, while longitudinal studies were underrepresented. While this systematic review provides valuable insights into the relationship between miswak use and gingival recession, its findings should be interpreted with caution given the aforementioned limitations. Indeed, this review underlines the need for more robust, standardised, and longitudinal research to determine the long-term effects of miswak use on gingival health to facilitate more accurate comparisons.

Conclusion

Miswak use has become prevalent especially in many developing countries. However, a definitive conclusion regarding the direct relationship between miswak use and increased prevalence of gingival recession cannot be drawn based on the current evidence. This review suggests that while miswak offers notable benefits for oral hygiene and certain aspects of periodontal health, its use may be associated with increased gingival recession if used excessively or improperly. It also emphasises the importance of considering cultural practices in oral health and highlights the need for careful evaluation of potential risks. Ultimately, this work contributes to the ongoing effort to improve oral health outcomes across diverse populations by promoting a balanced understanding of traditional oral hygiene practices like miswak use.

Ethics approval

This research does not require ethical statement/clinical trial registration number or informed consent.

CRediT authorship contribution statement

Bakhoum Bishoy: Data curation, Formal analysis, Investigation. **Sidrak Miriam:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology. **Suleman Nadia:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft. **Stevans Ana-Maria:** Data curation, Formal analysis, Investigation. **Noussair Julie:** Conceptualization, Formal analysis, Investigation. **Martins de Mello-Neto João:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Amaral Rodrigo Rodrigues:** Formal analysis, Investigation, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.hermed.2025.101003.

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