



Review

Burden of dental caries of permanent teeth among children aged 5-14 years in Southeastern European countries, 1990-2023

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Abstract

Aim: The aim of this analysis was to assess long-term trends in the burden of caries of permanent teeth among Albanian children aged 5-14 years from 1990 to 2023 and to compare national patterns with those observed in Southeastern European (SEE) countries.

Methods: This analysis was based on secondary data from the Global Burden of Disease (GBD) 2023 study. Disability-adjusted life years (DALYs) per 100,000 were extracted for Albania and other SEE countries. Trends over time were assessed for the period 1990-2023, including sex-specific patterns for Albania. Relative percentage changes were calculated to assess overall temporal variation.

Results: In Albania, the overall burden of caries of permanent teeth among children aged 5-14 years declined from 29.0 in 1990 to 26.3 in 2023 (DALYs per 100,000), representing a 9.3% reduction. A modest increase was observed during the 1990s, followed by a gradual decline thereafter. Girls consistently experienced a higher burden than boys throughout the study period. Compared with neighbouring countries, Albania exhibited one of the smallest relative reductions. Across SEE region, all countries demonstrated overall declines, although with varying magnitude, with Bosnia and Herzegovina and Serbia showing the largest reductions.

Conclusion: Despite overall improvements, the burden of dental caries in Albanian children remains substantial and displays slower progress compared with several countries in SEE region, highlighting the need for strengthened preventive strategies and equitable access to oral healthcare.

Keywords: Albania, caries, children, Global Burden of Disease (GBD), permanent teeth, oral health, Southeastern Europe.

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Data availability: All relevant data are publicly available at:

<https://vizhub.healthdata.org/gbd-results/>.

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Introduction

Dental caries remains the most common chronic oral disease worldwide and constitutes a major public health challenge across the life course, affecting individuals from childhood to old age (1-3). Despite being largely preventable, untreated dental caries affects billions of people and continues to impose a substantial burden on individuals, health systems, and societies (1-3), through pain (1), functional limitations (1), reduced quality of life (1,4), educational losses among children (2,5), and increased healthcare expenditures (1,2).

Globally, untreated caries of permanent teeth has consistently ranked as the most prevalent condition among oral diseases in successive Global Burden of Disease (GBD) studies (1,3,6). Recent estimates indicate that more than two billion people worldwide are affected by untreated caries of permanent teeth, highlighting the persistent need for effective prevention and timely treatment despite advances in oral healthcare (7). The global age-standardised prevalence of untreated dental caries of permanent teeth is estimated at 27,500 (95%CI=24,000-32,000) per 100,000 population (7).

Childhood represents a critical period for the prevention of dental caries because permanent teeth erupt during the school-age years and oral health behaviours established in childhood frequently persist into adulthood (1,2). Untreated caries during childhood may cause pain, infection, impaired mastication, sleep disturbances, school absenteeism, and diminished quality of life, thereby affecting children's physical, psychological, and social development (1,2,4,5,8).

The burden of dental caries is unequally distributed across countries and population groups (7). Although many high-income countries have experienced substantial improvements in oral health through widespread exposure to fluoride, preventive dental programmes, and improved access to oral healthcare, important socioeconomic and geographic inequalities persist both between and within countries (1,2,9). These disparities reflect differences in income, education, health system performance, dietary patterns, oral hygiene practices, and access to preventive and restorative dental services (9).

The GBD study provides the most comprehensive and internationally comparable estimates of disease burden by integrating multiple epidemiological data sources through standardized statistical modelling (10). In addition to estimating prevalence and incidence, the GBD quantifies health loss using disability-adjusted life years (DALYs), thereby allowing comparisons across diseases, populations, countries, and time (10). Consequently, GBD estimates have become an important resource for monitoring oral health at global, regional, and national levels (6,10).

Although several studies have described the global epidemiology and temporal trends of dental caries using GBD data, evidence focusing on Southeastern Europe (SEE) remains limited, particularly for Albania. Likewise, comprehensive analyses of long-term trends in the burden of permanent tooth caries among Albanian children are scarce.

In this context, the aim of this study was to assess temporal trends in the burden of caries of permanent teeth among Albanian children aged 5-14 years between 1990 and 2023 using GBD 2023 estimates. In addition, the study compared Albania with six other SEE countries to place



national trends within a regional context and to identify similarities and differences in the evolution of disease burden over the past three decades.

Methods

Study design and data source

This was a descriptive analysis based on secondary data obtained from the GBD Study 2023 (11). The GBD study, coordinated by the Institute for Health Metrics and Evaluation (IHME: <https://www.healthdata.org/>), provides standardized estimates of disease burden for countries and territories worldwide using a comprehensive analytical framework that synthesizes multiple data sources through statistical modelling (11,12).

Data on the burden of caries of permanent teeth were extracted for Albania and six other Southeastern European (SEE) countries: Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, Serbia, and Slovenia. Estimates were obtained for the period 1990-2023.

Outcome measure

The outcome of interest consisted of the burden of caries of permanent teeth, as defined according to the GBD cause hierarchy and modelled using standardized epidemiological methods (12).

The burden of caries of permanent teeth among children aged 5-14 years was expressed as DALYs per 100,000. DALYs quantify the overall health loss attributable to a disease by combining years of life lost due to premature mortality and years lived with disability (11,12). Because dental caries of permanent teeth is a non-fatal condition, the DALY estimates essentially reflect years lived with disability (YLDs) (11,12).

Age-specific DALY rates were extracted for all children aged 5-14 years combined and separately for boys and girls in Albania.

For the cross-country comparisons, overall DALY rates for children aged 5-14 years were obtained for each SEE country.

Statistical analysis

A descriptive trend analysis was conducted to examine changes in the burden of caries of permanent teeth over the study period. DALY rates were summarized at selected time points (1990, 2000, 2010, 2020, and 2023) to facilitate temporal and between-country comparisons.

For Albania, sex-specific trends were examined by comparing DALY rates among boys and girls over time. Relative percentage changes between 1990 and 2023 were also calculated for Albania.

For the cross-country analysis, total percentage changes in DALY rates between 1990 and 2023 were compared across the seven SEE countries using the estimates provided by the GBD Study. The GBD reports all estimates together with 95% uncertainty intervals (95% UIs), which reflect uncertainty arising from data availability, measurement error, model specification, and



parameter estimation (11,12). Changes were considered statistically robust when the corresponding 95% UI did not include zero.

Results

Table 1 presents the burden of caries of permanent teeth (DALYs per 100,000) among Albanian children aged 5-14 years during the period 1990-2023. The burden of caries of permanent teeth among Albanian children aged 5-14 years exhibited a gradual decline over the study period. However, the caries burden increased slightly during the 1990s, from 29.0 in 1990 to 29.6 in 2000 (DALYs per 100,000), before beginning a sustained downward trend. By 2023, the caries burden among Albanian children aged 5-14 years had declined to 26.3 DALYs per 100,000, representing a relative reduction of 9.3% compared with 1990.

Sex-specific analyses revealed consistently higher caries burden among girls than boys throughout the study period. Among Albanian boys aged 5-14 years, the caries burden increased modestly from 28.2 in 1990 to 28.9 in 2000 (DALYs per 100,000), followed by a continuous decline to 25.6 DALYs per 100,000 in 2023, corresponding to a relative decrease of 9.2%. Among girls, the caries burden remained relatively stable at around 30 DALYs per 100,000 during the 1990s and early 2000s, peaking at 30.4 DALYs per 100,000 in 2005, before declining steadily to 27.1 DALYs per 100,000 in 2023, with an overall relative reduction of 9.7%.

Figure 1. Burden of caries of permanent teeth (DALYs per 100,000) among Albanian children aged 5-14 years during 1990-2023 (11)

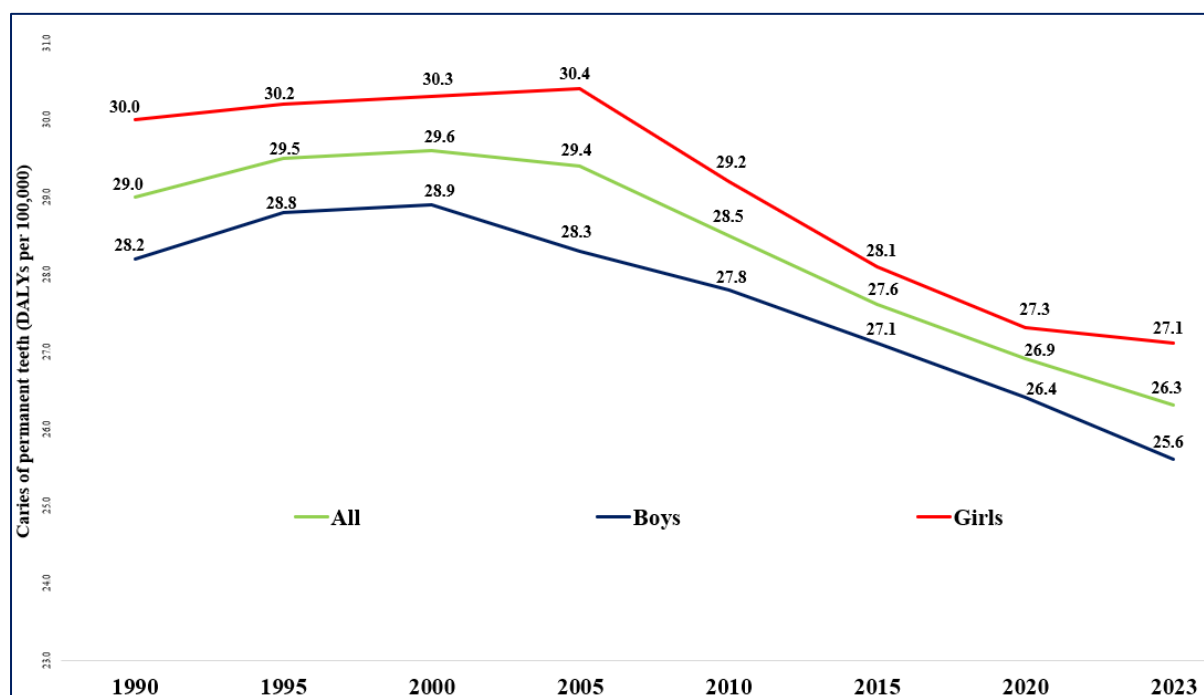




Table 1 presents the burden of caries of permanent teeth (DALYs per 100,000) among children aged 5-14 years in SEE countries during the period 1990-2023. Overall, all SEE countries experienced a decline in caries burden over the study period, although the magnitude and timing of the reductions varied considerably.

In 1990, Albania had one of the lowest burdens in the region, with 29 DALYs per 100,000, second only to Slovenia (approximately 27 DALYs per 100,000). In contrast, Bosnia and Herzegovina followed by Croatia recorded the highest burden in 1990 (with about 40 DALYs per 100,000).

By 2000, substantial reductions had occurred across most countries. Albania remained virtually unchanged (29.6 DALYs per 100,000), whereas Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, and Serbia experienced marked declines, converging to approximately 29-34 DALYs per 100,000. Slovenia maintained the lowest burden in the region (22.3 DALYs per 100,000).

Table 1. Overall burden of caries of permanent teeth (DALYs per 100,000) among children aged 5-14 years in Southeastern European countries during 1990-2023 (11)

Year	Albania	Bosnia and Herzegovina	Croatia	Montenegro	North Macedonia	Serbia	Slovenia
1990	29.0	40.0	39.5	38.3	38.2	38.5	27.4
2000	29.6	33.6	30.6	30.0	29.6	29.4	22.3
2010	28.5	28.1	37.6	28.3	28.2	30.3	24.7
2020	26.9	26.0	27.9	27.2	26.4	25.1	23.3
2023	26.3	25.8	27.6	26.5	26.3	24.7	23.6

Between 2000 and 2010, trends diverged. Albania continued to show a modest decline to 28.5 DALYs per 100,000, whereas Bosnia and Herzegovina, Montenegro, and North Macedonia also experienced continued improvements. In contrast, Croatia showed a notable increase, from 30.6 to 37.6 DALYs per 100,000, becoming the country with the highest burden in the region in 2010. Serbia also experienced a slight increase during this period, from 29.4 to 30.3 DALYs per 100,000, whereas Slovenia showed a small increase but continued to have the lowest burden overall.

By 2020, the burden had declined further in all countries. Albania reached 26.9 DALYs per 100,000, similar to Montenegro and North Macedonia (27.2 and 26.4 DALYs per 100,000, respectively), whereas Bosnia and Herzegovina declined to 26.0 DALYs per 100,000. Serbia recorded a comparatively lower burden (25.1 DALYs per 100,000), whereas Slovenia continued to report the lowest regional estimate (23.3 DALYs per 100,000). Croatia also demonstrated a substantial improvement from its 2010 peak, decreasing to 27.9 DALYs per 100,000.

In 2023, country differences narrowed considerably. Albania and North Macedonia reported identical estimates (26.3 DALYs per 100,000), whereas Montenegro and Bosnia and Herzegovina displayed similar levels (26.5 and 25.8 DALYs per 100,000, respectively). Serbia had the second-lowest burden (24.7 DALYs per 100,000), and Slovenia consistently



maintained the lowest burden throughout the study period (23.6 DALYs per 100,000). Croatia, despite substantial improvements since 2010, continued to have the highest burden among the seven SEE countries in 2023 (27.6 DALYs per 100,000).

Table 2 presents the total percentage change in the burden of caries of permanent teeth among children aged 5-14 years in SEE countries between 1990 and 2023. Overall, all SEE countries experienced reductions in the burden over the study period, although the magnitude of decline varied considerably.

The largest reductions were observed in Bosnia and Herzegovina and Serbia, both showing an overall 36% decrease in DALYs. These were followed by Montenegro and North Macedonia, each with a 31% reduction, and next Croatia, with a 30% reduction. In contrast, Slovenia and Albania experienced the smallest declines, amounting to 14% and 9%, respectively.

Table 2. Total percentage change in the burden of caries of permanent teeth among children aged 5-14 years in Southeastern European countries from 1990 to 2023 (11)

Country	Total percentage change (1990-2023)	95% uncertainty interval (95% UI)
Albania	-0.09	from -0.18 to 0.00
Bosnia and Herzegovina	-0.36	from -0.50 to -0.19
Croatia	-0.30	from -0.46 to -0.15
Montenegro	-0.31	from -0.48 to -0.16
North Macedonia	-0.31	from -0.47 to -0.17
Serbia	-0.36	from -0.54 to -0.22
Slovenia	-0.14	from -0.37 to 0.04

The 95% UIs indicated that the reductions were statistically robust for most countries, as the intervals lay entirely below zero. Specifically, Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, and Serbia all demonstrated clear evidence of declining disease burden over time. By contrast, the UIs for Albania and Slovenia included zero, indicating that the estimated reductions in these two countries have been comparatively modest and should be interpreted with greater caution.

Discussion

Findings from this analysis indicate a gradual improvement in oral health in Albanian children over the past two decades. However, notwithstanding the decrease in the burden of permanent tooth caries in both sexes after the mid-2000s, the sex gap remained remarkably stable, with girls consistently experiencing a caries burden approximately 1.5 DALYs per 100,000 higher than boys across the entire 1990-2023 period. Therefore, there is evidence suggesting steady improvements over the past two decades in Albania, while also indicating persistent sex-related differences in the burden of permanent dental caries.

Regarding the cross-country comparisons, overall, the findings indicate a regional decline in the burden of permanent tooth caries over the past three decades. Albania consistently remained



among the countries with the lowest burden throughout the study period, although its rate of improvement was more gradual than that observed in several neighbouring countries. By 2023, differences between countries had become relatively small, suggesting a convergence in the regional burden of permanent tooth caries among children.

Furthermore, although the burden of permanent tooth caries declined across all SEE countries between 1990 and 2023, the pace of improvement differed substantially between countries. Albania showed the smallest relative reduction in the region (9%), indicating slower progress compared with its neighbouring countries.

The observed burden of caries of permanent teeth among children appears broadly consistent with global patterns reported in high-income and upper-middle-income settings (6,10,13). In many high-income countries, substantial reductions in dental caries have been achieved over recent decades, largely attributed to widespread fluoride exposure, school-based preventive programmes, and improved access to dental care services (13-15). However, these countries have also reached a plateau phase in recent years, with relatively modest further declines in caries burden (6,7). In comparison, Albania's relatively low but slowly improving burden suggests a transitional profile, where overall levels are comparable to several higher-income settings, but progress is more gradual and less pronounced than in countries that implemented earlier and more comprehensive preventive strategies (1,6,13). Moreover, the persistence of sex differences and the limited magnitude of reduction further align Albania with settings where preventive coverage and behavioural determinants of oral health remain suboptimal (1,9), underscoring the need to strengthen population-level prevention and equitable access to oral healthcare (2).

Nonetheless, given the reliance on modelled GBD estimates and ecological data, there is need for further analyses providing more granular and country-specific evidence to capture heterogeneity and inequalities (17), thereby informing targeted interventions for addressing the burden of caries and other oral health issues in Albania and other SEE countries.

The World Health Organization (WHO) has recognized oral diseases as a global public health priority and has called for integrating oral health into universal health coverage and broader noncommunicable disease strategies (2,16). Monitoring trends in the burden of oral diseases is therefore essential for evaluating progress, identifying inequalities, and informing evidence-based policies and resource allocation (2,16).

Conclusion

This analysis provides a comprehensive assessment of long-term trends in the burden of caries of permanent teeth among Albanian children aged 5-14 years using estimates from the GBD 2023 study and places the national findings within a SEE context. Overall, findings indicate a modest but sustained decline in the burden of permanent tooth caries in Albania between 1990 and 2023, with a relative reduction of approximately 9%. Although Albania consistently exhibited one of the lowest DALY rates in the region throughout the study period, the magnitude of improvement was smaller than that observed in most neighbouring countries,



particularly Bosnia and Herzegovina and Serbia. Furthermore, Albanian girls consistently experienced a slightly higher burden than boys across the entire study period.

These findings suggest that, despite overall progress in reducing the burden of dental caries, further improvements in preventive oral health services, early detection, and equitable access to dental care are needed to accelerate progress and reduce persistent sex-related disparities among Albanian children.

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