MERAL Publications and Solutions Pvt. Ltd.

Original Article

Epidemiological profile of oral health among secondary school students in the high-altitude region of Peru

Galeord Huacasi[1*], Henry Quispe-Cruz[1], Jhony Rodriguez[1], Wilbert Arocutipa[1], Carlos-Vidal Cutimbo-Quispe[1]

[1]Department of Dentristy, Universidad Nacional del Altiplano de Puno, Puno, Perú.

Correspondence: Galeord Huacasi, Department of Dentristy, Universidad Nacional del Altiplano de Puno, Puno, Perú. gvhuacasi@unap.edu.pe

ABSTRACT

The oral health status of secondary school students in high-altitude regions of Perú presents unique challenges, requiring specific epidemiological insights. This study evaluates the prevalence of dental caries, periodontal disease, and malocclusion in a sample of 222 students from 7 provinces from Puno, Perú. Caries were highly prevalent, with a mean of 6.6 lesions per student, ranging from 0 to 18, reflecting significant variability. Periodontal health showed 3.5 sites with probing depths ≥3mm on average, while clinical attachment loss (NICM3mm) was less common, averaging 0.43 affected sites per student. Gingivitis affected 70.3% of the population, and only 18.5% displayed signs of periodontitis. Orthodontic issues were widespread, with 73% of students exhibiting malocclusion, the most common type being Class II. These findings underscore the importance of early intervention, especially in caries management and orthodontic treatment. These results could be attributed to variables including altitude, dietary deficits, and restricted access to specialised dental care. Planning for public health and allocating resources—which aim to reduce long-term issues and enhance overall dental health—needs an understanding of this population's oral health profile. This study highlights the necessity of more comprehensive dental care accessibility, preventive measures, and focused educational initiatives in order to lower the prevalence of oral diseases among adolescents residing in high-altitude areas. Further research is recommended to investigate the role of environmental and socioeconomic factors in shaping oral health outcomes in these areas.

Keywords: Dental caries, Epidemiology, Gingivitis, High-altitude regions, Malocclusion, Periodontitis

Introduction

Oral health remains a critical component of overall health, with substantial implications for the well-being of individuals, particularly adolescents [1, 2]. In high-altitude regions, such as the Peruvian Andes [3, 4], unique environmental, cultural, and socio-economic factors may contribute to variations in oral health outcomes [4]. The limited availability of specialized dental care and potential nutritional deficiencies in these areas pose specific challenges to oral health maintenance [5]. Despite the global emphasis on preventive oral care, there is insufficient research addressing the epidemiological profile of oral diseases in students living in these geographically isolated regions [4, 6]. This study aims to fill that gap by providing a comprehensive analysis of oral health among secondary school students in the high-altitude region of Perú [7, 8].

Periodontal diseases, dental caries, and malocclusion are the most prevalent oral health issues affecting adolescents worldwide [9]. These conditions not only impair oral function but also influence academic performance, quality of life, and self-esteem. Periodontitis, in particular, has been linked to chronic conditions like cardiovascular diseases, highlighting the need for early detection and management [10, 11]. The burden of dental caries remains high in many developing countries, exacerbated by limited access to dental services and fluoride [12, 13]. In high-

Access this article online	
Website: www.japer.in	**E-ISSN:** 2249-3379

How to cite this article: Huacasi G, Quispe-Cruz H, Rodriguez J, Arocutipa W, Cutimbo-Quispe CV. Epidemiological profile of oral health among secondary school students in the high-altitude region of Peru. J Adv Pharm Educ Res. 2024;14(4):63-8. https://doi.org/10.51847/oXr58ky3jp

altitude regions, the combined effects of cold climates and altered dietary habits may aggravate these conditions. The current study explores the prevalence of these oral diseases and evaluates the risk factors associated with them in the Peruvian context [14, 15]. The Peruvian government conducted by Mnister of Health (MINSA) [4, 11, 16], has initiated several public health interventions aimed at improving oral health, particularly in rural and high-altitude areas. However, existing oral health programs often fail to reach the most vulnerable populations, such as students in remote regions [17]. Cultural obstacles, a lack of dental professionals, and inadequate infrastructure make access to care even more difficult. Comprehending the oral health epidemiological profile of the area is essential to properly customising these initiatives [18]. This study seeks to provide data-driven insights that could support the development of more targeted oral health strategies in high-altitude communities.

Environmental factors, such as low oxygen levels, may also play a role in shaping oral health outcomes in high-altitude areas [16]. The reduced atmospheric pressure and its physiological effects on human health could potentially influence periodontal conditions, though this relationship has not been thoroughly investigated [19]. Additionally, socioeconomic factors like poverty, limited access to clean water, and inadequate oral hygiene education contribute to the higher prevalence of oral diseases in these regions. By exploring these elements, this study aims to build a comprehensive understanding of the multifactorial influences on oral health in high-altitude Peruvian students.

Materials and Methods

This cross-sectional study aimed to evaluate the epidemiological profile of oral health among secondary school students residing in the high-altitude region of Peru. The study population comprised students aged 15 and 16 years, enrolled in schools situated at altitudes exceeding 3,800 meters in locations such as Lampa, Sandia, Macusani, Huancané, Moho, Juliaca, and Puno. The sample size was determined based on an estimated 50% prevalence of dental caries, a 95% confidence level, and a 5% margin of error. These parameters resulted in a minimum required sample size of 222 students. Stratified random sampling was employed to ensure proportional representation by age and gender. Ethical approval for the study was request to Institutional Review Board of the Universidad Nacional del Altiplano de Puno. Additionally, authorization was granted by school administrators, and informed consent was obtained from the parents or legal guardians of all participants.

The clinical examination of each student was conducted by calibrated dental professionals, following the World Health Organization (WHO) oral health assessment guidelines [20]. Each examination took place in a designated area within the school premises to ensure privacy and minimize environmental factors that could interfere with the clinical assessment [21]. To guarantee uniformity in diagnosis, all examiners went through a calibration process before the trial began. The Kappa statistic was used to calculate the inter-examiner dependability. A result of 0.85 suggested a high degree of agreement between the examiners. This calibration process included multiple practice sessions involving clinical scenarios and discussions about diagnostic criteria for caries, periodontal disease, and malocclusion [9].

Dental caries were assessed using the WHO standard diagnostic criteria, specifically the Decayed, Missing, and Filled Teeth (DMFT) index [22, 23]. Each tooth was carefully examined for signs of decay, restoration, or extraction due to caries. The DMFT score was calculated for each participant, providing a quantitative measure of caries experience. Two examiners evaluated each student independently in order to reduce observer bias, and any differences were settled through discussion [23-25]. Additionally, the severity of caries was classified based on the number of surfaces affected, and this data was recorded separately for analysis.

Periodontal health was evaluated through a comprehensive assessment of gingival bleeding, plaque accumulation, and periodontal pocket depths. Gingival bleeding was measured using the gingival bleeding index (GBI), where the presence of bleeding upon probing was noted for each sextant of the dentition [26]. Probing pocket depths were measured using a calibrated periodontal probe, with a focus on identifying periodontal pockets of ≥3mm, which were classified as indicative of early periodontal disease. Clinical attachment loss (CAL) was also recorded, with sites showing CAL ≥3mm considered indicative of periodontitis [27]. The presence and severity of gingivitis were recorded, with all data entered into a standardized electronic data collection system.

Malocclusion was diagnosed based on Angle's classification, which classifies malocclusion into Class I (normal occlusion), Class II (retrognathism), and Class III (prognathism) types. For this study, additional malocclusion traits, such as crowding, spacing, and crossbite, were also documented. Each student's occlusion was assessed by direct visual examination, and the findings were corroborated by photographs taken during the examination [28]. This method gave a thorough explanation of orthodontic aberrations' qualitative and quantitative features. The examiners received specialised instruction on identifying subtle malocclusion traits in order to assure proper classification.

Environmental factors specific to high-altitude regions were also considered. These included access to fluoridated water, local dietary practices, and the availability of dental health services. Water samples from the local area were tested for fluoride concentration using a spectrophotometric method to determine the adequacy of natural fluoride levels in preventing dental caries [29]. Additionally, interviews with local health authorities and school administrators provided further context regarding the availability of dental health services and any regional public health initiatives aimed at improving oral hygiene. The integration of these environmental factors allowed for a more holistic understanding of the determinants of oral health in this population, in **Table 1**, we use descriptive statistics for each variable.

Table 1. Oral Health Variables Summary

Variable	Mean	Standard Deviation	Min	Max
Caries	6.59	3.76	0	18
Periodontal Disease	3.51	10.02	0	80
Malocclusion	2.72	1.18	1	4

Data were entered into R and RStudio for statistical analysis. Descriptive statistics were used to summarize the prevalence of dental caries, periodontal disease, and malocclusion. Continuous variables, such as the DMFT score and probing depths, were summarized using means and standard deviations, while categorical variables were expressed as frequencies and percentages [30]. Bivariate analyses were performed to examine the association between sociodemographic variables (age, gender) and oral health outcomes using chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression models were developed to identify potential risk factors for caries, periodontal disease, and malocclusion, with statistical significance set at $p < 0.05$.

To address potential confounding variables, multivariate logistic regression models were used to adjust for factors such as age, gender, and socioeconomic status [11]. These models allowed for a more accurate estimation of the independent effects of environmental and behavioral variables on the oral health outcomes of interest. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test, and the results were reported as odds ratios (OR) with corresponding 95% confidence intervals (CI). The final models provided insights into the key determinants of oral health in the study population, accounting for the unique environmental challenges faced by students living in high-altitude regions.

Results and Discussion

The prevalence of dental caries was notably high across all age and gender groups in the study. Among 15-year-old females, the prevalence was 100%, while among 15-year-old males, it was slightly lower at 97.22%. In the 16-year-old group, the prevalence remained similarly high, with 95.35% for females and 91.89% for males. These findings show that dental caries affects almost all of the students in this population. The statistical insignificance of the slight variations seen between age and gender groups indicates that the prevalence of caries is a problem that affects all age groups un this area.

Periodontal disease, as measured by the presence of probing depths of ≥3mm, was less prevalent than caries but still significant. In 15-year-olds, 27.27% of females and 22.22% of males showed signs of periodontal disease. Among the 16-year-olds, the prevalence was 25.58% for females and 24.32% for males. While the difference in periodontal disease prevalence between males and females was small, females in both age groups exhibited slightly higher rates of periodontal disease. These findings highlight the need for increased focus on periodontal health interventions, especially considering the potential for periodontal disease to progress if left untreated.

Malocclusion was another oral health issue of interest, with varying prevalence rates across different classes and gender groups. For Class I malocclusion, 21.21% of 15-year-old females were affected compared to 29.17% of males. Among 16-year-olds, the prevalence was 25.58% for females and 21.62% for males. The slightly higher prevalence among 15-year-old males suggests a trend that could be explored further in future studies, although the differences were not substantial enough to indicate a clear pattern. In the younger age range, Class I malocclusion was the most prevalent overall, indicating a strong need for early orthodontic examination.

Class II malocclusion was less common overall, but still noteworthy. In the 15-year-old group, 6.06% of females and 12.50% of males were affected. Among 16-year-olds, the prevalence increased to 18.60% for females, while it decreased slightly to 10.81% for males. These results suggest that Class II malocclusion becomes more prevalent with age, particularly in females. This malocclusion type, often associated with retrognathism, may require early orthodontic intervention to prevent further complications. The gender differences, with males exhibiting higher prevalence in the younger age group but lower in the older age group, could indicate varying rates of development or progression.

Class III malocclusion showed an interesting pattern, with 42.42% of 15-year-old females affected, compared to 29.17% of males. Among 16-year-olds, the prevalence decreased significantly for females to 18.60%, while it increased slightly for males to 27.03%. This suggests that Class III malocclusion may be more prevalent in younger females but could stabilize or decrease with age, while in males, it remains relatively consistent across age groups. Class III malocclusion, often associated with prognathism, poses significant functional and aesthetic challenges, highlighting the need for timely orthodontic evaluation and treatment in these students.

Finally, Class IV malocclusion exhibited the most variable prevalence among the different age and gender groups. Among 15-year-olds, 30.30% of females and 29.17% of males had Class IV malocclusion. However, among 16-year-olds, the prevalence increased notably, affecting 37.21% of females and 40.54% of males. This type of malocclusion, characterized by severe misalignment, may indicate a more advanced need for orthodontic treatment, particularly as students age. The higher prevalence in 16-year-olds suggests that malocclusion could worsen with time if left untreated, emphasizing the importance of early diagnosis and intervention.

The overall results suggest that while dental caries is nearly universal in this population, periodontal disease and malocclusion are also significant issues, though with varying prevalence rates across age and gender groups. Interestingly, males tended to show higher rates of Class I and Class II malocclusions in the younger age group, while females exhibited higher rates of Class III malocclusion, particularly at age 15. These patterns, while not statistically significant in some cases, offer insights into potential developmental differences that

warrant further investigation [31]. Moreover, the high rates of Class IV malocclusion across both age groups highlight the pressing need for comprehensive orthodontic assessments and treatment plans.

The findings from this study highlight the severe oral health challenges faced by secondary school students in the high-altitude region of Perú, with an alarmingly high prevalence of dental caries across all age and gender groups. Nearly 100% of the students had caries, which suggests that preventive measures such as regular dental check-ups, fluoride exposure, and oral hygiene education may be lacking or ineffective in this population. In **Table 2** we show the small differences observed between males and females, as well as between the two age groups, indicate that caries is a widespread issue affecting all students, with no clear demographic distinctions. This prevalence far exceeds global averages, signaling an urgent need for public health interventions aimed at caries prevention.

The results also indicate that periodontal disease, while less common than caries, still affects a significant proportion of students. The prevalence ranged between 22% and 27%, with slightly higher rates among females. These figures suggest that while periodontal disease may not be as rampant as caries, it remains a concern that could escalate without proper care. The presence of gingival bleeding and early signs of periodontitis in adolescents indicates insufficient oral hygiene practices, potentially exacerbated by limited access to dental care services in these remote areas. Given the long-term health implications of periodontal disease, including its association with systemic conditions such as cardiovascular disease, early intervention is crucial.

Malocclusion, particularly Class III and Class IV types, also emerged as a prevalent issue among the students. The high rates of these malocclusions, especially among 15-year-old females and 16-year-old males, reflect the complex orthodontic needs of this population. Class III malocclusion, often linked to severe prognathism, poses functional and aesthetic challenges that could impact both health and quality of life. Class IV malocclusion, characterized by more severe misalignments, was notably prevalent in both age groups, signaling the need for comprehensive orthodontic evaluations. These findings suggest that orthodontic services may not be readily available in this region, necessitating efforts to provide accessible and affordable care.

Table 2. Prevalence of Dental Conditions Among Study Participants

Age	15 Years		16 Years	
Sex	**F**	**M**	**F**	**F**
Total Students	33	72	43	74
Students with Caries	33	70	41	68
Caries Prevalence	100.00	97.22	95.35	91.89
Students with Periodontal	9	16	11	18
Periodontal Prevalence	27.27	22.22	25.58	24.32
Class 1 Malocclusion	7	21	11	16
Class 1 Prevalence	21.21	29.17	25.58	21.62
Class 2 Malocclusion	2	9	8	8
Class 2 Prevalence	6.06	12.50	18.60	10.81
Class 3 Malocclusion	14	21	8	20
Class 3 Prevalence	42.42	29.17	18.60	27.03
Class 4 Malocclusion	10	21	16	30
Class 4 Prevalence	30.30	29.17	37.21	40.54

The findings reveal that while periodontal disease is less prevalent than caries among the student population, it remains a significant issue with a prevalence of 22% to 27%. This percentage is slightly higher among females, indicating potential gender-based disparities in oral health. The early presence of gingival bleeding and signs of periodontitis highlights inadequate oral hygiene practices in these adolescents [32]. The situation is further exacerbated by the limited availability of dental care services in the remote regions, underlining the necessity for targeted preventive measures. Failure to address these early signs could result in long-term health impacts, particularly given the established connection between periodontal disease and systemic conditions such as cardiovascular diseases [9]. Therefore, early intervention through improved access to oral health care and education is critical.

The study also draws attention to the significant prevalence of malocclusion, particularly Class III and Class IV types, among secondary school students. The higher rates of Class III malocclusion, often associated with severe prognathism, represent both functional and aesthetic challenges, especially for 15-year-old females and 16-year-old males. This form of malocclusion not only impacts oral functionality but also affects self-esteem and overall quality of life. Similarly, the prevalence of Class IV malocclusion in these age groups further emphasizes the need for specialized orthodontic assessments and interventions. The lack of readily available orthodontic services

in the region is a major concern, and efforts should be made to enhance access to affordable and effective orthodontic care.

In light of these findings, a comprehensive approach to oral health that includes preventive, therapeutic, and educational measures is imperative. Addressing periodontal disease through early diagnosis, routine dental check-ups, and improved hygiene practices can reduce the progression of these conditions. Similarly, incorporating orthodontic evaluations as part of routine dental assessments could help identify and treat malocclusions early, reducing the need for more complex treatments later in life. The study highlights the broader issue of healthcare accessibility in remote regions and underscores the need for integrated policies that ensure both preventive and curative dental services are available to all segments of the population.

Conclusion

This study provides a detailed epidemiological profile of oral health among secondary school students in the high-altitude region of Perú, revealing an alarming prevalence of dental caries, significant rates of periodontal disease, and widespread malocclusion. The nearly universal occurrence of dental caries in this population underscores the critical need for enhanced preventive measures, including the implementation of routine dental check-ups, fluoridation programs, and improved oral hygiene education. Without immediate intervention, the long-term consequences of these untreated oral health issues could severely affect the overall health and quality of life of these students.

The presence of periodontal disease in nearly one-quarter of the students further highlights the insufficiency of current oral health care practices in the region. Early signs of periodontitis in adolescents indicate a lack of preventive dental care and insufficient oral hygiene, both of which need to be addressed through targeted public health initiatives. The findings suggest that more robust periodontal care, education, and regular dental cleanings should be integrated into existing health programs for these communities.

Orthodontic issues, particularly severe forms of malocclusion, were also prevalent, suggesting a high unmet need for orthodontic services. Class III and Class IV malocclusion, in particular, present significant functional and aesthetic challenges for these students, further stressing the importance of accessible orthodontic care. Addressing these malocclusions at an early stage is essential to prevent more complex health issues in adulthood, emphasizing the need for specialized care within the public health system. In conclusion, the findings from this study call for an urgent, multifaceted approach to improving oral health outcomes in the high-altitude regions of Perú. Comprehensive public health strategies that include preventive care, treatment for existing oral diseases, and access to orthodontic services are essential to mitigating the widespread burden of oral health issues in this underserved population. These interventions should be designed to meet the unique environmental, socioeconomic, and health challenges faced by students in high-altitude communities, ensuring that future generations have access to the care they need for a healthy life.

Acknowledgments: None

Conflict of interest: None

Financial support: Financial support for this study was provided by the Universidad Nacional del Altiplano de Puno. The project was funded through resources from FEDU, under Financing Contract No. 063-2023-VRI-UNA-PUNO.

Ethics statement: Ethical approval for the study was requested from Institutional Review Board of the Universidad Nacional del Altiplano de Puno. Additionally, authorization was granted by school administrators, and informed consent was obtained from the parents or legal guardians of all participants.

References

1. Yaghini J, Salmani SM, Hasheminejad SM, Mogharehabed A. Dentists' attention to periodontal therapy in the patients treatment planning to dental clinics of Isfahan city. Arch Pharm Pract. 2022;13(2-2022):51-6.
2. Alrakkad IA, Alrakkad RA, Altamimi MS, Alshammari NM, Alghuraymil AA, John MA, et al. Review on dental implant and infection management approach. Arch Pharm Pract. 2022;13(1-2022):37-9.
3. Aquino-Canchari CR, Caro-Aylas HW, Crisol-Deza DA, Zurita-Borja JL, Barrientos-Cochachi JE, Villavicencio-Caparo E. Clinical epidemiological profile of oral health in peruvian native communities. Rev Habanera Cienc Méd. 2019;18(6):907-19.
4. Garcés-Elías MC, Castillo-López CED, León-Manco RA, Agudelo-Suárez AA. Impact of the COVID-19 pandemic on the timing of dental care in Peruvian children. Dent Med Probl. 2022;59(1):37-44. doi:10.17219/dmp/141521
5. Villena RS, Pesaressi E, Frencken JE. Reducing carious lesions during the first 4 years of life: An interprofessional approach. J Am Dent Assoc. 2019;150(12):1004-14. doi:10.1016/j.adaj.2019.04.003
6. Aquino-Canchari CR, Crisol-Deza DA, Zurita-Borja JL. Body mass index and dental caries in native Peruvian communities. Braz J Oral Sci. 2020;19:1-9. doi:10.20396/bjos.v19i0.8658647
7. Afnan L, Tirupathi S. Dental students' perception in managing medical emergencies: A cross-sectional study. Ann Dent Spec. 2022;10(2-2022):67-72.
8. Alshaer N, Bakhaider R, Elias AY, Yamany I, Alshouibi E, Elias W. Dental misconceptions in social media accounts: Youtube and Instagram applications among fluoride toxicity, bleaching and, waterjet. Ann Dent Spec. 2022;10(2-2022):19-24.

9. Papillard C. Epidemiology of periodontal disease: The oral health index. Chir Dent Fr. 1967;37(27):39-40.
10. Durand RC, Gonzalez ML, Torres CD. Prevalence of partial edentulism according to Kennedy and Applegate in patients treated at a university dental clinic in Lambayeque-Peru. J Oral Res. 2019;8(3):236-43. doi:10.17126/joralres.2019.035
11. Aquino-Canchari CR, Gutierrez-Lazarte LH. Socioeconomic factor in relation to oral health in students of a Peruvian rural area. Rev Cuba Estomatol. 2020;57(4):1-12.
12. Zagade H, Varma S, Suragimath G, Zope S. Knowledge, awareness, and practices of oral health for debilitated patients, among nursing staff of Krishna hospital. Int J Pharm Res Allied Sci. 2022;11(2-2022):73-80.
13. Suragimath G, Ashwinirani SR, Shetgaonkar KA. Assessment of knowledge, awareness and practices about periodontal disease among secondary school teachers. Int J Pharm Res Allied Sci. 2022;11(3-2022):60-5.
14. Panigrahi C, Yuwanati M, Priyadharshini R. Determination of intracellular iron in oral squamous cell carcinoma using perl's prussian blue iron stain. Clin Cancer Investig J. 2022;11(5):7-10.
15. Domiaty DM. Gum Arabic mitigates AlCl3-induced nephrotoxicity by upregulating the XRCC1 gene and downregulating Ki67 and P53 expressions. Clin Cancer Investig J. 2022;11(4-2022):44-51.
16. Ruiz JA, Pisfil-Benites N, Azañedo D, Hernández-Vásquez A. Impact of health insurance on the use of oral health services in the peruvian population 2015–2019. BMC Oral Health. 2024;24(1):684. doi:10.1186/s12903-024-04441-0
17. Azañedo D, Hernández-Vásquez A, Visconti-Lopez FJ, Turpo Cayo EY. Frequency, inequalities and spatial distribution of oral health services utilization in Peruvian children under twelve years of age: A population-based comparative analysis of the years 2017 and 2021. BMC Oral Health. 2023;23(1):778. doi:10.1186/s12903-023-03528-4
18. Torres-Mantilla JD, Newball-Noriega EE. Factors associated with the use of oral health services in peruvian children under the age of 12 years. Clin Exp Dent Res. 2023;9(1):230-9. doi:10.1002/cre2.674
19. Melgar XC, Azañedo D, Hugo FN. Towards the integration of prevention and control of oral diseases within child primary healthcare: The case of Peru. Community Dent Oral Epidemiol. 2024;52:509-17. doi:10.1111/cdoe.12945
20. Suarez-Cabello C, Valdivia E, Vergara-Buenaventura A. Clinical-epidemiological profile of dental professionals associated with COVID-19 infection in Southern Peru: A cross-sectional study. Int J Environ Res Public Health. 2022;20(1):672. doi:10.3390/ijerph20010672
21. Takazoe I. Changing trends in dental diseases. A report based on the findings of the commission on oral health, research and epidemiology. Nihon Shika Ishikai Zasshi. 1985;38(1):21-8.
22. Mittinty MN. Estimating bias due to unmeasured confounding in oral health epidemiology. Community Dent Health. 2020;37(1):84-9. doi:10.1922/CDH_SpecialIssueMittinty06
23. Brown JP. Oral health of Hispanics: Epidemiology and risk factors. InHealth Policy/spec Sale/avail Hard Only 2019 Apr 16 (pp. 132-143). Routledge.
24. Cheng ML, Wang CX, Wang X, Feng XP, Tai BJ, De Hu Y, et al. Dental expenditure, progressivity and horizontal inequality in Chinese adults: Based on the 4th national oral health epidemiology survey. BMC Oral Health. 2020;20:1-0. doi:10.1186/s12903-020-01128-0
25. Murray Thomson W. Epidemiology of oral health conditions in older people. Gerodontology. 2014;31:9-16. doi:10.1111/ger.12085
26. Mazza C, De Sio E, De Sio G. Epidemiology the oral health in a school in albania. Prev Assis Dent. 2007;33(3):9-20.
27. Queiroz RL, Castro RK, Caponi LQ, Gosalvez MM, Calvo JC, Drago S, et al. Oral health conditions and self-reported presence of pain in rowers: An epidemiology study. Rev Bras Med Esporte. 2021;27(6):549-52. doi:10.1590/1517-8692202127062021_0131
28. Chenta-Irigoin E, Jiménez Torres EA, Farje-Gallardo CA, Coronel-Zubiate FT. Self-perception of malocclusions: Reference of mental states in university students. Rev Cienc Soc. 2024;30:217-28. doi:10.31876/rcs.v30i.42259
29. Liu L, Wu W, Zhang SY, Zhang KQ, Li J, Liu Y, et al. Dental caries prediction based on a survey of the oral health epidemiology among the geriatric residents of Liaoning, China. BioMed Res Int. 2020;2020(1):5348730. doi:10.1155/2020/5348730
30. Roland E, Gueguen G, Longis MJ, Boiselle J. Validation of the reproducibility of the DMF index used in oral health epidemiology and evaluation of its two clinical forms. World Health Stat Q. 1994;47(2):44-53.
31. Vega-Bazán L, Becerra-Bravo G, Mayta-Tristán P. Malocclusion, temporomandibular disorder and their association with neck pain. Fisioterapia. 2015;37:279-85. doi:10.1016/j.ft.2014.12.002
32. Aliaga-Del Castillo A, Mattos-Vela MA, Aliaga-Del Castillo R. Malocclusions in children and adolescents from villages and native communities in the Ucayali Amazon region in Peru. Rev Peru Med Exp Salud Publica. 2011;28(1):87-91. doi:10.1590/S1726-46342011000100014