ORIGINAL RESEARCH

Assessing Adherence to Provider's Recommendations in Caries Risk Assessment and Management: A Retrospective Data Review

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Abstract

Aim: To evaluate the distribution of caries risk category of patients at a dental institution and determine adherence to providers' recommendations.

Materials and methods: A cross-sectional retrospective review of 1,235 patients records that included data collection on demographics, the sum of the number of decayed, missing due to caries, and filled teeth in the permanent teeth (DMFT), presence of frequent snacking, stimulated salivary flow rate, stimulated saliva pH, saliva buffering capacity, biofilm activity, caries risk category, anti-caries prescription accept/decline, and change in the caries risk category. Statistical analysis was carried out through Pearson's Chi-squared test and linear model ANOVA with a significance level of 0.05.

Results: Pearson's Chi-squared test showed a statistically significant difference in frequency by risk category ($p < 0.001$) indicating that patients were skewed toward high and extreme caries risk. Linear model ANOVA showed that higher risk categories were associated with lower salivary flow rates ($p = 0.010$) and higher biofilm activity ($p < 0.001$). About, 1 out of 3 patients were reported to have frequent snacking ($N = 391$, 32%). Frequent snacking patients were more likely to present with higher caries risk assessment ($p < 0.001$), younger age ($p < 0.001$), and female ($p < 0.001$). Despite recommendations from the dental student provider, only 27% accepted the anti-cavity prescriptions while 61% declined the recommendation.

Conclusion: Distribution of caries risk category is not evenly distributed, but rather skewed toward high and extreme caries risk levels. Despite the identified risks, there is low adherence to the recommendations provided by healthcare providers. The results underscore the necessity for targeted interventions and initiatives aimed at fostering behavioral changes to enhance oral health outcomes.

Clinical significance: There is a high need for targeted interventions and initiatives that promote behavioral changes to enhance oral health outcomes.

Keywords: Adherence caries risk assessment, Diet, Fluoride.

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Introduction

Dental caries is a multifactorial disease that involves the dissolution of tooth structure due to prolonged periods of low pH and net tooth mineral loss, resulting from the formation of dental plaque.[1] It is a serious public health problem worldwide that affects people of all ages and can lead to pain, infection, tooth loss, and other health complications.[2] As such, Healthy People 2,030, the initiative that sets national objectives to help improve health and well-being for all people, highlighted the importance of preventing and managing dental caries through various approaches, such as reducing sugar consumption, increasing fluoride exposure, promoting dental sealants, and improving access to dental care. These objectives aim to improve the overall oral health and well-being of individuals and communities, especially those who are at higher risk of developing dental caries, such as children, low-income populations, and older adults.[3]

The fact that the prevalence of dental caries is not equally distributed but disproportionately affects certain population groups,[4] prompted patient-centered risk-based disease management as a vital component of modern caries management.[5] The process involves assigning a level of risk of caries to determine the probability of incidence of caries during a certain time-period. It also calculates the probability that there will be a change in the severity and/or activity of caries lesions by comprehensively evaluating caries disease indicators, risk factors, and protective factors.[6,7] A variety of caries risk questionnaires are available, such as tools of the American Academy of Pediatric Dentistry,

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American Dental Association (ADA), and the Caries Management by Risk Assessment (CAMBRA).[8–10] Based on the caries risk level that can range from low to extreme risk, the dental professional can provide a holistic approach for preventive measures, such as diet consultation, fluoride treatments, and oral hygiene practices to reduce the patient's risk of developing dental caries. Throughout the process, motivation plays a crucial role in helping patients to adopt and maintain healthy and beneficial habits.

Caries risk assessment tools are also essential guides for teaching dental students as they begin educating patients about oral health. At Loma Linda University School of Dentistry (LLUSD), students are required to complete a Caries Risk Assessment-Consortium for Oral Health-Related Informatics (CRA-COHRI) form on all patients receiving a comprehensive or periodic oral examinations (COE or POE). This requirement was implemented in 2017. The form guides the student dentist in asking key questions about their past and present caries experience and risk factors.

Over the past several years, it has been consistently observed by the faculty and students that many patients seem to fall under the high caries risk category despite periodic exams, cleanings, and oral hygiene instructions administered. In addition, it was noted that many patients tend to decline the use of recommended products for caries prevention, such as fluoride treatments, fluoride toothpaste, or xylitol products. This has led to questions as to whether LLUSD's patient population has a higher caries risk than other populations and whether there are underlying factors that may affect caries risk and accepting/declining provider-suggested recommendations. Therefore, the purpose of the study was to evaluate the distribution of caries risk category of LLUSD patients and determine adherence to providers' recommendations. Additionally, the study aimed to collect information on the prevalence of frequent snackers, change in caries risk category for patients with multiple CRAs, and the association between caries risk and susceptibility testing results. It was hypothesized that there would be no difference in caries risk category (low, moderate, high, and extreme) distribution and that there would be no association between caries risk and susceptibility testing results.

Materials and Methods

The study was approved for a retrospective data review by the Institutional Review Board (IRB #5220377). LLUSD dental management software axiUm (Exan software, Las Vegas, NV, United States of America) was accessed for records that met the following inclusion criteria: 1. Records had completed codes of D0120 (POE) or D0150 (COE); 2. Codes were completed during a 4-month period, between March 1 and June 30, 2023; Exams were completed at the student main clinic or wellness center. Clinic administration generated access to a total of 1,235 records that were compiled into an Excel spreadsheet.

Further data were collected by reviewing patients' records on gender, age, address zip code, the sum of the number of Decayed, Missing due to caries, and Filled Teeth in the permanent teeth (DMFT), presence or absence of frequent snacking as recorded in the CRA-COHRI form, stimulated salivary flow rate, stimulated saliva pH, saliva buffering capacity assessed with Saliva-Check Buffer (GC, Tokyo, Japan), biofilm activity assessed with CariScreen Testing Meter, CRA category, Carifree (Oral BioTech, Albany, OR, United States of America) prescription given, anti-caries prescription accept/decline, and change in CRA category.

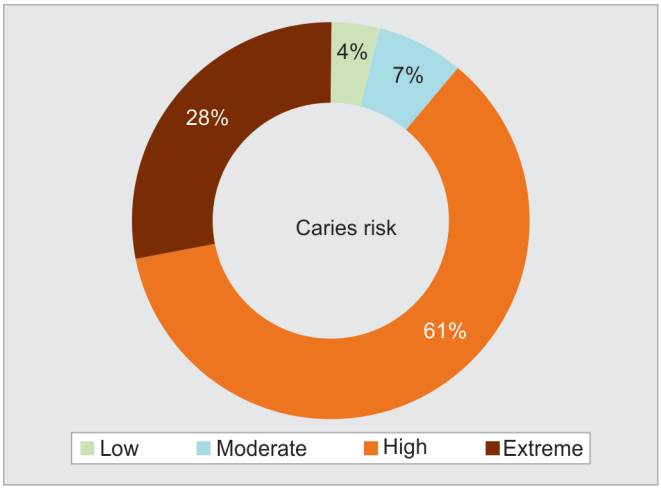

Fig. 1: Distribution of caries risk category

Table 1: Summary of caries susceptibility testing results

	*Saliva flow rate**	*Stimulated saliva pH*	*Buffering capacity*	*Biofilm activity*
Mean ± SD	1.2 ± 0.5	7.2 ± 0.4	10 ± 1.0	3289 ± 2699
Range	0–3.7	5–9	3–13	3–9999
Normal value	1.2	7.2	10–12	Less than 1500

*indicates mL/min

Descriptive statistics (means and standard deviations for continuous items, counts, and percentages for categorical items) were calculated. To analyze any associations between the categorical variables collected, a Chi-square test was performed. Linear model ANOVA was used to assess factors associated with high/extreme caries risk. Statistical significance was set at $p < 0.05$. The analysis was conducted with SAS V 9.4 (Cary, North Carolina, United States of America) and R V4.1.0.

Spatial Analytical Framework Design: Using Esri's ArcGIS Pro 2.8 software, we analyzed patients with high/extreme caries risk and patients reporting frequent snacking. The final generated descriptive density maps represent LLUSD patient population's geographic variation according to caries risk and frequent snackers.

Results

The 4-month review yielded 1235 records in total (COE = 466 and POE = 769), and out of those records, females comprised 58% and males comprised 42%. The age ranged from 14 to 95 years with a mean of 56 years. The DMFT ranged from 0 to 28 with a mean of 15.8 (D: 2.4; M: 3.7; F: 9.8).

The distribution of caries risk levels based on CRA assessments was as follows: 4% of individuals were categorized as having low caries risk, 7% were categorized as having moderate caries risk, 61% were categorized as having high caries risk, and 28% were categorized as having extreme caries risk (Fig. 1). Based on the Pearson's Chi-squared test, there was a statistically significant difference in frequency by risk category ($p < 0.001$) indicating that LLUSD patients were skewed toward high and extreme caries risk. Additionally, linear model ANOVA showed that higher risk categories were associated with lower salivary flow rates ($p = 0.010$)

and higher biofilm activity ($p < 0.001$). A summary of results from the objective caries susceptibility testing including stimulated salivary flow rate, stimulated saliva pH, saliva buffering capacity, and biofilm activity are summarized in Table 1. For all objective tests, the mean patient values were within the normal value while for the biofilm activity, the mean value represented at risk for caries.

About 1 out of 3 patients were reported to have frequent snacking ($N = 391$, 32%). Frequent snacking patients were more likely to present with higher CRA ($p < 0.001$), younger age ($p < 0.001$), and female ($p < 0.001$). Figure 2 illustrates the distribution of frequent snackers within the Inland Empire of Southern California which includes San Bernardino County, Riverside County, and part of Beaumont County. The map identified several geographic locations where more than half of the population reported frequent snacking.

Despite, recommendations from the dental student provider only 27% accepted the prescription while 61% declined the recommendation. It was also identified that 11% of records did not have data entry on the acceptance/rejection of the recommendation. The most common alternative method accepted for caries management was "Improve Oral Hygiene ($N = 779$, 63%)" followed by "Reduce Snacking ($N = 85$, 7%)", "Xylitol Mouth Spray ($N = 44$, 4%)", "Reduce Sipping ($N = 44$, 3%)." Some patients (23%) were not given an alternative.

Out of a total of 693 patients who had multiple CRA assessments, 54% (374 patients) had no change in their risk category, 24% (166 patients) had worsened risk category, and 22% (153 patients) improved toward a lower risk category.

The results indicated that the distribution of caries risk is not evenly distributed, but rather skewed toward high and extreme caries risk levels. Additionally, despite the identified risks, there was low adherence to the recommendations provided by healthcare providers.

Discussion

There has been a remarkable revolution in the field of medicine, marked by a shift from reactive to proactive care and a strong emphasis on the overall well-being of patients. According to Bartold and Ivanovski, P4 medicine emphasizes prediction, prevention, personalization, and participation for effective patient management, fostering a holistic and collaborative approach between patients and practitioners.[11] Dentistry is no exception, as evidenced by the use of CRA that embraces the four pillars of P4 medicine. By adopting these principles, dental practitioners can provide more effective, personalized, and patient-centered dental care, ultimately promoting better oral health outcomes.

The current study results are significant in that most studies on CRA have been conducted in children, and there is little information on caries risk distribution and best management protocols in the adult population.[12] Based on the results we rejected, our first hypothesis as the distribution of caries risk category was not evenly distributed but extremely skewed toward high and extreme risk. Thus, it could be predicted that for 9 out 10 patients, new caries lesions would develop or existing lesions progress unless therapeutic intervention was implemented. The uneven distribution is supported by Iqbal et al. and Agouropoulos et al. that reported about 85–87% of the population were at high risk for caries.[13,14] It is important to note that caries risk does vary among different populations and demographic groups. Factors such as age, socioeconomic status, oral hygiene practices, diet, access to dental care, and cultural practices have been reported by Su et al. to contribute to the variation in caries risk.[7] Additional linear modeling revealed an association between risk category and objective susceptibility measurements leading to the rejection of the second hypothesis. High caries risk category was related to reduced salivary flow rates and higher biofilm activity.

Snacking has become a common eating behavior in the United States. The prevalence of frequent snacking has increased over the years, with a significant portion of the population engaging in regular snacking habits. According to data from the National Health and Nutrition Examination Survey, nearly, 90% of adults in the United States reported consuming at least one snack per day.[15] The present study assessed the prevalence of frequent snackers who consume snacks between meals more than three times a day. Approximately, one-third of LLUSD patients were frequent snackers who were also associated with a higher caries risk category, younger age, and female gender. The findings are supported by other studies that reported that girls and women have higher DMF counts and are at higher risk than boys and men.[16,17] The geographic density map analyzed the distribution patterns of individuals who frequently snack, identifying areas where nutritional counseling has the potential to make a significant impact on both oral care and overall well-being.

Loma Linda University School of Dentistry advocates an evidence-based approach to managing adults at high risk of caries, which involves prescribing anti-caries products such as high-fluoride paste and mouth rinses. These recommendations are supported by the American Dental Association and studies that endorse the use of various high-fluoride products, including 2.26% fluoride varnishes, 1.23% fluoride gels, prescription-strength 0.5% fluoride gels or pastes for home use, and prescription-strength 0.09% fluoride mouth rinses.[18] However, the current study revealed a concerning trend, as approximately two-thirds of the patients declined to use the prescribed products and instead opted for alternative approaches primarily aimed at improving their oral hygiene care. There can be several reasons why patients decline their prescription for high-fluoride products despite being identified as high caries risk individuals. The most possible explanation was "cost" as these prescription products are generally not covered by dental coverage programs and are more expensive than over-the-counter products. According to Gibson et al., 1.1% sodium fluoride toothpaste or gel was among the most prescribed medications in the Veterans Affairs (VA). However, the refill rate was found to be low, as around 47% of patients never requested a refill.[19] Interestingly, cost does not seem to be a deterrent among the VA population, indicating the necessity to investigate alternative factors contributing to non-compliance.

In the present study, it was found that a significant proportion of the patient population at LLUSD, specifically 90%, were categorized as being at high or extreme risk for caries. Additionally, one-third of the patients reported frequent snacking, while over 60% declined the use of anti-caries prescriptions. Surprisingly, only 7% agreed to reduce their snacking habits. These findings highlight a notable deficiency in fostering patient "participation" in caries management, which is a crucial aspect of comprehensive holistic health care. One notable limitation of the study was the inability to establish a correlation between factors associated with the non-adherence to provider-recommended suggestions. To enhance patient engagement, implementing motivational interviewing techniques to promote healthier oral health behaviors,[20,21] along with emphasizing the importance of nutritional counseling in food selection and dietary habits as part of caries treatment and control,[22] may serve as a promising approach to improving the overall oral health and well-being of LLUSD patients.

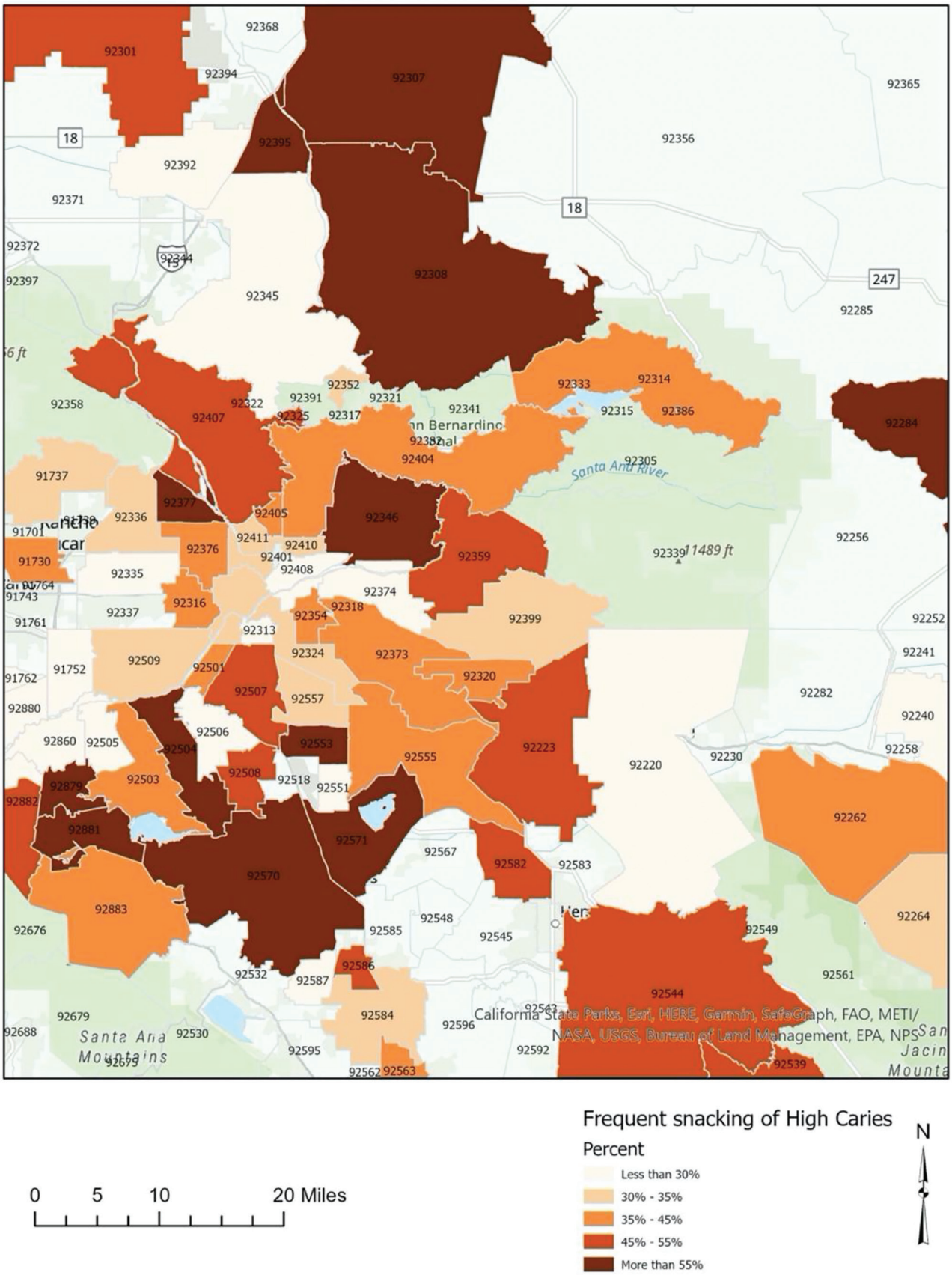

Fig. 2: Geographic density map of frequent snackers among high/extreme caries risk individuals

Conclusions

Within the limitations of the study, the findings suggest that the distribution of caries risk is not evenly distributed, but rather skewed toward high and extreme caries risk levels. Additionally, despite the identified risks, there was low adherence to the recommendations provided by healthcare providers. These results underscore the necessity for targeted interventions and initiatives aimed at fostering behavioral changes to enhance oral health outcomes.

References

1. Marsh PD. Are dental diseases examples of ecological catastrophes? Microbiology 2003;149:279–294. DOI: 10.1099/mic.0.26082-0.
2. Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries. A pending public health crisis. Am J Dent 2009; 22(1):3–8. PMID: 19281105.
3. Healthy People 2030. Building a healthier future for all. https://health.gov/healthypeople. Accessed July 20, 2023.
4. Dye BA, Tan S, Smith V, et al. Trends in oral health status: United States, 1988–1994 and 1999–2004. Vital Health Stat 2007;(248):1–92. PMID: 17633507.
5. Fontana M, Pilcher L, Tampi MP, et al. Caries management for the modern age: improving practice one guideline at a time. JADA 2018;149(11):935–37. DOI: 10.1016/j.adaj.2018.09.004.
6. Maheswari SU, Raja J, Kumar A, et al. Caries management by risk assessment: a review on current strategies for caries prevention and management. J Pharm Bioallied Sci 2015;7(Suppl 2):S320–S324. DOI: 10.4103/0975-7406.163436.
7. Su N, Lagerweij MD, van der Heijden GJMG. Assessment of predictive performance of caries risk assessment models based on a systematic review and meta-analysis. J Dent. 2021;110:103664. DOI: 10.1016/j.jdent.2021.103664.
8. American Academy of Pediatric Dentistry. Guideline on caries-risk assessment and management for infants, children, and adolescents. Reference Manual 2014;37(6):15–16.
9. American Dental Association. Caries form (Patients >6). 2008. Available at: https://www.ada.org/-/media/project/ada-organization/ada/ada-org/files/resources/public-programs/give-kids-asmile/gkas_caries_risk_assessment_forms.pdf. Accessed July 20, 2023.
10. Featherstone JDB, Chaffee BW. The evidence for caries management by risk assessment (CAMBRA!). Adv Dent Res 2018;29(1):9–14. DOI: 10.1177/0022034517736500.
11. Bartold PM, Ivanovski S. P4 Medicine as a model for precision periodontal care. Clin Oral Investig 2022;26(9):5517–5533. DOI: 10.1007/s00784-022-04469-y.
12. Fontana M, Gonzalez-Cabezas C. Minimal intervention dentistry part 2. Caries risk assessment in adults. Br Dent J 2012;213:447–451. DOI: 10.1038/sj.bdj.2012.1008.
13. Iqbal A, Khattak O, Chaudhary FA, et al. Caries risk assessment using the caries management by risk assessment (CAMBRA) protocol among the general population of Sakaka, Saudi Arabia-A cross-sectional study. Int J Environ Res Public Health 2022;19(3):1215. DOI: 10.3390/ijerph19031215.
14. Agouropoulos A, Birpou E, Twetman S, et al. Caries risk assessment with the 'Bangkok checklist' in preschool children: a prospective cohort study. Int J Paediatr Dent 2022;32(1):82–89. DOI: 10.1111/ipd.12794.
15. Sebastian RS, Enns CW, Goldman JD. MyPyramid Intakes and Snacking Patterns of U.S. Adults: What We Eat in America, NHANES 2007–2008. 2011 Jun. In: FSRG Dietary Data Briefs [Internet]. Beltsville (MD): United States Department of Agriculture (USDA); 2010–. Dietary Data Brief No. 5.
16. Winn DM, Brunelle JA, Selwitz RH, et al. Coronal and root caries in the dentition of adults in the United States, 1988–1991. J Dent Res 1996;75 Spec No: 642–651. DOI: 10.1177/00220345960750S04.
17. Martignon S, Roncalli AG, Alvarez E, et al. Risk factors for dental caries in Latin American and Caribbean countries. Braz Oral Res 2021;35(suppl 01):e053. DOI: 10.1590/1807-3107bor-2021.vol35.0053.
18. Marinho VC. Applying prescription-strength home-use and professionally applied topical fluoride products may benefit people at high risk for caries – the American Dental Association (ADA) 2013 clinical practice guideline recommendations. J Evid Based Dent Pract 2014;14(3):120–123. DOI: 10.1016/j.jebdp.2014.07.011.
19. Gibson G, Jones JA, Wehler CJ, et al. Addressing the discrepancy between efficacy and effectiveness of 1.1% sodium fluoride toothpaste or gel in adults as part of a caries prevention program. J Am Dent Assoc 2023;154(7):541–544:S0002-8177(23)00023-5. DOI: 10.1016/j.adaj.2023.01.004.
20. Wu L, Lo ECM, McGrath C, et al. Motivational interviewing for caries prevention in adolescents: a randomized controlled trial. Clin Oral Investig. 2022;26(1):585–594. DOI: 10.1007/s00784-021-04037-w.
21. Franki J, Hayes MJ, Taylor JA. The provision of dietary advice by dental practitioners: a review of the literature. Community Dent Health 2014;31(1):9–14. PMID: 24741887.
22. Touger-Decker R, Mobley CC, American Dietetic Association. Position of the American Dietetic Association: oral health and nutrition. J Am Diet Assoc 2007;107(8):1418–1428. DOI: 10.1016/j.jada.2007.06.003.