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RESEARCH ARTICLE

RESULTS OF PREVENTIVE EXAMINATION OF SCHOOL-AGED CHILDREN IN RURAL AREAS OF OSH REGION OF THE KYRGYZ REPUBLIC

Kalbaev Abibilla Akburaevich*[1], Ismailov Alimbek[2],Yuldashev Ilshat Muhidinovich[3] ,Usupbekova Tattybubu Ramankulovna[4], Akburaeva Asel Abdimitalovna[5] ,Imetkul Ismailov[6] ,Tulanbaeva Gulshanai Nodirbekovna[7]

[1.]Department of prosthetic dentistry, Kyrgyz State Medical Academy n.a. I.K. Akhunbaev, Bishkek, Kyrgyzstan
[2.]Associate Professor **Phd** Department of therapeutic dentistry with a course in paediatric therapeutic dentistry, Osh State University, Osh City, Kyrgyzstan, Department of therapeutic dentistry with a course in paediatric therapeutic dentistry ,Candidate of Medical Sciences, , Osh State University, Osh City, Kyrgyzstan
[3.]DMSc, professor. Department of Pediatric dentistry, Kyrgyz State Medical Academy n.a. I.K. Akhunbaev, Osh City, Kyrgyzstan
[4.]Department of therapeutic dentistry with a course in paediatric therapeutic dentistry, Osh State University, Osh City, Kyrgyzstan
[5.]Department of prosthetic dentistry, Kyrgyz State Medical Academy n.a. I.K. Akhunbaev, Bishkek, Kyrgyzstan
[6.]Department of Pathology, Basic and Clinical Pharmacology, Osh State University, Osh City, Kyrgyzstan
[7.]Department of therapeutic dentistry with a course in paediatric therapeutic dentistry, Osh State University, Osh City, Kyrgyzstan
***Corresponding Author: Kalbaev Abibilla Akburaevich** Department of prosthetic dentistry, Kyrgyz State Medical Academy n.a. I.K. Akhunbaev, Bishkek, Kyrgyzstan Email: kalbaev_abibilla@mail.ru

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ABSTRACT

Background: Dental caries represents a major public health issue that affects children living in underprivileged rural areas. The relationship between environmental factors such as climate and geographical conditions and oral health outcomes remains poorly documented regarding caries prevalence differences between different zones. The Osh region of Kyrgyzstan with its varied highland and flatland areas creates an ideal environment to study how geography affects pediatric dental health. Knowledge about caries patterns in these populations is essential for developing targeted preventive measures and maximizing resource effectiveness.

Objective: The study aimed to compare the prevalence, intensity, and care indices (K/P components) of dental caries among children aged 7, 12, and 15 years in rural highland and flatland schools of Kyrgyzstan's Osh region.

Methods: The research included 218 children who attended either a highland school with 102 students or a flatland school with 116 students. The dental examinations evaluated caries prevalence in both primary and permanent teeth as well as caries intensity through DMFT/dmft indices and the "K" (caries experience) and "P" (preventive/restorative care) components.

Results: The prevalence of caries in primary teeth reached alarming levels in both zones (94.87% highland vs. 93.80% flatland). The caries intensity in permanent teeth was high to very high throughout all age groups without any noticeable differences between geographical areas. The two schools showed low "P" scores (indicating insufficient preventive/restorative care) together with elevated "K" scores (indicating substantial untreated caries burden).

Conclusion: The high caries burden persisted regardless of geographical location because systemic gaps in oral healthcare access and prevention remained unaddressed. The urgent need requires community-level interventions together with preventive education and equitable dental care infrastructure to tackle this widespread problem in rural Kyrgyzstan.

Keywords: Dental caries, Pediatric dentistry, Rural populations, Geographical variation, Kyrgyzstan.

1. INTRODUCTION

Dental caries stands as the leading chronic disease affecting children worldwide because it creates significant impacts on their quality of life and nutrition and general health status[1]. The World Health Organization (WHO) reports that untreated dental caries in permanent teeth affects 3.7 billion people worldwide with children from low-resource settings being the most affected[2]. With their DMFT values representing major oral health difficulties, school-aged children in metropolitan areas show rates of dental caries development reaching 70-90%[3]. The Commonwealth of Independent States (CIS) shows concerning figures on this respect. By the age of 12, children in CIS cities show caries development at rates ranging from 55.6% to 72.3%; these rates rise to between 70.2% and 94.3% by the age of 15[4]. The elevated prevalence rates in this region indicate a significant public health crisis, exacerbated by disparities in access to preventive care and economic inequalities as shown in Figure 1. The Central Asian nation of Kyrgyzstan exhibits comparable patterns of dental caries, as studies indicate that 95-100% of schoolchildren are affected by this condition.

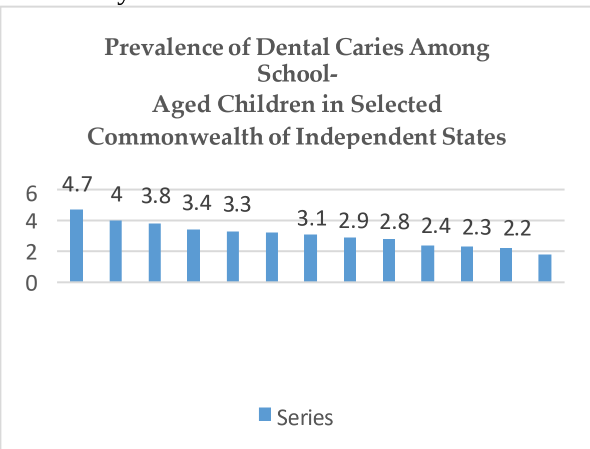

Figure 1. Intensity of dental caries in 12-year-old children according to the KPU index in selected cities.

The continuous dental health burden requires immediate implementation of targeted interventions which must consider specific environmental and cultural elements affecting oral health. The rising number of caries cases in Kyrgyzstan's children demonstrates that the country has not established adequate preventive healthcare systems[5]. The DMFT index of 12-year-olds in 2021 reached 4.28 ± 0.22 according to national surveys which shows a significant increase from 3.1 in 1995 while dental care progresses globally. Western European nations maintain DMFT scores below 1.5 for their 12-year-olds which demonstrates Kyrgyzstan's failure to implement successful preventive healthcare systems. The population living in rural areas experiences enhanced caries risks because they face both geographic barriers to healthcare and limited dental facilities and consume diets rich in carbohydrates[6]. The high-altitude communities located above 2,000 meters experience distinctive health risks because they have limited access to fresh produce and face harsh climate conditions and fluoride-deficient water. The current research primarily investigates urban and lowland populations while ignoring how altitude and rurality affect oral health outcomes together[7].

This study addresses this critical gap by examining caries patterns in contrasting geographic zones, offering insights into the role of environmental determinants in a high-burden setting. The existing research in Kyrgyzstan depends on national aggregated data which conceals differences between subregions. The detailed examination reveals specific risk factors in particular areas which helps develop focused interventions including fluoride programs for schools and dietary education initiatives[8]. The study follows WHO guidelines for periodic epidemiological monitoring to assess preventive care effectiveness and develop policy directions. The research demonstrates how LMICs can develop location-specific caries control strategies through the combination of spatial data analysis with standardized dental indicators. The study promotes equal geographic-based measures to reduce caries issues in at-risk children while expanding international knowledge about environmental variables affecting dental health. The purpose of this study is also to compare the prevalence and severity of dental caries in children from two rural schools in the Osh region of Kyrgyzstan, located at different altitudes (highland vs. lowland) and to determine the impact of geographical factors on oral health inequalities.

2, MATERIAL AND METHODS

2.1 Study Design and Setting

The research used a cross-sectional comparative design to assess dental caries prevalence and intensity and care indices among children in two rural schools located at different altitudes in the Osh region of Kyrgyzstan. The World Health Organization recommended dental examinations for children in the key age groups of 7, 12 and 15 years for epidemiological surveillance.The schools were selected based on their geographic location: one in the the village of Kenje (D. Sultanov School) in a flatland zone(744 meters above sea level) and the other in a highland zone (2,468 meters above sea level). Written permission from parents or guardians and school administrations was acquired before enrollment to guarantee ethical compliance and voluntary participation.

1.2 Sample Selection and Clinical Examination

The research included 218 children who were divided into three age groups (88 seven-year-olds, 77 twelve-year-olds, and 53 fifteen-year-olds). The examinations were conducted by dentists who received clinical calibration through standardized WHO oral health assessment protocols (2013) under uniform lighting and diagnostic conditions. The dmft index evaluated primary teeth by assessing decayed teeth and teeth missing due to caries and teeth that received fillings. The DMFT index (Decayed, Missing, Filled Teeth) was used to evaluate permanent teeth. T

he researchers analyzed both the K component which represents structural caries experience and the P component which represents preventive/restorative care and the KPU index that includes decayed, filled and missing permanent teeth. The classification of caries activity relied on the combination of treatment history and lesion progression.

1.3 Data Analysis and Ethical Compliance

The data analysis was performed using SPSS v.26 and MS Excel. The data analysis included descriptive statistics which presented caries prevalence and intensity through means, standard deviations and frequencies. The Student's t-tests and chi-square tests were used to evaluate differences between highland and flatland groups with $p < 0.05$ as the significance level. The research followed ethical standards by obtaining IRB approval from the ethical committee of Kyrgyz State Medical Academy named after I.K. Akhunbaev, Bishkek, Kyrgyzstan and Osh State University, Osh, Kyrgyzstan and maintaining data anonymity while following the Declaration of Helsinki principles[9].

The research investigated altitude-based differences to develop specific public health approaches for Kyrgyzstan's underserved rural communities.

2. RESULTS AND DISCUSSION

A comparative analysis was conducted on the oral health status of children from two schools—A. Murzakulov School and D. Sultanov School—using the components of the KPU (Decayed, Missing, and Filled Teeth) and kp (decayed and filled primary teeth) indices. The detailed results are presented in Tables 1 and 2. The "K" (decayed permanent teeth) component among 7-year-old children showed a significant difference between the two schools. The "K" value at A. Murzakulov School was 0.28±0.04, whereas at D. Sultanov School it was significantly higher at 1.38±0.20. These results show that the flatlands have a higher incidence of untreated carious lesions than the highlands.

Table 1. Prevalence and intensity of dental caries in children of the A. Murzakulov school in the Chon-Alai district of the Osh region.

Age	Quantity examined	Prevalence	TO	P	U	CPU	Prevalence	To	p	kp
7 Years	39	17.94 %	0.28 ± 0.04	0	0	0.28 ± 0.04	94.87%	6.6±1.07	0.0±0.01	6.7±1.08
12 Years	37	89.20 %	4.11 ±0.69	0.54±0.09	0.16±0.03	4.84± 0.79	16.20%	0.38±0.06	0	0.38±0.06
15 Years	26	96.20 %	2.96 ±0.47	0.81±0.13	0.35±0.06	4.12± 0.66	7.69%	0.04±0.01	0	0.04±0.01
	102									

Regarding the "P" (filled permanent teeth) component, a value of 0 was recorded for 7-year-olds at A. Murzakulov School, suggesting either a lack of dental treatment services or low utilization of available preventive care. In contrast, the "P" component at D. Sultanov School was 1.56±0.19, implying that restorative dental treatments and preventive measures are actively practiced among the children in this region. Additionally examined was the "U" component—missing permanent teeth from caries. At A. Murzakulov School, the "U" value among pupils was 0, meaning no recorded cases of removed permanent teeth. At D. Sultanov School, the "U" value was 1.67±0.23, which would suggest a greater rate of extractions—perhaps from severe untreated caries. Table 2 describing the age distribution of surveyed children (7, 12, and 15 years) together with dental caries prevalence and a comprehensive evaluation of the KPU and kp indices with their respective components. The table contains data about surveyed children in each age group including total numbers of children and caries prevalence rates and standard error values for K, P and U components as well as permanent teeth KPU index and primary teeth kp index calculations.

The caries prevalence among 7-year-old children reached 93.8% while their KPU value (1.59±0.16) showed moderate permanent tooth involvement alongside a high kp index (5.57±0.25) which indicated substantial primary dentition problems. The caries prevalence at 12 years reached 95% with a substantial KPU index increase (6.40±0.43) that placed the caries intensity into the "very high" category according to WHO standards. The kp index at this age dropped to 1.88±0.37, consistent with the natural exfoliation of primary teeth. The caries prevalence among 15-year-olds reached 96.2% while their KPU index measured 6.33±0.65. The kp index decreased to 1.25±0.17 but some adolescents retained a few primary teeth.

Table 2. Prevalence and intensity of dental caries in children of the D. Sultanov school in Karasu district of Osh region.

Age	Surveyed Quantity	Prevalence	TO	P	U	CPU	Prevalence	To
7 years	49	16%	1.38 ± 0.20	1.56 ± 0.19	1.67 ± 0.23	1.59 ± 0.16	93.80%	5.41 ± 0.26
12 years	47	95%	6.21±0.43	1.23 ± 0.13	1.00± 0.00	6.40 ± 0.43	20.0%	1.88 ± 0.37
15 years	27	96.20%	5.78±0.57	1.63 ± 0.28	1.00± 0.00	6.33 ± 0.65	3.70%	1.00 ± 0.00
	116							

The overall KPU index reflected these trends: it was significantly lower at A. Murzakulov School (0.28±0.04) compared to D. Sultanov School (1.59±0.16), confirming a greater burden of permanent tooth decay and treatment history in children from the flatlands. Given that the children examined had primary (deciduous) teeth across all age groups, the kp index and its components ("k" and "p") were also assessed.

The results showed that kp values were greater in 7-year-olds than in 12 and 15 year olds, suggesting that younger age groups had more carious lesions.

Whereas it was 5.41±0.26 at D. Sultanov School, the "k" component—decayed primary teeth—for 7-year-old children at A. Murzakulov School was 6.6±1.07. The findings show that D. Sultanov School implements dental treatment and preventative programs more precisely. With values of 6.7±1.08 at A. Murzakulov School and 5.57±0.25 at D. Sultanov School, both groups had generally high kp indices. These results suggest that children from the highland region had a greater average number of carious primary teeth than those from the flat zone. Regarding the "p" component (filled primary teeth), values were 0.0±0.01 at A. Murzakulov School and 1.33±0.23 at D. Sultanov School. So, children attending D. Sultanov School (flat zone) showed higher rates of dental treatment (fillings and extractions), whereas those from A. Murzakulov School (highlands) had higher rates of untreated caries, highlighting disparities in access to and utilization of dental healthcare services between the two regions.

The study showed significant differences between the two groups of 12-year-old children regarding dental caries prevalence and KPU index and its separate elements. Dental caries prevalence reached high levels in both populations since 89.2% of students at A. Murzakulov School (highland region) and 95.0% of students at D. Sultanov School (flat zone) suffered from the condition. Although dental caries impacts both surroundings widely, youngsters residing in the flat zone exhibit more frequency rates. The "K" component analysis highlighted a clear variation between the two demographic groupings. Whereas D. Sultanov School pupils had a far higher score of 6.21±0.43, the mean "K" value at A. Murzakulov School reached 4.11±0.69. Children from the flat zone show more untreated carious lesions than their counterparts from the highland region.

The "P" component (number of filled permanent teeth) was also evaluated. In the highland group (A. Murzakulov School), the mean number of filled teeth was 0.54±0.09. In contrast, children from D. Sultanov School demonstrated a higher mean "P" value of 1.23±0.13. This difference indicates more frequent utilization of dental restorative services among flat zone children, reflecting better access to or uptake of dental treatment. The overall KPU index, which measures the intensity of caries experience, was 4.84±0.79 in children from the highland settlement and 6.40±0.43 among children from the flat zone. The 12-year-old students from the flatlands demonstrated higher total caries experience than students from the highland area. The dental caries prevalence remains high in both regions but children from the flat zone have higher untreated decay rates and more severe caries intensity according to the elevated KPU index. The results demonstrate the requirement for better dental prevention and treatment services which should focus on both geographic areas.

In the research conducted by Averianov S.V. et al. 2016, the prevalence of caries among 12-year-old children in Ufa was found to be 84.28 ± 3.27, which is roughly comparable to our findings. Additionally, the KPU index reported was 2.83 ± 1.58, notably lower than the results we obtained. In 2022, Kasoev V.G. and Gabaraev D.E. conducted a preventive examination of 12-year-old children. Their findings indicated a caries prevalence of 85% and a KPU index of 4.5, which closely aligns with the results of our studies.

2.1 Caries Intensity Assessment and Condition of Primary Teeth

The World Health Organization (WHO) classifies the severity of dental caries at age 12 based on the KPU (Decayed, Missing, and Filled Permanent Teeth) index as follows: (Very low: 0–1.1), (Low: 1.2–2.6), (Moderate: 2.7–4.4), (High: 4.5–6.5), (Very high: ≥6.6). The CCI scores of the 12-year-old children surveyed indicate that the intensity of dental caries falls under the "high" and "very high" categories regardless of the school location. This indicates a high caries burden in both populations.

The assessment of these teeth used the "kp" index because certain 12-year-old children still had their primary teeth. The "k" component (decayed primary teeth) measured 0.38±0.06 in students from A. Murzakulov School (highland region) and students from D. Sultanov School (flat zone) showed a significantly higher value of 1.88±0.37. The results show untreated carious lesions in primary teeth occur much more frequently among flat zone children. The "p" component (filled primary teeth) showed no presence in children from both schools because restorative treatment for decayed primary teeth was nonexistent. The total "kp" index followed the "k" component values with 0.38±0.06 for A. Murzakulov School and 1.88±0.37 for D. Sultanov School.

3.2 Caries Prevalence and Intensity in 15-Year-Old Children

Among 15-year-old children in both areas, the frequency of caries in permanent teeth stayed somewhat high. Dental caries afflicted 85% of D.Sultanov School pupils and 96.2% of A. Murzak School students. The KPU index readings revealed significant degrees of caries intensity. The KPU index score of 6.33±0.65 was observed in D. Sultanov School students but students from A. Murzakulov School had a slightly lower score. The results demonstrate that flat zone adolescents bear a more significant total burden of caries experience. The "K" component (decayed permanent teeth) was still the most prominent in both groups, which means that the problem of untreated caries continues. The "P" component (filled teeth) was lower than the "K" component in both populations, but was higher in D. Sultanov students. This suggests slightly better, though still insufficient, access to restorative dental care in the flat zone compared to the highland area.

Examination of the "U" component (extracted permanent teeth) highlighted a concerning trend: tooth loss due to caries was present among adolescents in both groups. The "U" value was markedly higher in D. Sultanov School students (1.00±0.00) compared to those from A. Murzakulov School (0.35±0.06). This finding reflects a greater severity of untreated carious lesions leading to tooth loss among flat zone children. Interestingly, remnants of primary dentition were still found in this age group. Children from D. Sultanov School had a "kp" index of 1.25±0.17, much higher than those from A. Murzakulov School reported at 0.04±0.01. Only the D. Sultanov group showed the existence of the "p" component—filled primary teeth—which highlights even more the geographical variations in the approach to juvenile dental treatment.

3. Future Recommendations

3.1 *Implement Comprehensive School-Based Preventive Programs:* The school health services should implement regular preventive measures which include fluoride varnish applications dental sealants and oral hygiene education. Early intervention of children leads to substantial reduction in caries burden throughout both highland and flatland areas[10,11].

3.2 *Expand Access to Restorative Dental Care:* The research shows that dental treatment is not available, especially in the highlands. Mobile dental clinics, government-supported dental camps, and partnerships with local health providers should be established to ensure that all children, regardless of their location, have access to basic restorative treatments[12,13].

3.3 *Strengthen Parental and Community Education Initiatives:* Educational programs for parents and community leaders about the importance of oral hygiene, regular dental visits, and healthy dietary

3.4 habits could help improve the oral health behaviors at the household level, leading to better outcomes in children[14,15].

3.5 *Conduct Longitudinal Monitoring of Dental Health Trends:* Future research should include longitudinal studies to track changes in caries prevalence and treatment rates over time. This would help assess the effectiveness of interventions and adapt strategies to evolving needs[16,17].

3.6 *Develop Region-Specific Oral Health Policies:* Public health policies need to be customized according to the different caries intensity levels found between flatland and highland populations. The highland regions need additional outreach and preventive services but flatland areas require better treatment compliance and maintenance programs[18,19].

CONCLUSION

The main research outcome from this study shows dental caries continues to affect children aged 7, 12, and 15 years in both highland and flatland regions with persistent high disease prevalence rates. The study shows that the burden of this disease affects children throughout all geographic areas since the analysis shows both temporary and permanent teeth caries. Children living in highland areas had high KPU index scores yet the children from the flat zone had even more severe caries experiences indicated by very high KPU index scores. The study indicates that untreated dental decay affects children in flatland areas more severely than in highland areas. The limited dental treatment access demonstrated through very low "p" component scores at the high-mountain school reveals both treatment service deficiency and lack of dental care availability. These populations share a fundamental issue of insufficient preventive strategies despite showing varying levels of disease severity between locations. The dental public health program demonstrates major system failures because the number of treated teeth remains low and decayed teeth remain along with extracted teeth in older students. The persistence of untreated primary teeth among 12- to 15-year-old children demonstrates inadequate treatment timing alongside insufficient preventive outreach programs. School-aged children receive insufficient preventive measures regardless of their geographical location according to the research results. The present situation requires immediate and continuous work to create preventive school programs and dental education for communities and expanded clinical service availability. The identified gaps require urgent attention because they prevent the reduction of caries burden while simultaneously impairing the long-term quality of life and oral health results for children across highland and flatland areas. The implementation of strong preventive strategies along with early intervention services will decrease caries prevalence while decreasing treatment costs and leading to better oral health equity for upcoming generations.

DECLARATIONS

Ethical approval and consent to participate

Not Applicable

Availability of data and material

All data generated or analyzed during this study are included in the published article.

Competing interest

The authors declare that there are no competing interests.

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