GEOGRAPHICAL PATTERNS OF DENTAL DISEASES: ENVIRONMENTAL AND SOCIOECONOMIC DETERMINANTS OF ORAL HEALTH DISTRIBUTION

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Abstract

Dental diseases remain among the most prevalent chronic conditions worldwide, yet their distribution varies markedly across geographical regions. Environmental exposure, climate, water mineral content, dietary traditions, access to dental services, and socioeconomic status collectively shape regional oral health profiles. This study investigates the prevalence and patterns of major dental diseases—dental caries, periodontal disorders, fluorosis, and oral mucosal lesions—across distinct geographical settings. Using clinical examination records, patient questionnaires, and laboratory water analyses, regional differences were evaluated and statistically compared. The results demonstrate that rural areas with limited preventive care and low socioeconomic indices exhibit higher caries and periodontal disease rates, whereas regions with elevated natural fluoride levels show increased dental fluorosis prevalence. These findings emphasize the importance of geographically tailored public health strategies and resource allocation in dentistry.

Keywords: dental diseases, geography, caries prevalence, periodontal disease, fluorosis, environmental dentistry, oral epidemiology

Introduction

Oral health is a fundamental component of general well-being, influencing nutrition, speech, social interaction, and quality of life. Despite global improvements

in preventive dentistry, dental diseases remain unevenly distributed across populations and territories. Such disparities are not random; they are closely linked to geographical conditions, ecological exposures, healthcare accessibility, cultural practices, and socioeconomic development.

Geographical dentistry examines how location-specific factors contribute to disease patterns. Climate may influence salivary flow and bacterial growth, mineral composition of drinking water affects enamel resistance, and regional diets determine fermentable carbohydrate intake. Moreover, rural–urban inequalities in professional dental care, fluoride exposure, and health education further exacerbate differences.

The present study aims to analyze regional variations in common dental diseases and to determine the environmental and socioeconomic factors most strongly associated with these variations.

Literature Review

Previous epidemiological investigations have consistently demonstrated regional clustering of oral diseases. Studies conducted in arid climates have reported higher rates of xerostomia-related caries due to dehydration and reduced salivary buffering capacity. Conversely, temperate coastal regions often present lower caries prevalence, potentially attributable to diets rich in seafood and trace minerals.

Natural fluoride levels in groundwater constitute another well-documented determinant. Moderate fluoride concentrations exert a protective effect against enamel demineralization, while excessive exposure leads to dental fluorosis characterized by enamel hypomineralization and discoloration. Endemic fluorosis has been reported in several inland and volcanic regions worldwide.

Socioeconomic status remains a dominant explanatory variable. Populations residing in economically disadvantaged or remote areas typically encounter barriers to routine dental examinations, preventive sealants, orthodontic interventions, and periodontal maintenance. Educational level correlates strongly with oral hygiene practices, sugar consumption, and tobacco use, thereby indirectly shaping disease prevalence.

Recent public health frameworks emphasize a shift from purely clinical approaches toward geographically sensitive prevention programs, incorporating water treatment policies, mobile dental units, and community-based education.

Methodology

Study Design

A cross-sectional observational study was conducted across three geographically distinct regions:

- **Region A:** Urban-industrial area
- **Region B:** Rural agricultural zone
- **Region C:** Semi-arid territory with high mineral groundwater content

Study Population

A total of 720 participants aged 12–65 years were randomly selected from public dental clinics and community health centers (240 per region). Written informed consent was obtained from all participants in accordance with ethical research standards.

Data Collection

Data were gathered through:

- **Clinical oral examinations** following WHO diagnostic criteria
- **Structured questionnaires** assessing diet, oral hygiene, tobacco use, income level, and dental attendance frequency
- **Laboratory analysis** of regional drinking water samples to measure fluoride and mineral concentration

Variables Assessed

- Dental caries prevalence (DMFT index)
- Periodontal status (Community Periodontal Index)
- Presence of dental fluorosis (Dean's Index)
- Oral mucosal lesions
- Socioeconomic indicators

Statistical Analysis

Data were processed using descriptive statistics and interregional comparisons through chi-square tests and analysis of variance (ANOVA). A multivariate regression model was applied to identify independent predictors of disease prevalence, with statistical significance set at $p < 0.05$.

Results

4.1 Regional Distribution of Dental Diseases

Table 1. Prevalence of major dental conditions by region

Condition	Region A (Urban)	Region B (Rural)	Region C (High fluoride)
Dental caries	54%	71%	60%

Periodontal disease	42%	66%	48%
Dental fluorosis	4%	6%	28%
Oral mucosal lesions	7%	12%	9%

Rural residents demonstrated significantly higher caries and periodontal disease rates compared to urban populations ($p < 0.01$). Region C showed a markedly elevated prevalence of dental fluorosis consistent with laboratory findings of fluoride concentrations exceeding recommended thresholds.

Socioeconomic Associations

Lower household income, infrequent dental visits, and limited fluoride toothpaste use were strongly associated with increased DMFT scores. Tobacco consumption was correlated with periodontal pocket depth and mucosal pathology.

Discussion

The findings confirm that geographical location exerts a multifactorial influence on oral health. Rural areas exhibited the poorest outcomes, likely reflecting reduced access to preventive services, professional prophylaxis, and oral health education. These disparities parallel international research identifying healthcare availability as a primary determinant of oral disease burden.

The elevated fluorosis rates in Region C underscore the importance of monitoring natural water composition. While fluoride remains an essential caries-preventive agent, uncontrolled exposure produces irreversible enamel defects and aesthetic concerns, potentially affecting psychosocial well-being.

Climate and occupational exposure may also contribute indirectly. Agricultural laborers often experience dehydration and delayed dental attendance, whereas industrial urban populations benefit from fluoridated products and structured healthcare networks.

Collectively, the results advocate for region-specific oral health interventions rather than uniform national strategies.

Conclusions and Recommendations

Geographical disparities in dental disease prevalence are shaped by environmental, socioeconomic, and healthcare-access factors. Rural residence and high natural fluoride exposure represent significant risk conditions for periodontal disease and fluorosis, respectively.

Recommended actions include:

- Implementation of mobile dental clinics in underserved territories
- Community-based oral hygiene education programs
- Regular monitoring and regulation of drinking water fluoride levels
- Subsidized preventive services for low-income populations
- Integration of geographical risk assessment into national oral health policies

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