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RESEARCH ARTICLE

PREVALENCE OF DENTAL CARIES AMONG SCHOOLCHILDREN OF CHON ALAI DISTRICT OF THE KYRGYZ REPUBLIC

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ABSTRACT

Background: The worldwide decrease in dental caries prevalence during recent decades has not included sufficient research on rural high-altitude populations from Central Asia. The burden of dental caries among schoolchildren in geographically isolated mountainous regions of Kyrgyzstan remains poorly documented because socioeconomic constraints and dietary habits and healthcare access disparities may increase disease risk. This research examines the dental caries epidemiological patterns together with their changeable risk factors among schoolchildren in the unexplored rural highlands of southern Kyrgyzstan.

Research methods: The study included 413 students from Myrzakulov Secondary School located in Chon Alai District of Osh Region. The researchers obtained demographic information along with ethnic background and behavioral data through anonymous structured questionnaires that assessed oral health knowledge and attitudes and practices. The analysis of caries prevalence (percentage affected) and intensity (dft/DMFT indices) used descriptive statistics and logistic regression methods.

Results: The prevalence of caries in deciduous and permanent dentition was 94.2% and 95.5%, respectively. The prevalence of caries in permanent teeth was 77.7% among children aged 8–17 years. The dft score of 6-year-olds was 6.25 ± 1.4 and the DMFT index of 12-year-olds was 4.81 ± 0.79, which indicates a subcompensated caries intensity level. The proportion of restored teeth (f-component) was found to be low in all age groups.

Conclusion: The dental caries prevalence among rural Kyrgyz highland schoolchildren reaches concerning levels in their primary and permanent teeth. The results demonstrate the need to strengthen school-based preventive programs and implement oral health education to reduce sugar consumption and extend restorative dental services to underprivileged areas.

Keywords*:* Dental caries, epidemiology, disease prevalence, caries intensity, rural highland populations, Kyrgyzstan

1. INTRODUCTION

Dental caries stands as one of the leading chronic diseases worldwide which disproportionately affects children who live in low-resource areas and geographically isolated communities. The World Health Organization (WHO) reports that untreated dental caries in permanent teeth affects 2.3 billion people worldwide and developing region children suffer most because they

lack access to preventive and restorative dental care[1]. The caries prevalence in urban and high-income settings has decreased due to oral health education and fluoridation programs and dietary guidelines but rural and mountainous populations in Central Asia still face systemic barriers to achieve oral health equity[2]. The landlocked country of Kyrgyzstan demonstrates the difficulties that its rugged terrain and high-altitude settlements create. The population of Kyrgyzstan exceeds 60% in rural areas where socioeconomic inequalities combine with insufficient healthcare facilities and carbohydrate-based diets to increase dental disease risk. Rural communities including those in Chon Alai district of Osh region receive inadequate attention from the country's oral health policies because they focus primarily on urban areas[3]. Most existing epidemiological research about dental caries in Kyrgyzstan studies urban pediatric populations while ignoring the distinct risk factors of children living in remote high-altitude areas. The current research gap requires studies that focus on specific contexts to develop effective intervention strategies[4].

The widespread dental caries problem among schoolchildren in Kyrgyzstan's rural highlands demonstrates an important public health issue which combines socioeconomic factors with environmental conditions and behavioral elements[5]. The regions show concerning high caries rates but researchers have not gathered complete information about disease severity and risk factors and preventive practices. The people of Chon Alai rural area face multiple barriers to dental care because they lack fluoridated water supply and have few dental facilities and traditional eating habits that include frequent consumption of sweetened tea and dried fruits along with carbonated beverages[6]. The combination of low parental understanding about oral hygiene and limited financial resources prevents families from obtaining prompt dental care. The lack of school-based oral health programs enables the cycle to continue which puts children at increased risk of experiencing pain and infection and missing school[7]. This research investigates caries prevalence together with intensity and modifiable risk factors within a high-altitude rural population[8]. The research findings have global implications because mountainous regions across the Andes and Himalayas and other parts of the world face identical obstacles including geographical barriers and cultural eating habits and inconsistent healthcare systems. The study reveals local determinants through its findings which establish a framework to analyze caries epidemiology in comparable settings and promote targeted solutions to reduce oral health disparities[9,10].

The research adds fresh knowledge to worldwide oral health research by studying schoolchildren in remote high-altitude communities of Kyrgyzstan.

The majority of Central Asian research has analyzed urban populations or used outdated national surveys which fail to properly represent remote mountainous areas. The study provides a comprehensive epidemiological dental caries profile of this unique population by using WHO-standardized diagnostic criteria together with structured questionnaires that collect demographic and behavioral and socioeconomic data. The research will establish caries patterns by age group for both primary and permanent teeth while assessing the effects of diet and oral hygiene habits and determining care access challenges to develop evidence-based interventions. The study introduces the "subcompensated" caries intensity classification to describe this population's disease progression which shows moderate severity without adequate restorative treatment to guide clinical decision-making in limited resource settings. The results demonstrate the critical requirement for school-based preventive programs and policy reforms to increase dental workforce distribution in rural areas through their evidence of low filled teeth (f-component) and elevated untreated decay rates. The research outcomes will guide Kyrgyzstan's national oral health strategy development while providing reference material for mountainous regions dealing with similar challenges to establish cross-regional partnerships for addressing rural pediatric oral health neglect.

2. MATERIAL AND METHODS

2.1 Study Design

The research took place as a cross-sectional epidemiological study during November 2022 at Myrzakulov Secondary School located in Daroot Korgon village of Chon Alai district in Osh region within the Kyrgyz Republic. The village located at a high-altitude mountainous location which reaches 2,468 meters above sea level and contains 4,726 residents according to the 2009 census. The research evaluated dental caries prevalence and intensity and risk factors among 6-17 year-old schoolchildren while following national dental prevention programs and ethical standards from the Kyrgyz Ministry of Health and the Helsinki Declaration [11].

2.2 Study Setting and Population

The research included all students who enrolled at Myrzakulov Secondary School with a total number of 413 participants. The study excluded students who were absent from school because of illness during the three-day examination period (n = 27). The research participants included students from various ethnic

groups mainly consisting of Kyrgyz and Uzbek students who matched the population demographics of Chon Alai district.

The research included students whose parents provided written consent and who gave their own written agreement to participate without any age or gender limitations.

2.3 Materials and Data Sources

2.3.1 WHO Diagnostic Criteria: The dental examinations used standardized WHO protocols (2013) to evaluate caries prevalence and intensity. The evaluation of primary and permanent dentition used decayed, filled teeth (dft) and Decayed, Missing, Filled Teeth (DMFT) indices. The assessment included records of caries complications and teeth that required extraction because of caries and teeth that received sealing[12].

2.3.2 Demographic and Behavioral Data: A structured anonymous questionnaire captured age, gender, ethnicity, parental education, oral hygiene practices (e.g., toothbrush frequency, fluoride use), dietary habits (sugar consumption, carbonated drinks), tobacco use initiation, and dental visit frequency.

2.4 Data Collection Procedures

2.4.1 Clinical Examination: Two trained dentists conducted visual-tactile examinations under natural light conditions by using sterilized probes and mirrors. The examiners received calibration to achieve inter-rater reliability (kappa = 0.85). The WHO oral health assessment forms were used to document the findings.

2.4.2 Questionnaire Administration: The distribution of self-administered questionnaires by teachers occurred during school hours while maintaining anonymity. The instructions were delivered in both Kyrgyz and Uzbek languages to support students with different linguistic backgrounds.

2.5 Caries Assessment Criteri

2.5.1 Primary Dentition (dft): Calculated as the sum of decayed (d), filled (f), and teeth extracted due to caries (t) in children ≤12 years.

2.5.2 Permanent Dentition (DMFT): Sum of decayed (D), missing (M), and filled (F) teeth in children ≥6 years. Caries intensity was classified as *subcompensated* (DMFT 3.5–6.4) based on WHO thresholds.

2.6 Statistical Analysis

Data were analyzed using IBM SPSS Statistics v.19. Descriptive statistics—means, standard deviations, percentages—summed caries frequency (dft/DMFT) and behavioral variables. While t-tests examined variations in caries severity, chi-square tests evaluated categorical variables—e.g., caries rates by age group. High DMFT scores were linked, according to multivariate logistic regression, to risk variables including sugar intake, irregular brushing. Set significance at *p* 0.05.

2.7 Ethical Statement

The Institutional Review Boards of Osh State University and I.K. Akhunbaev Kyrgyz State Medical Academy approved the study through Protocol No. 14 on June 3, 2021. The researchers obtained written consent from parents/guardians and student assent from participants. The research maintained complete data anonymity while following both the Helsinki Declaration and Kyrgyz national ethical guidelines for human subjects research.

3. RESULTS

In all, 413 students between the ages of 6 and 17 years old who were enrolled in grades 1-11 were included in the research. The gender and age distribution of the participants is shown in Table 1, which provides information about individually.

Table 1. Characteristics of study participants (n-413).

N	Age	Boy	Girl	Total
	6	8	11	20
	7	17	22	39
	8	15	17	32
	9	27	27	54
	10	24	19	43
	11	26	23	49
	12	14	23	37
	13	14	14	28
	14	17	22	39
	15	10	16	26
	16	8	9	17
	17	4	9	13
Σ		202	211	413

The occurrence of caries in primary teeth among children aged 6 to 7 years was found to be 94.2%. The occurrence of permanent teeth caries among children aged 11-12 years was found to be 95.5%. The occurrence of caries in permanent teeth among children aged 8 to 17 years stands at 77.7%. Table 2 illustrates the occurrence and severity of dental caries in schoolchildren categorized by age.

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Table 2. Prevalence and intensity of dental caries among schoolchildren according to age (n- 413).

Age	*n*	*D*	*F*	*M*	*DMFT*	*d*	*f*	*df*
6	20	0,35±0,08	0	0	0,35±0,08	6,25±1,4	0	6,25±1,4
7	39	0,28±0,04	0	0	0,28±0,04	6,67±1,07	0,08±0,01	6,75±1,08
8	32	0,41±0,07	0,06±0,01	0	0,47±0,08	5±0,88	0,13±0,02	5,13±0,9
9	54	1, 20±0,16	0,06±0,01	0	1,26±0,17	3,63±0,49	0,07±0,01	3, 70±0,5
10	43	2,09±0,32	0,19±0,03	0,05±0,01	2,33±0,36	1,67±0,25	0,02±0,03	1,69±0,26
11	49	3,69±0,53	0,18±0,03	0,06±0,01	3,93±0,56	0,16±0,02	0	0,16±0,02
12	37	4,11±0,69	0,54±0,09	0,16±0,03	4,81±0,79	0,38±0,06	0	0,38±0,06
13	28	2,5±0,47	0,5±0,09	0,04±0,01	3,04±0,57	0,04±0,01	0	0,04±0,01
14	39	3, 10±0,49	0,36±0,06	0	3,46±0,55	0,08±0,01	0	0,08±0,01
15	26	2,96±0,47	0,81±0,13	0,35±0,06	4,12±0,66	0,04±0,01	0	0,04±0,01
16	17	3,06±0,74	0,41±0,1	0,24±0,06	3,71±0,9	0	0	0
17	13	2,92±0,8	1,38±0,38	0,31±0,09	4,61±1,28	0	0	0
	413	2,23±0,11	0,31±0,02	0,08±0,03	2,62±0,13	2,12±0,13	0,03±0,01	2,15±0,16

4. DISCUSSION

By ethnic composition, the children mostly belonged to the Kyrgyz population. There are isolated cases where people of Tajik ethnicity reside in the area and the neighboring mountainous regions. We have not found any difference in the prevalence and intensity of dental caries and oral diseases based on ethnicity. In Table 2, it is seen that the average intensity of caries of deciduous teeth in children aged 6 years was 6.25 ± 1.4, and in children aged 7 years, it was 6.75 ± 1.08. The intensity index of caries of permanent teeth (DMFT) in 12-year-old children was 4.81±0.79. Based on the caries intensity classification created for the Kyrgyz Republic by Prof. G. Cholokova in 2000, the level of dental caries (in both baby and adult teeth) is considered sub-compensated. The low percentage of the index of *f* – filled teeth is noteworthy. For 6-year-olds, it amounted to 1.2% of the total index. 11.2% of the 12-year-old students' entire index was made up of sealed teeth. In general, for all ages of schoolchildren, only 11.8% of the total DMFT index consisted of sealed teeth. Such low indicators show the insufficiency of the ongoing prophylactic and rehabilitation work among schoolchildren[13].

The situation is also evidenced by the results of an anonymous survey conducted among 225 schoolchildren, mainly middle and older age groups (130 of them boys and 151 girls). 63.3% of respondents rated the condition of their teeth as "excellent," "good," or "satisfactory." The condition of the gums was also assessed by 52%. Additionally, 13% of schoolchildren found it “difficult to answer” the first question, and 9.6% found it difficult to answer the second question. To the question: "Have you visited a dentist in the last 12 months?" 59% answered yes often, sometimes, or rarely. 28% of respondents have never visited a dentist, and 13% found it difficult to answer this question. To the same question, asked in a different" way—"How often have you visited the dentist in the last 12 months?"—the" answer was also identical (59%). 1-2 times-(36%), 3 or more times-23%. 20% of respondents answered that they had not visited a dentist, and 14% found it difficult to answer this question. In the rest of the answers, the students visited the dentist only a few times. For 49% of respondents, the reason for visiting the dentist was either pain (31%) or dental treatment (18%). Only 18% of respondents applied to a dentist to examine the condition of their teeth and oral cavity. 26% found it difficult to answer this question. Of the total number of respondents, 89 (32%) brush their teeth two or more times a day and 107 (38%) once a day. 74 (26%) rarely brush their teeth, of which 32 (11.4%) do

so several times a month, 15 (5%) once a week, and 27 (9.6%) several times a week[14]. Of the oral hygiene products, 90% of respondents use a toothbrush, 19% use wooden toothpicks, 10% use plastic toothpicks, 11% use miswak, and 7.5% use dental floss.93% of respondents use toothpaste; 11% use toothpaste with fluoride content, and 26% use toothpaste without fluoride content. 21% of respondents found it "difficult to answer" this question. The next group of questions concerned the subjective assessment of the condition of one's own teeth and problems with them. According to the answers received, 27% (76) of respondents are not satisfied with the condition of their teeth, and 22% found it difficult to answer this question. 13%—try not to smile because of the appearance of their teeth. 12% found it difficult to answer. 8% answered that the children laugh at the sight of my teeth, and 19% found it difficult to answer. 17% missed lessons due to toothache, and 14% found it difficult to answer. 12% replied that they had difficulty biting off food, and 8% found it difficult to answer. 15% have difficulty chewing food, and 9% found it "difficult to answer."

Some questions concerned the dietary preferences of schoolchildren and determined their indirect effect on the prevalence and intensity of diseases of tough dental tissues. According to the respondents' answers, it was determined that fresh fruits were consumed frequently-several times a day, daily, or several times a week—by 71% of the schoolchildren who answered, while 20% rarely consumed fresh fruits. Biscuits, cookies, and sweet pies are often consumed by 45%, and 60% often consume jam, while 17% consume it rarely. Further, chewing gum is often consumed by 48% and rarely by 26%. 48% consume sweets frequently, while 25% consume them rarely. Lemonade, cola, and other carbonated drinks are often consumed by 35% and rarely by 33%. Milk with sugar is often consumed by 38% and rarely by 32%. 52% often consume tea with sugar, while 20% rarely do so. National drinks Kumuz (from mare's milk) is often consumed by 12.5% and rarely by 60%. 8% often consume Zharma, the national drink, while 57% consume it rarely. National drinks-Kumuz and Zharma are low-alcohol, and their rare use, according to the results of the survey, suggests relatively reliable answers to questions, since they are not often consumed by school-age children.

The questionnaire included questions about the use of cigarettes, tobacco, and other smoking mixtures. According to the respondents' answers, 2% often use cigarettes (several times a day or a week), 16% rarely (1-2 times a month), and occasionally they have tried or respondents. Another type of tobacco-Nass chewing tobacco-is often used by 3%, rarely by 3%, and practically do not smoke-88% of the occasionally they have tried it or practically do not use it—80%. Regarding parental education, we received the following responses. The education of the father or guardian in 4% of cases is lower than secondary or primary, in 16% secondary, and in 32% higher education, institute, and university. In 3.5% of cases, the mother's education is lower than average or primary; in 13%, secondary; and in 42%, higher education, institute, and university. 41% of respondents could not determine the level of education of their father and mother.

This research was carried out for the very first time in Kyrgyzstan since it gained its independence. Studies that were quite similar to this one were carried out in the past, either in the valley and the mid-mountain levels of the republic, or in the towns of the republic. More than ninety percent of the land of the country is comprised of hilly regions. Based on the findings of our research, we discovered that the high-mountainous regions have a higher incidence of caries. In terms of dental caries intensity, it is somewhat equivalent to that of other locations[15]. As a result of the comparatively limited accessibility of high-altitude locations, relatively poor indicators of schoolchildren's knowledge of the detrimental effects of sugars, sugar-containing goods, and carbonated beverages on dental and oral health were identified[16]. An insufficient level of primary prevention of caries and diseases of hard tissues of teeth is indicated by the fact that schoolchildren are unable to determine the level of education of their parents (41 percent of respondents), or that the level of education of their parents is low (four percent of them have levels of education that are below average or primary, and thirteen to sixteen percent of them have secondary levels of education). Dental caries is a prevalent condition characterized by a moderate level of severity[17]. The inadequate implementation of preventive measures, coupled with the limited educational background of parents, can also be attributed to the climatic and geographical characteristics of Kyrgyzstan, particularly the deficiency of essential minerals such as calcium, fluorine, and iodine in the drinking water supply. The mountainous regions of Kyrgyzstan are characterized by a notable deficiency of fluorine and iodine, rendering them an endemic zone. In certain areas, access to clean drinking water is limited[17,18].

The data collected align well with findings from earlier research. Our investigation revealed a significant occurrence of dental caries. It is recognized that the occurrence of caries is not directly influenced by a country's economic development. However, the implementation of social hygiene initiatives and preventive strategies can contribute to stabilizing or

lowering the intensity of this condition. Our findings indicate that ethnicity did not have a significant impact on the index indicators related to the prevalence and intensity of dental diseases[19]. Our findings indicate that climatic and geographical living conditions, awareness of primary prevention measures, and the availability and regular implementation of dental preventive care have a significant influence. This locality is home to a regional hospital and a regional family medicine center. The Family Medicine Center comprises essential specialists and divisions within the medical service. There are dental offices available, but there are only two dentists present, excluding any specialists in stomatology. Dental X-ray equipment absence at both the district hospital and Family Medicine Center prevents healthcare providers from detecting non-visible tooth areas and surfaces including approximal and subgingival regions. The inability to diagnose caries on invisible tooth surfaces becomes a challenge because of the limited diagnostic capabilities. The remote mountainous regions of Kyrgyzstan face a major challenge because of their healthcare professional shortage. State insurance covers medical dental services with planned preventive work but the available number of dentists and stomatologists fails to meet patient needs[20].

It is essential to consider the educational background of parents; notably, 41% of children were unable to identify their parents' level of education. In 4% of instances, it was found that the educational attainment of the parents was classified as low and below the average standard. The educational level does not provide adequate understanding of the basic requirements for implementing preventive measures for children and school-aged individuals. The research did not include an examination of schoolteachers' knowledge and awareness regarding the skills necessary for conducting health lessons, particularly in the area of oral health[12,22]. The research indicated that schoolchildren exhibited a limited understanding of dental disease prevention, particularly regarding caries. Kyrgyzstan has initiated a program aimed at preventing caries and other significant dental diseases. However, it has not yet been adopted at the state level. We believe it is essential for the program to encompass the enhancement of knowledge among parents and educators, particularly those teaching at the primary level, regarding the prevention of significant dental diseases[23].

5. Future recommendation to combat the challenges:

5.1 *Integrate School-Based Oral Health Education into National Curricula:* Create educational modules about oral health for students at primary and secondary school levels which cover hygiene practices and dietary guidelines and caries prevention. The training of teachers especially in rural areas to deliver these modules will enable children to become behavioral change agents for their families. The approach supports WHO school-based health promotion guidelines while addressing the study's findings about limited awareness[24].

5.2 *Implement Targeted Fluoridation Programs in Mountainous Regions:* The endemic fluoride deficiency and mineral-poor water sources require the implementation of cost-effective fluoridation strategies through salt fluoridation or school-based fluoride varnish applications. The caries incidence in high-altitude districts such as Chon Alai could decrease by 20–40% through similar interventions that have been successful in LMICs[25.]

5.3 *Strengthen Rural Dental Workforce Capacity:* The critical shortage of dental professionals in mountainous areas should be addressed by providing incentives for dentists to practice in rural areas through scholarships, housing allowances, or loan forgiveness. Furthermore, train mid-level dental therapists to perform basic preventive and restorative care, as recommended by the FDI World Dental Federation for underserved regions[26].

5.4 *Deploy Mobile Dental Units with Portable Diagnostic Tools:* Mobile clinics should receive compact radiographic devices (handheld X-ray units) and tele-dentistry capabilities to enhance early caries detection in remote villages. This would bypass the lack of fixed infrastructure and enable timely management of approximal and subgingival lesions, reducing complications[27.]

5.5 *Launch Parental Literacy Campaigns on Preventive Care:* Community leaders and local media should work together to spread educational materials about sugar reduction and fluoride use and routine dental visits which are culturally appropriate. The educational materials should use low-literacy formats such as visual posters and radio broadcasts to reach parents who have limited formal education since they make up 17% of the study population. The distribution of affordable hygiene kits containing toothbrushes and fluoride toothpaste by NGOs would help strengthen these messages[28].

6. CONCLUSION

The study reveals a significant oral health problem impacting high-mountain regions of Kyrgyzstan kids as restorative dental treatment is still inadequate and dental caries rates are very high. Treatment limitations have caused the caries intensity categorization of subcompensated to show that the disease has progressed to moderate to severe degrees. The

extremely low rates of filled teeth across all age groups demonstrate major shortcomings in dental service delivery and access that exceed global standards.

The high prevalence of dental caries in this populationstems from endemic mineral deficiencies and excessive consumption of cariogenic foods and poor oral health literacy among children and their caregivers. The research demonstrates how isolated populations face increased vulnerability because environmental conditions and socioeconomic factors and infrastructural limitations work together to worsen oral health problems. A comprehensive public health strategy needs to be established to tackle these challenges. The priorities should include school-based preventive programs combined with fluoridation initiatives and workforce task-shifting models and dietary regulations and culturally appropriate health education campaigns. The treatments must especially adapt for the unique socioecological setting of high-altitude areas. Resolving disease-causing elements at the population level calls for the harmonization of national oral health campaigns with global health criteria and sustainable development objectives. Future research needs to assess the effectiveness and scalability of proposed interventions to develop evidence-based policies that enhance outcomes for similar underserved populations.

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Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate: All procedures performed in the present study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the declaration of Helsinki 1975, which was revised in 2000. Approval to conduct the study was obtained from the Institutional Ethics Board of the Osh State University and IK Akhunbaev Kyrgyz State Medical Academy (N14, June 03, 2021).

Competing interests: The authors declare that they have no competing interests.

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