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Dental caries burden and associated factors among 5–15-year-old children in Başkale, Van: a retrospective cross-sectional study

Adem YAĞAN

admygn@icloud.com

Van Yüzüncü Yıl University

Burak Resul ÇİFTÇİ

Emir YAĞAN

Adem CANAN

Bilal ARSLAN

Van Yüzüncü Yıl University

Research Article

Keywords: Dental caries, child health, school screening, rural health, Turkey

Posted Date: March 16th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8472034/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Dental caries is one of the most common chronic conditions in childhood, with significant impacts on children's quality of life and health systems. Evidence from disadvantaged rural areas remains limited. This study aimed to quantify the burden of dental caries and associated factors among school-aged children in Başkale district, Van, Türkiye.

Methods

A retrospective cross-sectional analysis was conducted using records from the 2024–2025 national school screening program. A total of 4,996 children aged 5–15 years were included after excluding incomplete records. Data on age, sex, residence, body mass index (BMI), and comorbid conditions (gingivitis, tonsillitis, orthodontic problems) were extracted. Dental caries was assessed clinically as the number of decayed teeth. Statistical analyses included t-tests, one-way ANOVA, chi-square tests, and correlation analysis.

Results

Overall, 91.9% of children had at least one carious tooth, with a mean of 4.31 ± 3.03 caries per child. Caries prevalence decreased with age (93.9% in 5–8 years vs. 83.5% in 13–15 years, $p < 0.001$). Boys had higher mean caries counts than girls (4.49 vs. 4.11, $p < 0.001$). Rural children had more caries than urban peers (4.43 vs. 3.99, $p < 0.001$). BMI was inversely correlated with caries ($\rho = -0.173$, $p < 0.001$). Children with tonsillitis (mean 8.52) and gingivitis (mean 6.90) had significantly higher caries counts compared to those without comorbidities (mean 3.49, $p < 0.001$).

Conclusion

Dental caries burden among children in Başkale is alarmingly high, particularly in younger age groups and rural settings. Findings highlight the urgent need for integrated, school-based preventive strategies, including supervised toothbrushing, improved access to fluoride toothpaste, parental and teacher education, and strengthened referral pathways in rural areas.

INTRODUCTION

Dental caries is a major public health concern worldwide due to its high prevalence and lifelong consequences (1). The World Health Organization (WHO) emphasizes that oral diseases are largely preventable yet remain highly prevalent, particularly dental caries in childhood, which is among the most common conditions. WHO further recommends strengthening oral health in alignment with universal

health coverage goals and expanding community- and school-based preventive approaches (1, 2). From a primary care perspective, WONCA's concept of "comprehensive care" provides a framework that supports the integration of oral health into school and primary care services (3).

In childhood, dental caries negatively affects individual quality of life through pain, infection, difficulties in nutrition, sleep disturbances, and school absenteeism, while also imposing an economic burden on families and the health system due to treatment needs. Therefore, monitoring both the "frequency" and "severity" dimensions of caries burden is critical for planning preventive programs at the local level (1–3). School-based cross-sectional screenings, particularly in large samples, stand out as a practical approach to making the caries burden visible and identifying high-risk groups (4–6).

Studies conducted among school-aged children in different countries have reported that the burden of dental caries can be high and may show patterns associated with variables such as age, sex, place of residence, and socioeconomic conditions. A cross-sectional study among schoolchildren in Tripoli, Libya highlighted the high prevalence of caries and the importance of associated factors (4). Similarly, studies conducted in rural and highland regions of Vietnam demonstrated that rural conditions and behavioral/social determinants may be linked to caries burden (5, 6). A study among school adolescents in Uganda also revealed the widespread occurrence of caries and its associated factors (7).

Systematic reviews and meta-analyses have shown that the burden of dental caries varies widely across regions and that the need for surveillance remains particularly strong in disadvantaged and rural populations. A systematic review and meta-analysis on the prevalence of permanent tooth caries among 12-year-olds in Africa indicated a substantial burden across the continent (8). Similarly, a systematic review and meta-analysis focusing on schoolchildren in Libya highlighted the high burden and the necessity for continued monitoring (9).

In Türkiye, studies have also reported a substantial burden of dental caries among both school-aged and preschool children, with patterns linked to oral hygiene behaviors, socioeconomic factors, and access to services (10–12). The present retrospective, analytical cross-sectional evaluation, based on records from the 2024–2025 National School Screening Program in Başkale district of Van province, represents the first study to quantitatively document the caries burden in a rural district of Türkiye using national school screening data, to provide quantitative evidence on dental caries burden in this context.

METHODS

Study design and setting: This retrospective, cross-sectional analytical study used routine records from the national school screening program conducted during the 2024–2025 academic year in Başkale district, Van province, Türkiye. Screening examinations were carried out in the school setting as part of routine service delivery.

Data source: Data were extracted from the standardized school screening forms used by the Başkale District Health Directorate. The forms included demographic information, anthropometric

measurements, and predefined clinical assessment fields. Although a section for hearing screening was included, these data were not consistently recorded and were therefore excluded from the analyses. All data were anonymized prior to analysis and contained no direct personal identifiers.

Study population and inclusion/exclusion criteria: A total of 5,036 screening records of children aged 5–15 years were reviewed. Records with missing or erroneously coded key variables (age, sex, place of residence, height, weight, and/or total number of decayed teeth [caries count]) were excluded (n=40), resulting in a final sample of 4,996 children.

Variables: The dependent variable was the total number of decayed teeth identified during clinical examination (caries count); no distinction was made between primary and permanent teeth. Independent variables included age, sex, place of residence (rural/urban), body mass index (BMI), and clinical conditions recorded in the screening forms (e.g., gingivitis, tonsillitis, orthodontic treatment need/severe malocclusion). Age was categorized into three groups: 5–8, 9–12, and 13–15 years.

Anthropometric measurements and BMI: BMI was calculated as weight (kg)/height (m)². Because the dataset did not include exact dates of birth (day/month/year), standardized BMI-for-age classification (z-scores/percentiles) could not be applied by age and sex. BMI was analyzed as a continuous variable; additionally, for descriptive purposes, it was presented in four categories to illustrate the sample distribution: <14.00, 14.00–15.99, 16.00–17.99, and ≥18.00 kg/m².

Oral examination and caries assessment: Caries assessment was based on the number of teeth recorded as decayed during the clinical examination conducted as part of the screening program (caries count). No distinction was made between primary and permanent teeth (dmft/DMFT), and no radiographic assessment was performed. Information on gingivitis and tonsillitis was obtained from the clinical condition fields of the screening forms.

Statistical analysis: Analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, and categorical variables were presented as counts and percentages. Independent samples t-tests were used for two-group comparisons, and one-way ANOVA was applied for comparisons across multiple groups. Categorical variables were evaluated using the chi-square test. The relationship between caries count and continuous variables was examined using Pearson's or Spearman's correlation analysis, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethics approval and permissions: Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Van Yüzüncü Yıl University (Decision No: 2025/02-17; Date: 11 March 2025). Institutional approval was obtained from the Van Provincial Health Directorate (Document No: E-50817530-771-278408566; Date: 28 May 2025). As this study involved retrospective review of anonymized records, the requirement for individual informed consent was waived.

RESULTS

A total of 4,996 students were included in the study, of whom 51.9% were male. The mean age of the students was 8.77 ± 2.53 years, and the mean BMI was 16.27 ± 2.62 kg/m². Overall, 72.4% of the participants lived in rural areas. At least one dental caries was detected in 91.9% of the students (n=4,590), with a mean caries count of 4.31 ± 3.03 (Table 1).

Table 1. Characteristics of study participants (N = 4,996)

Characteristic	Value
Age, years (mean ± SD)	8.77 ± 2.53
Sex, n (%)	Male: 2595 (51.9); Female: 2401 (48.1)
Place of residence, n (%)	Rural: 3618 (72.4); Urban: 1378 (27.6)
Body mass index (BMI), kg/m² (mean ± SD)	16.27 ± 2.62
Number of dental caries per child (mean ± SD)	4.31 ± 3.03
Dental caries prevalence (≥1 caries), n (%)	4590 (91.9)

Abbreviation: BMI, body mass index.

The distribution of dental caries is shown in Figure 1.

Age groups:

The prevalence of dental caries decreased with increasing age: 93.9% in the 5–8 age group, 91.5% in the 9–12 age group, and 83.5% in the 13–15 age group. The difference among age groups was statistically significant ($\chi^2(2) = 61.495$; $p < 0.001$). These findings are presented in Figure 2.

Gender:

The mean dental caries count was 4.49 ± 3.15 among male students and 4.11 ± 2.88 among female students. The difference between the groups was statistically significant ($p < 0.001$). These results are presented in Figure 3.

Place of residence:

The mean dental caries count was 4.43 ± 3.06 among children residing in rural areas and 3.99 ± 2.92 among those living in urban areas. The difference between the groups was statistically significant ($p < 0.001$). This comparison is presented in Figure 4.

BMI groups:

According to BMI categories, the mean dental caries counts were <14: 4.73, 14–15.99: 4.78, 16–17.99: 4.11, and ≥18: 3.26. A Spearman correlation analysis indicated a statistically significant negative

association between **BMI (kg/m², continuous)** and dental caries count (ρ = −0.173, p < 0.001). The findings are presented in Figure 5.

Caries burden by comorbidity group:

Mean dental caries count differed significantly across comorbidity groups. The mean count was 8.52 ± 2.84 in the tonsillitis group, 6.90 ± 3.47 in the gingivitis group, 6.12 ± 2.71 in the gingivitis plus orthodontic treatment need group, 3.57 ± 2.53 in the orthodontic treatment need/severe malocclusion group, and 3.49 ± 2.36 among children without comorbid conditions. One-way ANOVA confirmed a statistically significant difference among groups (p < 0.001). These findings are presented in Figure 6.

Vision status:

The mean dental caries count was 4.35 ± 3.05 in the normal vision group and 4.05 ± 2.89 in the visual impairment group. An independent samples t-test (Welch's t-test, assuming unequal variances) indicated a statistically significant difference between the groups (p = 0.007) (Table 2).

Table 2. Mean number of dental caries per child by selected characteristics (N = 4,996)

Variable	Category	n	Mean ± SD	Test / p-value
Sex	Male	2595	4.49 ± 3.15	t-test, p < 0.001
	Female	2401	4.11 ± 2.88	
Residence	Rural	3618	4.43 ± 3.06	t-test, p < 0.001
	Urban	1378	3.99 ± 2.92	
Vision status	Normal vision	4220	4.35 ± 3.05	t-test, p = 0.007
	Visual impairment	776	4.05 ± 2.89	
Orthopedic screening	Normal	4755	4.31 ± 3.04	t-test, p = 0.713
	Problem detected	241	4.24 ± 2.88	
BMI category (kg/m²)	<14	724	4.73 ± 3.22	One-way ANOVA, p < 0.001
	14-15.99	1976	4.78 ± 3.19	
	16-17.99	1357	4.11 ± 2.81	
	≥18	939	3.26 ± 2.51	
Comorbidity group	Tonsillitis	29	8.52 ± 2.84	One-way ANOVA, p < 0.001
	Gingivitis	1103	6.90 ± 3.47	
	Gingivitis + orthodontic treatment need	59	6.12 ± 2.71	
	Orthodontic treatment need / severe malocclusion	217	3.57 ± 2.53	
	Ectodermal dysplasia	1	1.00 ± —	
	No comorbidity	3587	3.49 ± 2.36	

Abbreviations: BMI, body mass index; SD, standard deviation. Two-group comparisons use independent samples t-test. Multi-group comparisons use one-way ANOVA. **Footnote:** *Ectodermal dysplasia is a group of (often inherited) disorders affecting ectoderm-derived tissues (e.g., teeth, hair, nails, sweat glands) and may present with dental anomalies such as missing or malformed teeth.*

DISCUSSION

Overall caries burden and regional interpretation: In this study, the prevalence of dental caries was 91.9% among children aged 5–15 years, with a mean caries count of 4.31 ± 3.03, indicating a substantial burden of childhood dental caries in Başkale. High prevalence rates have been reported in school-based studies, particularly in disadvantaged or rural settings across different countries (4–8,13). For example, a considerable caries burden among schoolchildren has been documented in rural/highland areas of Vietnam, and similarly high prevalence rates have been reported among schoolchildren in Libya (4–6). Studies focusing on preschool and school-aged children in Ethiopia have also underscored the magnitude of the caries burden (13,14). The high dental caries burden observed in Başkale is consistent with the global oral disease burden and inequalities emphasized by the World Health Organization (WHO). This pattern is comparable to those reported in vulnerable communities, particularly rural areas with limited access to transportation and scarce resources (1,2,5–8,13,14).

However, because caries was recorded as the “number of decayed teeth” rather than using the dmft/DMFT index, and no distinction was made between primary and permanent dentition, comparisons with national and international literature should be interpreted with caution (4,5,7,8,13,14). Nonetheless, the high prevalence and elevated mean caries count suggest a substantial—and largely preventable—disease burden in this population, even with these measurement limitations (1–3).

Age groups: Decline in prevalence with age

In our study, the prevalence of dental caries decreased from 93.9% in children aged 5–8 years to 83.5% in those aged 13–15 years. This reduction may partly reflect dentition changes: primary teeth, which are more susceptible to caries, are more prevalent at younger ages, and exfoliation or replacement of carious primary teeth may lower the recorded caries count over time. This pattern is consistent with studies reporting a high caries burden in preschool and younger age groups (15–17), including reports on early childhood caries among 3–5-year-olds in Tunisia and preschool children in Serbia (15,16). In addition, self-care skills, health literacy, and toothbrushing routines are expected to improve with age, and oral hygiene behaviors among school-aged children have been associated with caries outcomes (12,18). Findings from a study in Türkiye assessing diet and oral hygiene practices provide further support for this relationship (18). Finally, older children may be more likely to have received dental treatment in previous years, which could reduce the documented presence of untreated caries in screening records (2). From a public health perspective, these findings support prioritizing early, school-based preventive actions—such as supervised toothbrushing and fluoride-based interventions—particularly for younger children.

Gender: Higher caries counts among boys The higher mean caries count observed among male students may reflect behavioral and socio-cultural differences between genders. Evidence regarding the direction of this association is mixed across settings, and dietary habits, oral hygiene practices, and patterns of health service utilization may vary by gender (4–7,19). School-based studies in Vietnam and Libya have reported differing associations between gender and caries, while a study among primary school children in Japan suggested that gender differences should be interpreted alongside lifestyle indicators (4,5,19). From a public health perspective, this finding suggests that school health programs may benefit from reinforcing oral health education and follow-up activities among boys (1–3,11).

Residence: Higher caries burden in rural areas The higher mean caries count observed among children living in rural areas is consistent with the literature on oral health inequalities (1,2,8). Barriers such as limited access to dental services (geographic distance, transportation and appointment-related barriers), reduced availability of preventive services and practices, and lower levels of oral health literacy may contribute to an increased caries burden in rural settings. This pattern aligns with studies conducted in rural highland regions of Vietnam (5,6). Cross-sectional studies from Romania and Ghana have similarly reported higher childhood caries in rural or underserved areas, underscoring the need for community-based preventive programs (20,21). Field studies from rural Türkiye also provide national evidence supporting a substantial regional burden (10,12). In this study, rural–urban status was recorded simply as “village / district center,” limiting more detailed socioeconomic stratification. Nevertheless, the fact that even this simple classification yielded a significant difference suggests that disadvantaged groups should be prioritized in oral health interventions (1–3,8,9).

BMI and inverse association: Lower caries counts with higher BMI: The relationship between BMI and dental caries is context-sensitive and multifactorial: while higher sugar and energy intake may increase risk, lower BMI can also be associated with clusters of risk factors such as undernutrition and socioeconomic disadvantage (13,18). In our study, BMI-for-age percentiles could not be calculated due to the absence of exact birth date information; therefore, analyses relied on BMI (kg/m²) values, limiting interpretation because age-related variability during growth could not be accounted for (22). Accordingly, this finding should not be interpreted as a causal “protective effect,” but rather as an observed pattern that should be considered cautiously in relation to local nutritional and socioeconomic conditions and the study’s age distribution (1,2,13,22).

Comorbid conditions: Higher caries burden with tonsillitis and gingivitis The higher caries burden observed among children with tonsillitis and gingivitis recorded in the screening forms may reflect shared risk factors such as inadequate oral hygiene, plaque accumulation, and inflammation. A study examining the relationship between passive smoking exposure, periodontal findings, and caries in schoolchildren supports considering inflammatory oral conditions alongside caries; biomarker studies further suggest that the burden of oral infection and inflammation may relate to broader health contexts (23,24). The association between tonsillitis and caries may be linked to co-occurring factors, such as poorer oral hygiene, mouth breathing and xerostomia, and care-seeking patterns driven by symptoms. However, given the cross-sectional design, this finding should be interpreted cautiously as an indicator of

a potentially “high-risk subgroup” rather than a causal relationship (1–3). The absence of a significant association between orthodontic problems and caries may reflect heterogeneity in recording/measurement and differences in follow-up; therefore, this result should be interpreted in light of possible data inconsistencies (4–7).

Visual impairment and orthopedic condition: The lower mean caries count observed among children with visual impairment was small in magnitude and may reflect factors such as limited sample size, measurement bias, or greater contact with health services. However, because the dataset does not allow these mechanisms to be tested, this result should be interpreted cautiously. Similarly, the lack of a significant difference between orthopedic conditions and caries may be related to recording limitations and heterogeneity (4,5).

Implications for quality of life and service planning: The high prevalence observed in Başkale indicates not only a need for treatment but also a priority for interventions **to address** functional impairment and oral health–related quality of life (1,2,17,25). These findings also have implications for local service planning, including the scaling up of school-based prevention and referral pathways. A randomized controlled trial on early childhood caries (ECC) reported that **toothpaste-based approaches alone** were insufficient to prevent caries, underscoring the need for more effective, evidence-based, multi-component preventive strategies (26).

Methodological limitations and strengths:

This study, based on records from the national school screening program, benefits from its large sample size and reliance on real-world data, which provide valuable insights for local service planning. Nonetheless, several methodological limitations should be noted. Dental caries was documented solely as the number of decayed teeth rather than using the dmft/DMFT index, and no distinction was made between primary and permanent dentition; therefore, comparisons with national and international literature, as well as dentition-specific interpretations, must be approached with caution. Furthermore, the absence of key behavioral and preventive variables—such as toothbrushing frequency, sugar intake, dental visits, and fluoride use—restricted the ability to explore underlying mechanisms. Due to the lack of exact birth dates, BMI-for-age percentiles could not be calculated, and analyses relied on raw BMI (kg/m^2) values. In addition, multivariable modeling was not performed, limiting adjustment for potential confounders. Rural residence was classified in a binary manner (“village / district center”), which constrained more nuanced socioeconomic stratification. Despite these limitations, the very high prevalence observed and the consistent subgroup differences highlight the robustness of the findings and underscore the urgent need to strengthen local preventive oral health programs.

CONCLUSION

The caries burden among children aged 5–15 years in Başkale is very high. This situation, particularly pronounced in rural areas and younger age groups, represents an important public health priority. The findings indicate that school-based preventive approaches should be strengthened in close integration

with primary care. Priority actions should include supervised toothbrushing, oral health education, improved access to fluoride toothpaste, and the establishment of regular screening, follow-up, and referral mechanisms. High-risk schools in rural areas should be prioritized. For sustainable impact, oral health must be integrated into broader child health and education policies.

Declarations

Ethics approval and consent to participate:

This study was approved by the Non-Interventional Clinical Research Ethics Committee of Van Yuzuncu Yil University (Decision No: 2025/02-17; Date: 11 March 2025). Institutional permission was obtained from the Van Provincial Health Directorate (Document No: E-50817530-771-278408566; Date: 28 May 2025). As this was a retrospective record review, individual informed consent was not required. The study was conducted in accordance with the principles of the Helsinki Declaration.

Consent for publication:

All authors consent to the publication of this manuscript.

Availability of data and materials:

The datasets used and/or analysed during the current study are not publicly available due to institutional restrictions but are available from the corresponding author on reasonable request, subject to ethics committee approval and institutional permission.

Competing interests:

The authors declare no competing interests.

Funding:

This research received no external financial support. All costs of the study were covered by the authors.

Use of AI tools:

A large language model (ChatGPT, OpenAI) was employed in drafting and/or refining the code for the visualization of the authors' own dataset (figure formatting, labeling, and layout). All outputs were carefully reviewed, edited, and verified by the authors, who take full responsibility for the content. No generative AI was used to create or modify images.

Authors' contributions:

Adem Yağan: Study design, data analysis, manuscript writing, final approval.

Burak Resul Çiftçi: Data collection, field coordination, manuscript contribution.

Emir Yağan: Data collection, field implementation.

Adem Canan: Clinical evaluation, manuscript support.

Bilal Arslan: Clinical evaluation, manuscript support.

All authors contributed to the study and approved the final version.

Acknowledgements:

We thank all healthcare professionals involved in the national school screening program and the Van Provincial Health Directorate for their contributions.

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Figures

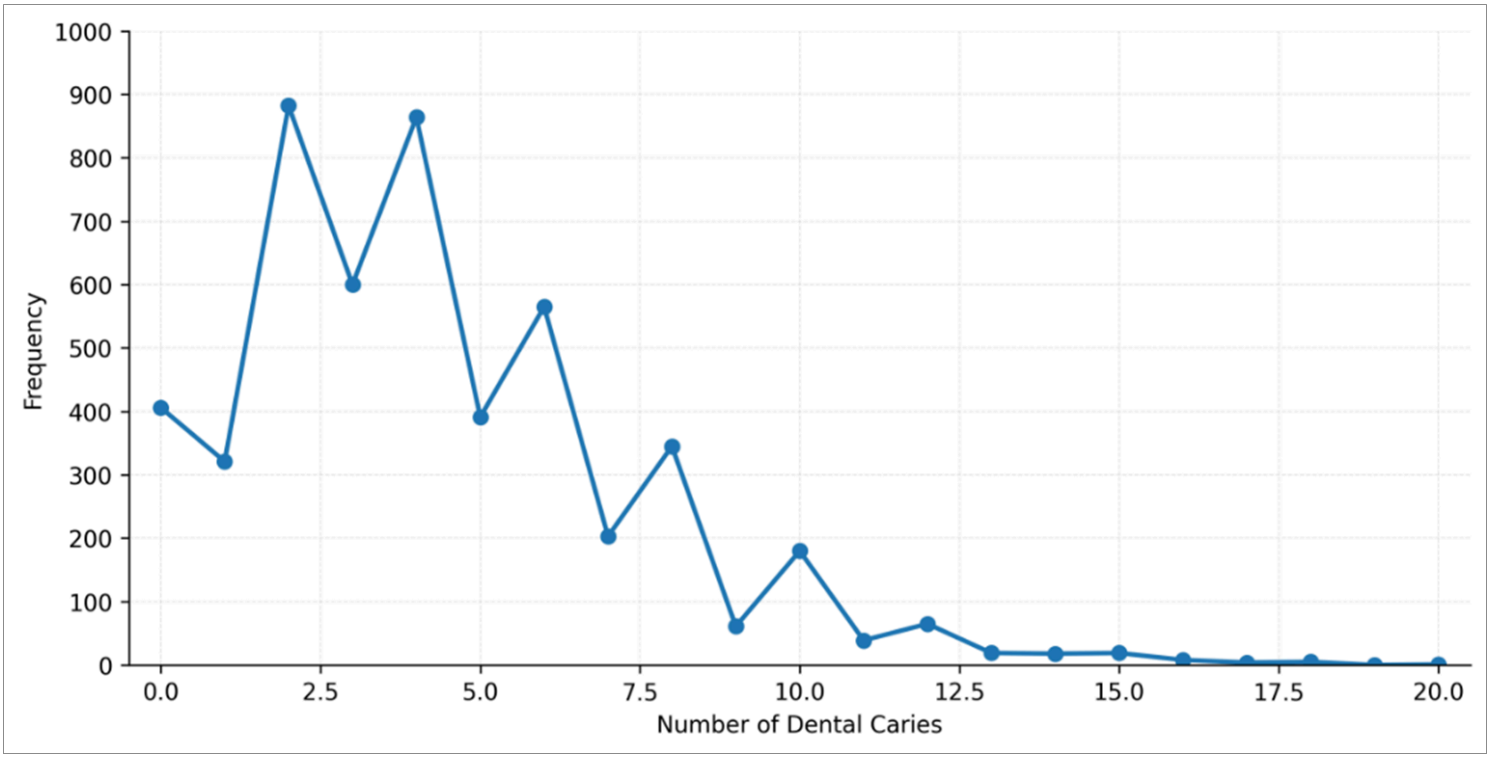


Figure 1

Distribution of the number of dental caries

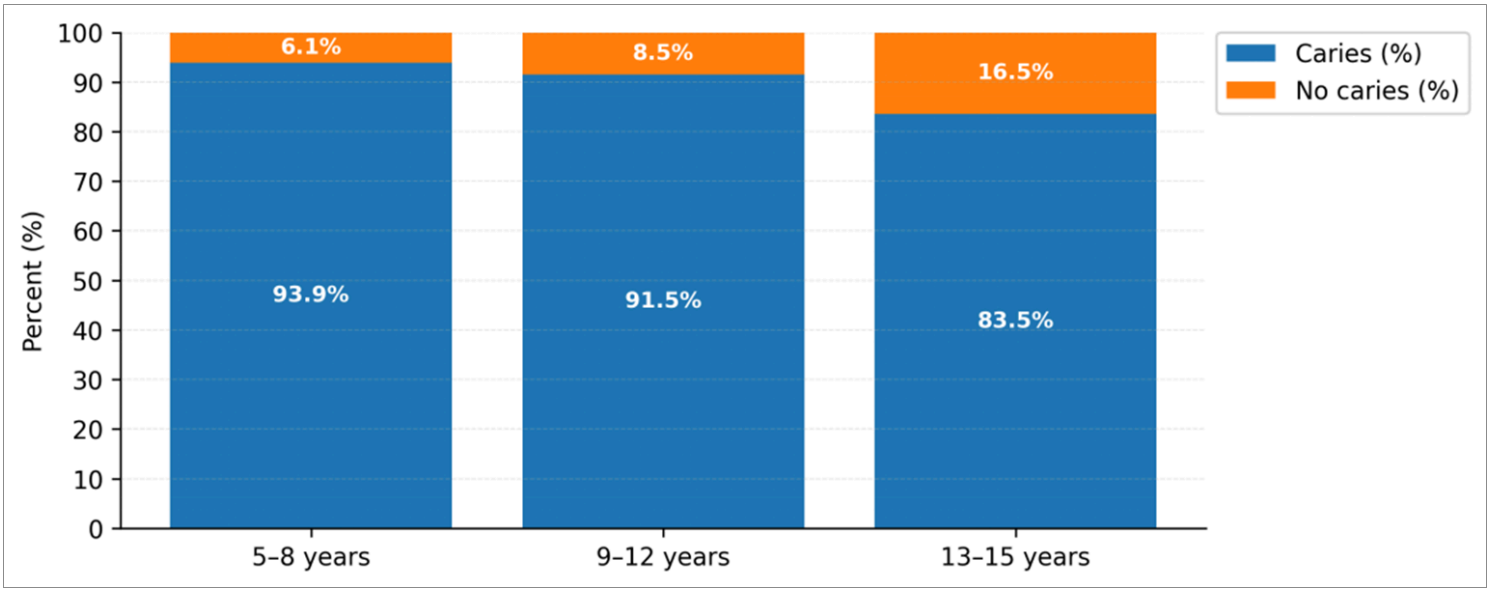


Figure 2

Distribution of dental caries across age groups

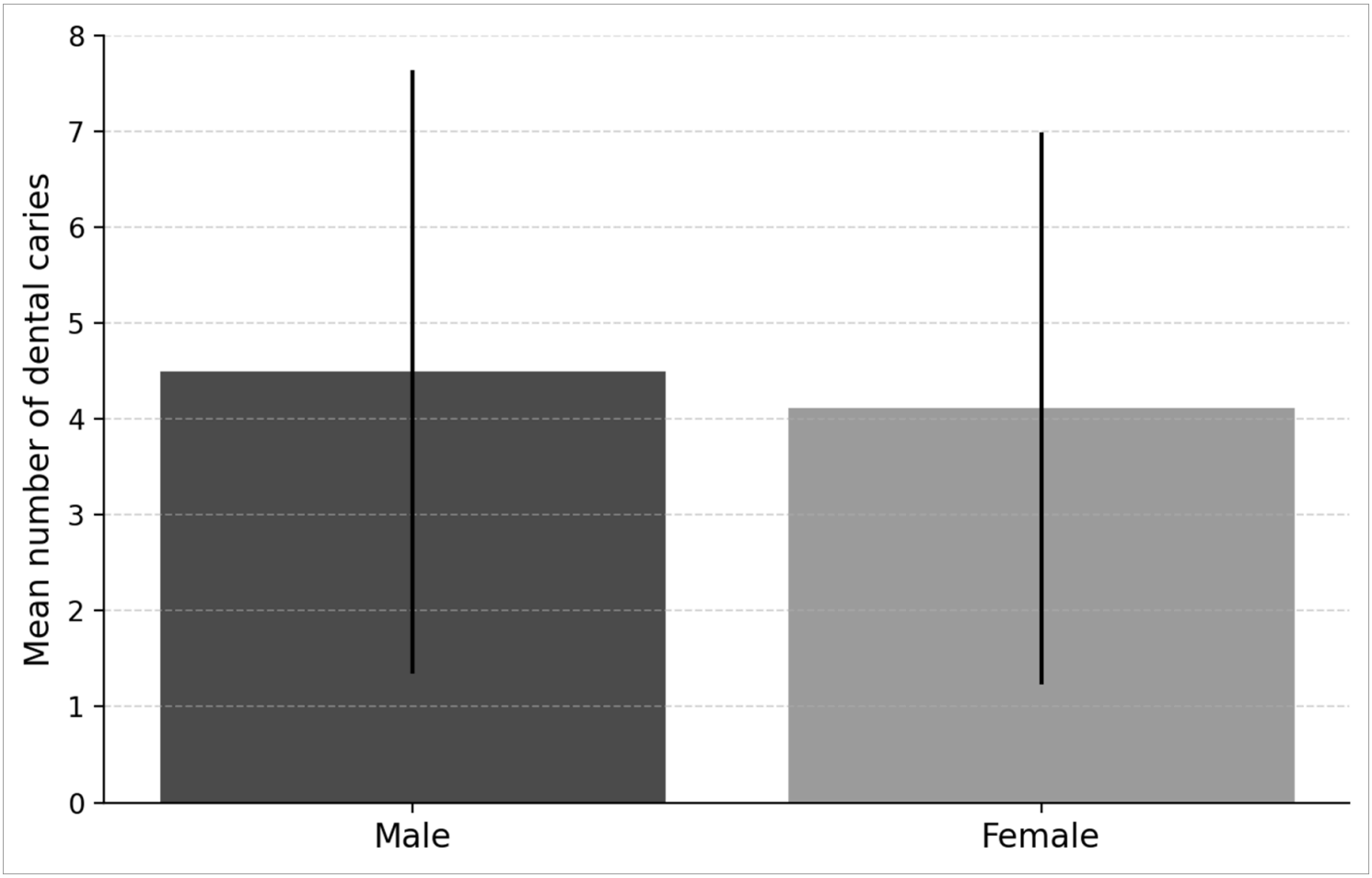


Figure 3

Mean dental caries count stratified by gender

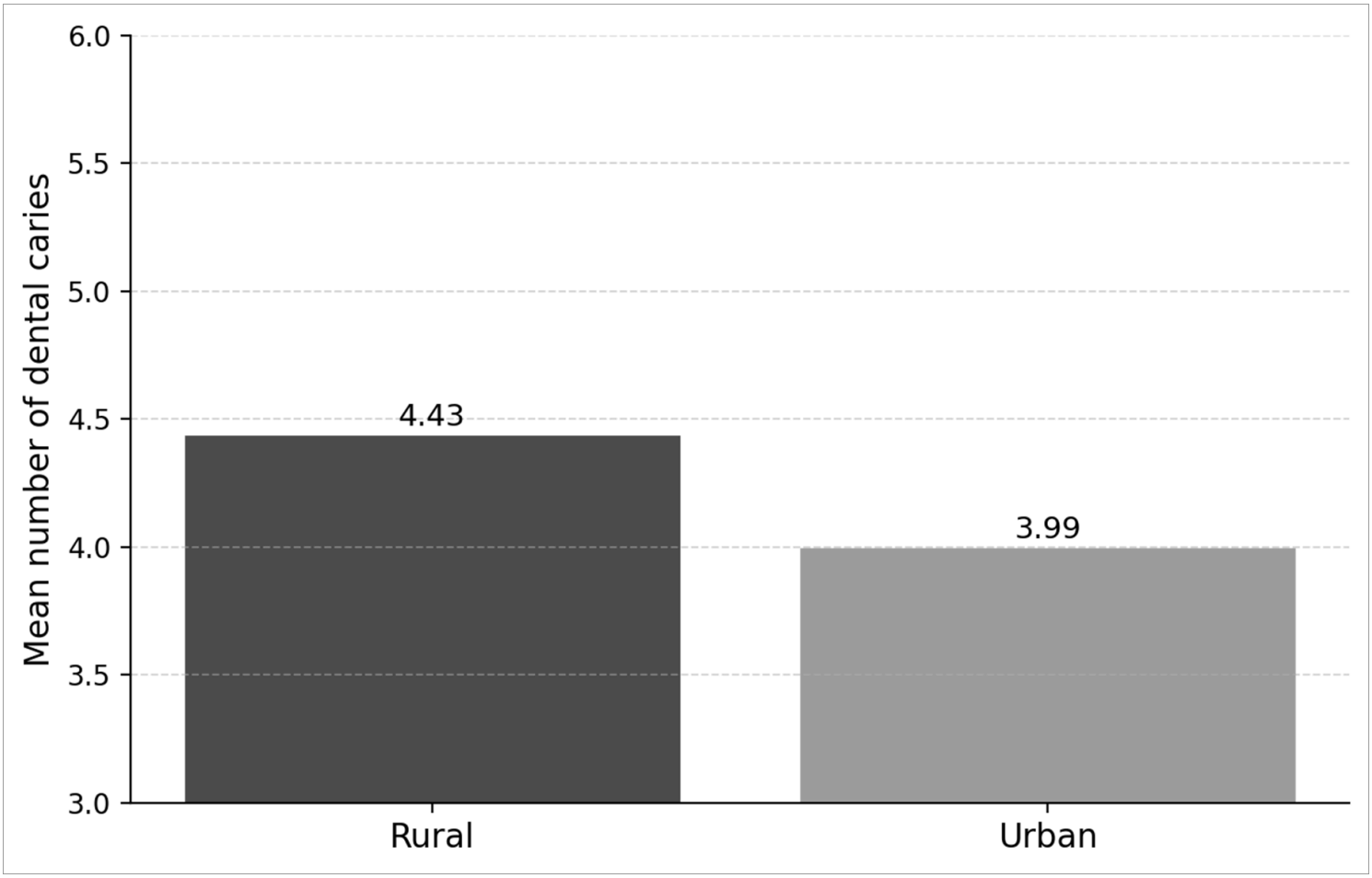


Figure 4

Mean dental caries count stratified by place of residence

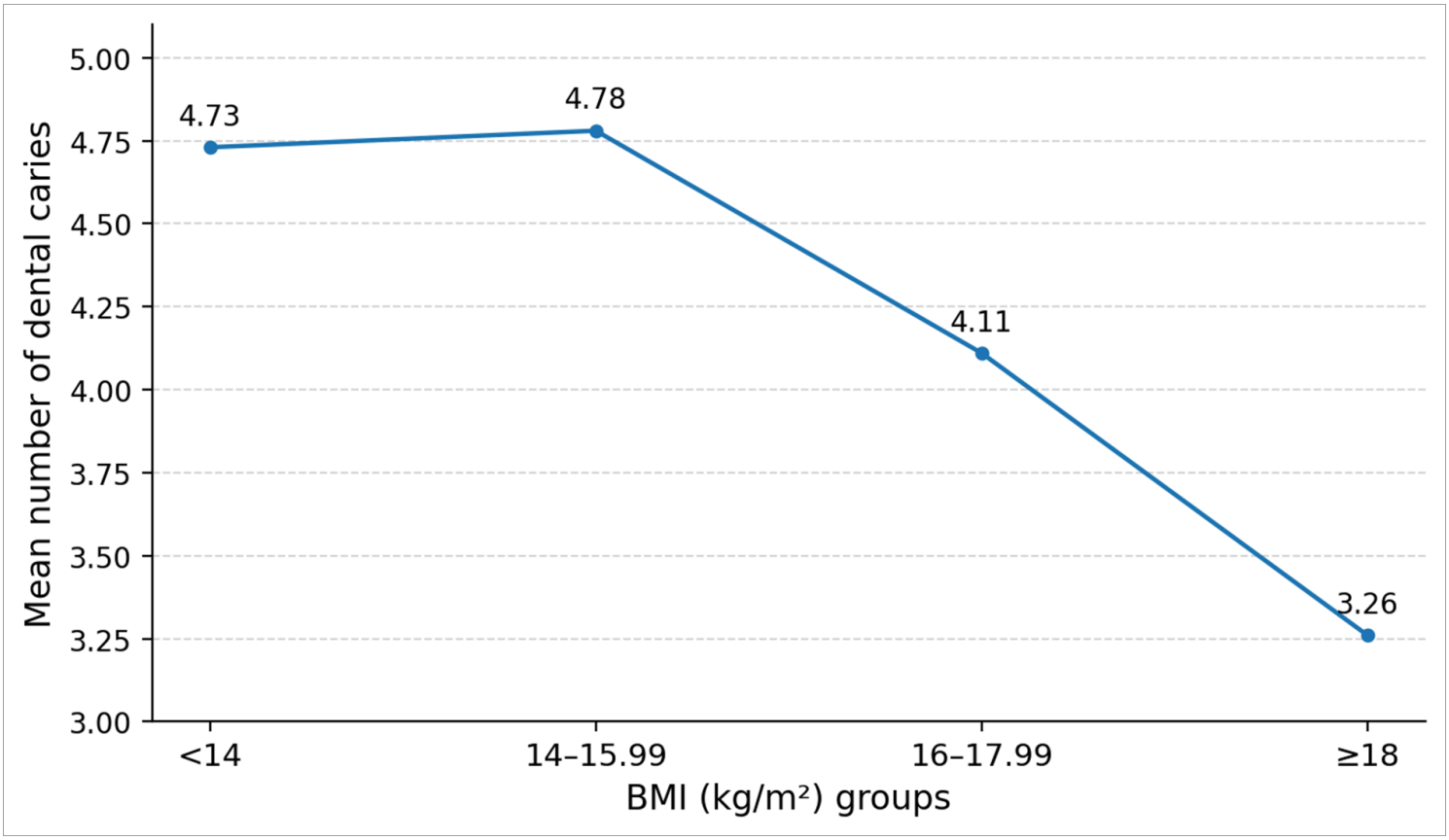


Figure 5

Association between **BMI and dental caries count**

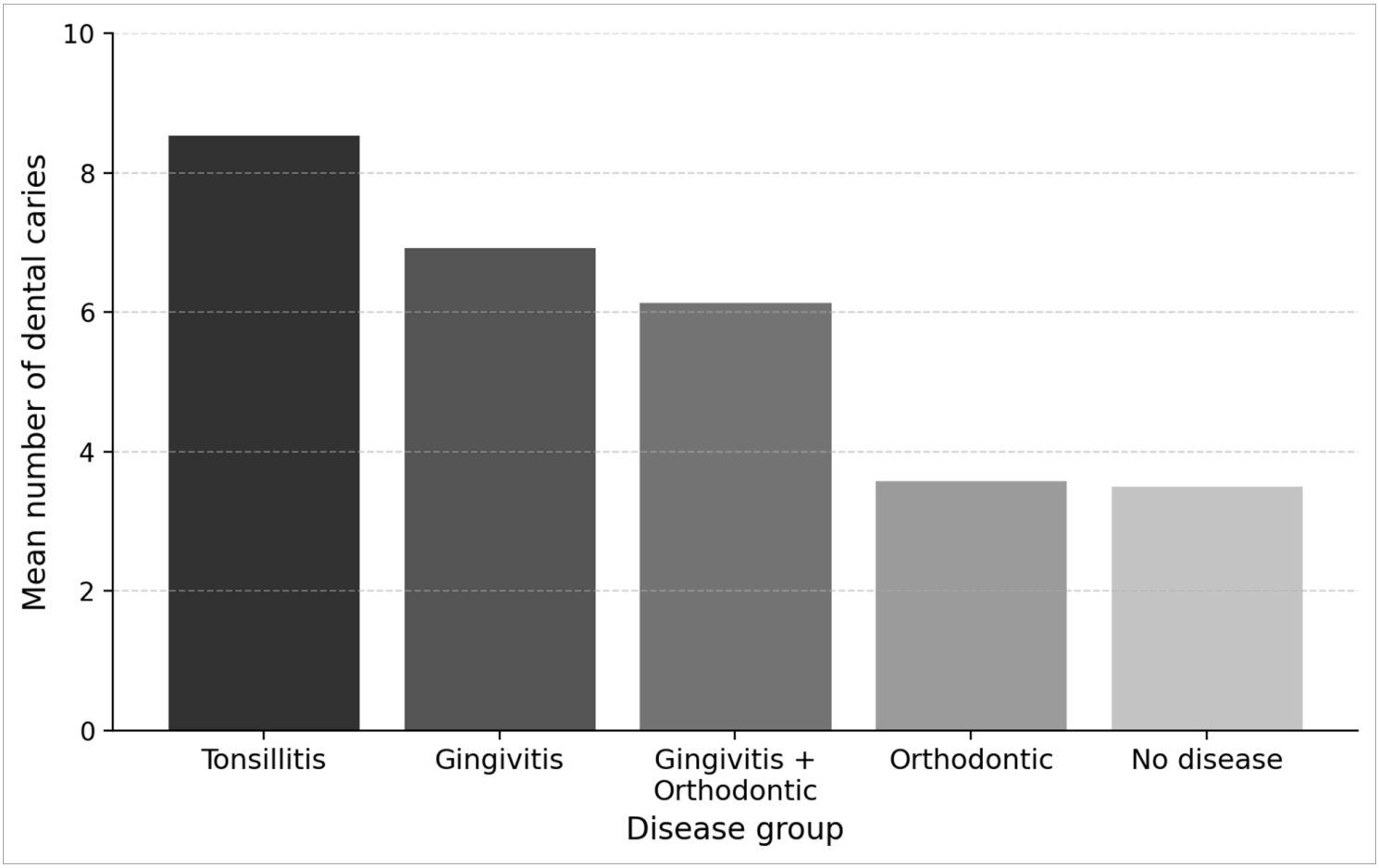


Figure 6

Association between comorbidity groups and mean dental caries burden