

Clinical and Epidemiological Evaluation of the Effectiveness of Prevention of Periodontal Diseases Associated with the Consumption of Groundwater

Abbosov Mustafo Mardonovich¹, Sanakulov Jamshed Obloberdiyevich²,

1st year clinical residency resident of Samarkand State Medical University¹, Assistant of the Department of Stomatology, Samarkand State Medical University DKTF,

Received: 2026-03-03 · Accepted: 2026-04-20

Abstract

Periodontal diseases remain one of the most common chronic inflammatory conditions affecting the oral cavity worldwide. Environmental, nutritional, and hygienic factors significantly influence the prevalence and progression of periodontal pathology. Among these factors, the quality and mineral composition of groundwater consumed by the population play an important role in oral and periodontal health. This study aimed to conduct a clinical and epidemiological evaluation of the effectiveness of preventive measures against periodontal diseases associated with groundwater consumption. A total of 240 individuals aged 18–60 years living in regions with varying groundwater mineralization levels participated in the study. Clinical examinations included assessment of oral hygiene status, gingival bleeding index, periodontal pocket depth, and community periodontal index. Preventive interventions included oral hygiene education, professional dental cleaning, fluoride-containing products, balanced dietary recommendations, and monitoring of groundwater quality. The results demonstrated that populations consuming groundwater with imbalanced mineral composition showed significantly higher prevalence of gingivitis and periodontitis compared to populations consuming water with optimal mineral levels. After implementation of preventive programs for twelve months, significant improvement in periodontal indices and reduction in inflammatory manifestations were observed. The findings confirm that preventive strategies combined with monitoring of groundwater quality contribute to reducing periodontal disease prevalence and improving oral health indicators. The study emphasizes the importance of integrating environmental and dental preventive approaches into public healthcare systems. Periodontal disorders remain among the most widespread chronic oral conditions affecting different population groups across the world. The occurrence and progression of inflammatory lesions in periodontal tissues are closely associated not only with microbial factors and inadequate oral hygiene but also with environmental influences, including the quality of consumed drinking water. Groundwater serves as a primary source of water supply for many rural and semi-urban communities, and its chemical composition may significantly affect oral tissue metabolism, mineral balance, and immune resistance within the oral cavity. The present study was aimed at conducting a comprehensive clinical and epidemiological assessment of preventive approaches directed at reducing periodontal pathology associated with long-term groundwater consumption.

Keywords: periodontal diseases, groundwater, oral health, epidemiology, prevention, gingivitis, periodontitis, mineral composition, dental hygiene, public health.

1. Introduction

Periodontal diseases represent a major global public health concern due to their high prevalence and significant impact on quality of life. Chronic inflammatory lesions affecting the gingiva and supporting tissues of the teeth can lead to tooth mobility, tooth loss, systemic complications, and functional impairment. The etiology of periodontal diseases is multifactorial and includes microbial biofilm accumulation, inadequate oral hygiene, nutritional deficiencies, smoking, systemic diseases, and environmental influences. In recent years, increasing attention has been directed toward ecological and environmental determinants of oral health, particularly drinking water quality.

Groundwater serves as the principal source of drinking water for millions of people worldwide. The mineral composition of groundwater varies depending on geological and environmental characteristics of specific regions. Deficiency or excess of minerals such as fluoride, calcium, magnesium, iron, and nitrates may influence oral tissue metabolism, microbial activity, and immune response in the oral cavity. Long-term consumption of groundwater with inappropriate mineral composition can contribute to inflammatory changes in periodontal tissues and increase susceptibility to oral diseases.

Fluoride concentration in drinking water is one of the most extensively studied factors associated with oral health. Optimal fluoride levels contribute to enamel resistance and reduction of dental caries, while excessive or insufficient fluoride intake may negatively affect oral tissues. Calcium and magnesium also play important roles in maintaining mineral balance of teeth and periodontal structures. In addition, groundwater contamination by industrial waste, agricultural chemicals, and heavy metals may indirectly affect periodontal tissues through chronic toxic exposure and immune dysfunction.

Epidemiological studies conducted in different countries have demonstrated regional differences in periodontal disease prevalence associated with environmental conditions and water quality. However, comprehensive clinical and epidemiological evaluation of preventive measures targeting periodontal diseases associated with groundwater consumption remains insufficiently studied. Effective prevention requires not only professional dental interventions but also environmental monitoring and community-based educational programs.

The present study was conducted to assess the relationship between groundwater consumption and periodontal disease prevalence and to evaluate the effectiveness of preventive measures implemented among populations living in regions with varying groundwater characteristics. The research highlights the importance of integrated preventive dentistry and environmental health strategies for improving periodontal status and reducing chronic oral disease burden.

2. Materials and Methods

The study was carried out between 2024 and 2025 among residents of rural and semi-urban regions relying primarily on groundwater sources for daily consumption. A total of 240 participants aged between 18 and 60 years were included in the investigation. Participants were divided into two groups according to the mineral composition and sanitary condition of consumed groundwater.

Group I consisted of 120 individuals consuming groundwater with balanced mineral composition and acceptable sanitary indicators. Group II included 120 individuals consuming groundwater characterized by low fluoride concentration, increased hardness, and elevated nitrate levels. Water quality analysis was performed using laboratory examination of collected groundwater samples from regional water supply systems and household wells.

Clinical dental examinations were conducted under standardized conditions using sterile dental instruments and artificial illumination. Periodontal status was evaluated according to the following indices:

- Oral Hygiene Index Simplified (OHI-S)
- Gingival Bleeding Index (GBI)
- Community Periodontal Index (CPI)
- Periodontal pocket depth measurement
- Gingival inflammation assessment

Sociodemographic data, dietary habits, oral hygiene practices, frequency of dental visits, smoking history, and duration of groundwater consumption were recorded using structured questionnaires. Participants with severe systemic diseases, recent periodontal treatment, pregnancy, and antibiotic

therapy within the previous three months were excluded from the study.

Preventive interventions were implemented over a twelve-month period and included:

- Professional oral hygiene procedures every six months
- Individual oral hygiene instruction
- Use of fluoride-containing toothpaste and mouth rinses
- Educational seminars regarding nutrition and oral care
- Recommendations for water filtration and mineral balance correction
- Periodic monitoring of oral health indicators

Statistical analysis was performed using standard biomedical statistical methods. Mean values, standard deviations, and percentage distributions were calculated.

3. Results

The conducted clinical and epidemiological assessment revealed significant differences in periodontal health indicators between populations consuming groundwater with satisfactory mineral composition and those exposed to water characterized by unfavorable chemical parameters. Individuals relying on groundwater with reduced fluoride concentration and elevated hardness demonstrated considerably higher prevalence of gingival edema, bleeding tendency, plaque accumulation, and periodontal pocket formation. Chronic inflammatory manifestations were more pronounced among participants with prolonged exposure to environmentally compromised water sources.

Initial clinical examination identified unsatisfactory oral hygiene status in a substantial proportion of participants from regions with poor groundwater quality. Thick bacterial deposits and calculus accumulation were frequently observed along the gingival margin, contributing to progression of inflammatory changes within periodontal tissues. Gingival hyperemia, swelling, and bleeding during probing were recorded significantly more often among these individuals compared to participants consuming water with balanced mineral composition.

Epidemiological analysis demonstrated that moderate and severe forms of periodontitis occurred predominantly among residents exposed to long-term consumption of mineral-deficient groundwater. Increased periodontal pocket depth and clinical attachment loss indicated gradual destruction of supporting tissues surrounding the teeth. Furthermore, individuals from environmentally unfavorable regions frequently complained of gingival discomfort, unpleasant oral odor, tooth sensitivity, and recurrent episodes of gingival bleeding during tooth brushing.

Implementation of preventive measures over the observation period resulted in substantial improvement of clinical periodontal indicators. Educational programs directed toward proper oral hygiene practices significantly increased patient awareness regarding prevention of inflammatory oral diseases. Participants who regularly followed recommendations concerning tooth brushing techniques, use of fluoride-containing hygiene products, and balanced dietary intake demonstrated visible reduction in gingival inflammation and plaque accumulation.

Professional oral sanitation procedures also produced favorable clinical outcomes. Removal of dental plaque and calculus contributed to normalization of gingival tissue condition and reduction of periodontal pocket depth in a large proportion of examined individuals. Improvement in oral hygiene behavior was accompanied by decreased frequency of gingival bleeding and stabilization of periodontal structures.

Additional positive effects were observed among participants who adopted recommendations regarding water purification and reduction of exposure to environmentally unfavorable groundwater sources. These individuals demonstrated lower intensity of inflammatory symptoms and improved overall oral condition during follow-up examinations. The obtained results support the assumption that environmental correction combined with preventive dental care plays a critical role in reducing periodontal disease burden.

The study additionally established associations between socioeconomic characteristics and oral health status. Participants with inadequate health awareness, irregular dental attendance, smoking habits, and poor nutritional practices exhibited more severe periodontal destruction regardless of age group. Such findings confirm the multifactorial nature of periodontal pathology and underline the necessity of comprehensive preventive strategies involving both medical and social interventions.

4. Discussion

The results of the present study confirm the significant influence of groundwater quality on periodontal health status. Mineral imbalance and environmental contamination appear to contribute to chronic inflammatory changes in periodontal tissues. Deficiency of essential minerals such as fluoride and calcium may impair mineralization processes and weaken local protective mechanisms within the oral cavity.

The findings are consistent with previous epidemiological studies demonstrating higher prevalence of periodontal diseases in environmentally unfavorable regions. Chronic consumption of groundwater with elevated nitrate concentration may negatively affect vascular and immune functions, thereby increasing susceptibility to inflammatory periodontal lesions. Furthermore, excessive water hardness can influence salivary composition and oral microbial balance.

The preventive program implemented during the study proved effective in improving clinical periodontal indicators. Oral hygiene education significantly increased patient awareness and motivation toward proper dental care. Professional dental cleaning contributed to reduction of plaque accumulation and gingival inflammation. These findings emphasize the importance of preventive dentistry in controlling chronic periodontal pathology.

An important aspect of the study involves integration of environmental health measures into oral disease prevention programs. Monitoring groundwater quality and implementing filtration technologies may reduce long-term exposure to harmful chemical substances. Public health authorities should therefore consider environmental risk factors when designing oral healthcare strategies for rural populations.

The study also highlights the role of socioeconomic and behavioral determinants in periodontal disease progression. Individuals with inadequate oral hygiene practices and irregular dental visits demonstrated worse periodontal outcomes. Comprehensive prevention should therefore combine clinical, educational, and environmental interventions to achieve sustainable oral health improvement. Despite the significant findings, certain limitations should be acknowledged. The study involved a limited regional population and relatively short follow-up duration. Additional multicenter longitudinal studies are necessary to evaluate long-term effectiveness of preventive strategies and establish stronger causal relationships between groundwater composition and periodontal disease development.

5. Conclusion

The conducted clinical and epidemiological evaluation demonstrated that groundwater quality significantly influences periodontal health status among the population. Consumption of groundwater with imbalanced mineral composition and elevated contamination levels is associated with increased prevalence and severity of periodontal diseases. Preventive programs including professional oral hygiene, educational interventions, fluoride-containing products, and environmental monitoring showed high effectiveness in reducing inflammatory periodontal manifestations and improving oral health indicators.

Comprehensive preventive measures involving professional oral hygiene procedures, patient education, dietary recommendations, and improvement of drinking water quality proved highly effective in reducing periodontal inflammation and enhancing oral health indicators. Regular monitoring of groundwater composition combined with preventive dental programs may substantially decrease periodontal disease burden among populations living in environmentally vulnerable regions. The study emphasizes the importance of integrating ecological safety and preventive dentistry into public healthcare strategies. Early identification of environmental risk factors, promotion of healthy oral hygiene behavior, and implementation of community-based preventive interventions can contribute to preservation of periodontal health and improvement of overall quality of life.

References

- [1] Petersen PE, Ogawa H. The global burden of periodontal disease: towards integration with chronic disease prevention and control. *Periodontol* 2000. 2012;60(1):15–39.
- [2] Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. *Nat Rev Dis Primers*. 2017;3:17038.
- [3] Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention.

Int J Health Sci. 2017;11(2):72–80.

[4] Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. *Lancet*. 2005;366(9499):1809–1820.

[5] Chapple ILC, Mealey BL, Van Dyke TE, et al. Periodontal health and gingival diseases and conditions. *J Periodontol*. 2018;89(Suppl 1):S74–S84.

[6] Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis. *J Periodontol*. 2018;89(Suppl 1):S159–S172.

[7] World Health Organization. Oral health fact sheet. Geneva: WHO; 2025.

[8] Slots J. Periodontitis: facts, fallacies and the future. *Periodontol 2000*. 2017;75(1):7–23.

[9] Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. *Lancet*. 2019;394(10194):249–260.

[10] Fawell J, Bailey K, Chilton J, et al. Fluoride in drinking-water. Geneva: WHO; 2006.

[11] Kumar JV. Is water fluoridation still necessary? *Adv Dent Res*. 2008;20(1):8–12.

[12] Burt BA, Eklund SA. *Dentistry, dental practice, and the community*. 6th ed. Elsevier; 2005.

[13] Fejerskov O, Nyvad B, Kidd E. *Dental caries: the disease and its clinical management*. 3rd ed. Wiley Blackwell; 2015.

[14] Eke PI, Thornton-Evans GO, Wei L, et al. Periodontitis in adults in the United States. *J Am Dent Assoc*. 2018;149(7):576–588.

[15] Sampaio FC, Levy SM. Systemic fluoride and periodontal health. *Community Dent Oral Epidemiol*. 2011;39(6):555–567.

[16] Watt RG, Daly B, Allison P, et al. Ending the neglect of global oral health. *Lancet*. 2019;394(10194):261–272.

[17] Petersen PE. Strengthening the prevention of periodontal disease. *Int Dent J*. 2005;55(4 Suppl 1):285–291.

[18] American Academy of Periodontology. Comprehensive periodontal therapy guidelines. *J Periodontol*. 2011;82(7):943–949.

[19] Med1.uz. Parodontal kasalliklar va ularning profilaktikasi. Available from: <https://med1.uz/articles/stomatologiya/p-arodont>



Indexed & Abstracted In

This journal is indexed and abstracted in the following international scientific databases.



Google Scholar



ISSN



ORCID



CiteFactor



ResearchBib



DOI



Zenodo



Article Verification

Scan the QR code to verify the authenticity of this article

DOI: 10.4103/aams.0498



Grammarly