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Assessment of Risk Factors and Periodontitis in Ukraine: Unraveling the Impact of Smoking, Stress, and More

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Abstract

This article focused on the "Assessment of the impact of various risk factors (e.g., smoking, stress) on the prevalence and severity of periodontitis in the Ukrainian population". The study's primary goals were to assess the prevalence of periodontitis, various risk factors, and their influence on periodontitis within the Ukrainian population. A descriptive cross-sectional study design was employed. Secondary data collected. Descriptive statistics were obtained and utilized.

The prevalence of oral health issues especially periodontitis varies across age groups, with a significant proportion affected, including 46.5% of children (1-9 years) having untreated deciduous tooth caries, persisting into adulthood (32.4% with permanent tooth caries, ages 5+). Severe periodontal disease affects 18.9% (ages 15+), and 14.0% (ages 20+) experience edentulism. Results further show that sugar availability at 91.3g/day; tobacco use at 11.6% (males) and 40.7% (females); and average alcohol intake of 8.3 units, notably higher for females and periodontitis. These findings suggest females' increased tobacco and alcohol consumption and stress may contribute to a higher oral disease risk, necessitating deeper analysis. Results further highlight the periodontitis determinants encompass structural (macroeconomic policies, globalization), intermediate (socio-economic factors), and proximal (diet, hygiene, inflammation) influences, collectively impacting oral health burdens, especially periodontitis. Current evidence indicates high periodontal disease prevalence in Ukraine, with stress and smoking highly prevalent and possibly contributing. More research is needed to understand their exact connection for better treatment approaches.

Keywords: Impact assessment, Periodontitis prevalence, Severity, Smoking, Stress, Ukrainian population

Introduction

Oral illnesses, even though they may be avoided in most cases, place a significant burden on public health in many nations and impact people throughout their whole lives, causing discomfort, suffering, deformity, and in some cases even death. It is estimated that over 3.5 billion individuals worldwide suffer from oral disorders. The chronic inflammatory illness known as periodontitis, which affects the tissues that hold teeth in place, is a major cause for worry in terms of public health across the world. Several risk factors have been linked to the development and advancement of the disorder, and the prevalence and severity of the condition can vary greatly from community to population. Smoking and stress have been identified as two of the most significant contributions to the genesis of periodontitis, among the several risk factors. The purpose of this study is to conduct a complete analysis of the influence that several risk variables have on the prevalence and severity of periodontitis among the Ukrainian population, with a particular emphasis on smoking and stress (Salari *et al*., 2022).

Periodontitis poses a substantial burden on both individuals and healthcare systems. It leads to tooth loss, functional impairment, and decreased quality of life, while also increasing the risk of systemic conditions like cardiovascular disease and diabetes. The World Health Organization (WHO) estimates that periodontitis affects 10-15% of the global population, with significant regional variations. Eastern European countries, including Ukraine, have shown relatively higher prevalence rates compared to other parts of the world. Understanding the factors contributing to this increased prevalence is crucial for designing targeted prevention and treatment strategies (Ziuzin *et al*., 2021a).

It is vital to understand the incidence and severity of periodontitis in the Ukrainian population before diving into the influence of risk factors. Studies that have already been conducted have demonstrated that the illness may be found across Ukraine but with differing degrees of severity across different age groups and geographical areas. An investigation of the prevalence of periodontal disease across the nation lays the groundwork for determining the potential risk factors that are responsible for these trends (Lorenzo-Erro *et al*., 2022).

Smoking has long been recognized as a major modifiable risk factor for periodontitis. Cigarette smoke contains numerous harmful chemicals, such as nicotine and tar, that can negatively affect oral health. These drugs decrease the immune response, limit blood flow to the gums, and encourage bacterial colonization, which together produce an environment that is favorable to the growth of periodontal infections. Studies from other populations have established a robust association between smoking and an

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increased risk of periodontitis (Karobari *et al*., 2022). Considering this, researching the connection between tobacco use and periodontal health in the context of Ukraine is necessary.

In recent years, the role of psychosocial factors, particularly stress, has garnered attention in the etiology of periodontitis. Chronic stress can lead to dysregulation of the immune system and increase susceptibility to infections, including those affecting the oral cavity. Moreover, stress may influence oral health behaviors, such as brushing and flossing frequency, which can further impact periodontal health. Investigating the interplay between stress and periodontitis in the Ukrainian population will provide valuable insights into potential avenues for intervention and support (World Health Organization, n.d.).

While smoking and stress represent two major risk factors, it is essential to consider other potential contributors to periodontal disease in the Ukrainian population. Poor oral hygiene, inadequate nutrition, systemic health conditions like diabetes, and genetic predispositions may all play roles in the development and progression of periodontitis. A comprehensive assessment of these factors will provide a more holistic understanding of the disease burden in Ukraine (Humanitarian Data Exchange, n.d.; World Health Organization, n.d.).

The creation and use of novel technology, processes, and strategies for the enhancement of the provision of healthcare services are referred to as innovative activities in healthcare. Next-generation sequencing, 3D printing, telemedicine, electronic health records, personalized and precision medicine, artificial intelligence, and nanotechnology are a few examples of such breakthroughs (Kaminskyy & Viesova, 2022). Artificial intelligence and digital technologies, especially information technology (IT), have played a key role in a variety of facets of healthcare in Ukraine, including dental health and the identification of risk factors for illnesses such as periodontitis (Sofy, 2023). In recent years, there has been a significant adoption of digital technology in modern medicine. This has resulted in the creation of an environment that is favorable for examining potential paths for future clinical trials. The field of healthcare is facing new problems as a result of recent theoretical advancements and clinical findings. The problems of disease surveillance, prompt and early detection, enhancing the efficiency of diagnosis and treatment, searching for novel ways of therapy and rehabilitation, bringing healthcare closer to the patient, and personalizing medicine are all topics that are now being rethought (Rakhimov & Mukhamediev, 2022). Oral health issues and the variables that put patients at risk can both be uncovered with the use of digital technologies. The use of information technology can facilitate the creation of interactive risk assessment tools as well as mobile applications. Individuals can use these tools to assist them in self-assessing their risk for periodontitis based on several different characteristics, and they can give individualized advice for the prevention and treatment of the condition. Additionally, mobile applications can provide notifications and reminders regarding dental checkups and hygiene habits (Khalid, 2023). There are several compelling reasons why it is important to research the prevalence and severity of periodontitis in the Ukrainian population, one of which is that it is crucial to assess the impact of various risk factors including smoking and stress. For effective prevention and treatment strategies to be developed and put into practice, it is essential to comprehend the role that specific risk factors play in the onset and progression of periodontitis. In Ukraine, periodontitis is a significant public health issue. Because it offers a more detailed understanding of the relationship between risk variables and periodontitis, this study is particularly helpful. The different social, cultural, and demographic characteristics of the Ukrainian population may also influence the association between risk factors and periodontitis.

Aims and Objectives

The following are the aims and objectives:

1. To assess the occurrence of periodontitis and identify associated risk factors within the Ukrainian population.
2. To investigate how different risk factors influence both the prevalence and seriousness of periodontitis among individuals in Ukraine.

Research Questions

1. What is the current prevalence of periodontitis among different age groups within the Ukrainian population?
2. How do different risk factors including smoking, good dental hygiene habits, and underlying health issues affect the prevalence and severity of periodontitis in the Ukrainian population?

Materials and Methods

General Background

The supporting components of teeth are affected by periodontitis, a chronic inflammatory disease that has become a major public health problem worldwide. Understanding how different risk factors, like as stress and smoking, affect the frequency and severity of periodontitis in the Ukrainian population is crucial. Smoking, which has been shown to have negative impacts on oral health, can aggravate inflammation and decrease immunological responses, which may hasten the development of periodontal disease.

Data Analysis

Secondary data was utilized in this research by extraction through already published articles within the Ukrainian population on the assessment of the impact of various risk factors (e.g., smoking, stress) on the prevalence and severity of periodontitis in the Ukrainian population. Both quantitative and qualitative data types were utilized. No analysis was conducted. To summarise and characterise the data acquired table and graph were plotted.

Results and Discussion

Prevalence of Oral Disease

Figure 1 highlights the prevalence rates of various oral health conditions among different age groups. Among children aged 1-9 years, a concerning 46.5% suffer from untreated caries in their deciduous teeth. This condition persists into adulthood, with 32.4% of people aged 5 and above having untreated caries in their

permanent teeth. Additionally, 18.9% of individuals aged 15 and above are affected by severe periodontal disease, which can lead to serious dental issues if left untreated. Furthermore, the data reveals a distressing 14.0% of individuals aged 20 and above experiencing edentulism, indicating a loss of all their natural teeth. These statistics underscore the importance of promoting comprehensive oral healthcare and early intervention to address these prevalent oral health challenges and improve the overall well-being of individuals across different age groups.

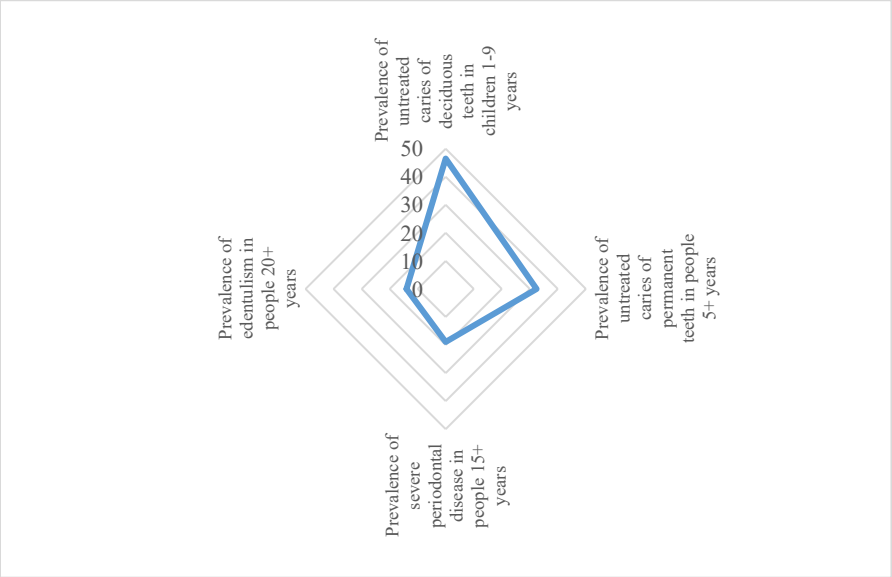

Figure 1. Burden of Oral Health Problems (Periodontitis)
Source: Authors' development based on WHO Data n.d.

Prevalence Risk Factors of Oral Disease

Table 1 illustrates the risk factors associated with oral diseases in 2019, categorized by gender. The dataset comprises three key variables: per capita sugar consumption (g/day), prevalence of current tobacco usage among individuals aged 15 and above, and per capita alcohol consumption within the same age bracket. Regarding "Per Capita Availability of Sugar," specific figures for males and females are not provided, but the overall average is documented at 91.3 grams per day. Concerning tobacco use, the prevalence among males is recorded at 11.6%, whereas among females, it notably rises to 40.7%. Moving on to alcohol consumption, the data shows that males averaged 3.7 units, females consumed an average of 14.0 units, and the overall average stood at 8.3 units. These findings imply that females exhibit a higher tendency for increased tobacco usage and alcohol consumption, which could potentially contribute to an elevated risk of oral diseases within this gender group. Nevertheless, drawing more definitive conclusions would necessitate additional analysis and consideration of other conceivable risk factors.

Table 1. Risk Factors of Oral Health Problems (Periodontitis)

Variables	Male	Female	Total
Per capita availability of sugar (g/day)	-	-	91.3
Prevalence of current tobacco use, 15+ years (%)	11.6	40.7	26.2
Per capita alcohol consumption, 15+ years	3.7	14.0	.0 8.3

Source: Authors' development based on Oral Health Country Profile WHO n.d.

Determinates of Oral Health Problems (Periodontitis)

Table 2 presents the determinants of oral diseases, specifically focusing on periodontitis. These determinants are categorized into three levels: structural, intermediate, and proximal. At the structural level, issues such as macroeconomic laws, welfare policies, trade restrictions, international development plans, globalization, and urbanization all play a part in the process of determining the prevalence of oral illnesses as well as the influence that they have. The intermediate determinants include a wide range of socioeconomic characteristics, some of which include social class, income, education, gender, ethnicity, material circumstances, social interactions, psychological issues, and access to health care and environmental conditions. In conclusion, the proximal determinants have a direct impact on the development of periodontitis. These proximal determinants include factors such as nutrition, alcohol intake, cigarette use, physical activity, hygiene habits, inflammation, infection, and immunological response. The eventual consequences of these factors may be seen in the prevalence of dental disorders and non-communicable diseases, most notably periodontitis. Understanding these factors and taking a comprehensive approach to treating them can assist in the

development of successful methods for the prevention and management of periodontitis as well as the reduction of the disease's negative effects on overall health.

Table 2. Determinates of Oral Health Problems (Periodontitis)

Structural determinates	Macroeconomic regulations Welfare along with social policy, trade regulations, international development strategies, globalization, and urbanization
Intermediate determinates	Social class, income education gender, ethnicity, material circumstances, social relationships, psychosocial factors, health services availability or use, and environmental setting
Proximal determinates	Diet, alcohol consumption, tobacco use, physical activity, hygiene, inflammation, infection and immune response
Outcomes	Oral disease and NCD burden (Periodontitis)

Source: Authors' development based on (Global Oral Health Status Report WHO, n.d.).

According to the findings of the investigation, the incidence of periodontal disease is rather high in Ukraine. In a similar vein, research that was carried out in the year 2020 discovered that 81.58 percent of patients in Chernivtsi who had metabolic syndrome also had periodontal disease (Hlushchenko *et al*., 2020). Another study conducted in Ukraine found that tooth decay was the main oral pathology, affecting 60.3% of the population (Ziuzin *et al*., 2021b). According to the findings of a study conducted on gingival recession in individuals suffering from periodontitis in the Ukrainian population, the prevalence of gingival recession was one hundred percent (Humagain & Kafle, 2013). The World Health Organization estimates that severe periodontal diseases impact around 19% of the world's adult population, which equates to more than 1 billion people affected globally (World Health Organization, 2023). Based on the findings of a recent study, the average age-standardized prevalence rate of severe periodontitis increased by 8.44% worldwide between the years 1990 and 2019 (Chen *et al*., 2021). In individuals suffering from periodontitis in the Ukrainian population, gingival recession was determined to have a prevalence of one hundred percent, according to a study on gingival recession (Mazur *et al*., 2020).

Regarding the evaluation of the influence of various risk factors on the prevalence and severity of periodontitis in the Ukrainian population, there is vast research that focuses on issues associated with this topic. This finding is consistent with earlier research that has revealed a greater frequency of smoking among girls in Ukraine and a high incidence of periodontitis or oral health concerns. The prevalence of tobacco usage is much higher among females than it is among males. Additionally, there is a larger intake of alcohol per capita among females, which is consistent with the findings of earlier research that indicated higher rates of alcohol consumption among females and a high incidence of periodontitis or other oral health problems in Ukraine (Ludvigsson & Loboda, 2022; Center of Excellence in Newcomer Health, n.d.).

Plaque on teeth is the single most important risk factor for periodontitis, which is a chronic inflammatory disease that is caused by a complicated interaction of several risk factors (GOV.UK, 2021). According to the Global Oral Health Status Report published by the World Health Organization (WHO), the two most significant risk factors for periodontal disease are improper oral hygiene and cigarette use (World Health Organization, 2023). Tobacco use, improper dental hygiene, diabetes, certain medications, advanced age, genetic predisposition, stress, nutrition, intake of alcoholic beverages, regular physical activity, inadequate hygiene practices, periodontitis, infection, and immunological response are some of the additional risk factors for periodontitis. There is some evidence to suggest that a lower amount of sleep is connected with an increased prevalence of periodontitis (Alhassani & Al-Zahrani, 2020).

The effect of various stressors on the prevalence of periodontitis in Ukraine and worldwide is a complex topic that requires comprehensive research. Association between chronic stress and periodontitis was studied in a study conducted in the South Indian population found a positive association between chronic stress and chronic periodontitis. However, it is essential to point out that this study had certain shortcomings, including a limited sample size and a lack of temporality in the events that were examined. To determine whether or if there is a genuine connection between stress and periodontitis, further prospective research with bigger sample numbers is required (Varma *et al*., 2023).

It's important to note that periodontal disease is influenced by various factors, including poor oral hygiene, tobacco use, diabetes, and health inequalities. Stress may be one of the contributing factors, but its exact role and impact on the prevalence of periodontitis require further investigation (World Health Organization, 2023). In another study that sought to determine how stress affects periodontal health, individuals who suffered from periodontal disease were shown to have a much higher incidence of anxiety, depression, distress, and moderate to high levels of stress. This shows that stress may affect periodontal health; however, further study is required to understand the particular processes and causation involved in this relationship (Corridore *et al*., 2023).

Conclusion

In conclusion, the prevalence of periodontal disease in Ukraine appears to be a big problem, since studies indicate high rates of both periodontitis and other oral health concerns such as tooth decay and gingival recession. In addition, the prevalence of periodontal disease in Ukraine looks to be a serious concern. Despite severe periodontal diseases afflicting a sizeable proportion of the adult population across the world, the prevalence of these conditions in Ukraine appears to be significantly greater than the norm for the rest of the world. The progression and severity of periodontitis are both influenced by several risk factors, some of which are a lack of proper dental hygiene, the use of tobacco products, the intake of alcohol, diabetes, and maybe even stress. Although stress has been hypothesized to have a role in the development of periodontal disease, the nature of this function and the effects it has on the body are still not fully understood and require more research. There is a need for further strong research

to demonstrate a conclusive relationship between chronic stress and periodontitis. Although some studies point to a connection between chronic stress and periodontitis, there are limitations in the study design and the sample size. Comprehensive and prospective research is required because of the interaction of stress with other risk factors that are present in the Ukrainian community as well as the particular impact that stress has on periodontal health. Furthermore, addressing periodontal health requires a holistic approach that encompasses various factors, including oral hygiene practices, tobacco and alcohol use, diabetes management, and potentially stress reduction. Improving public awareness, promoting healthier lifestyles, and enhancing access to oral healthcare services are crucial steps in mitigating the burden of periodontal disease in Ukraine and globally.

In summary, the information that is currently available reveals that there is a considerable incidence of periodontal disease in Ukraine and draws attention to the probable role that stress and smoking play as contributing factors. Despite this, further study is required to determine the precise link that exists between stress, smoking, and periodontitis. Because of this, it will be possible to establish solutions that are more focused and more successful in promoting periodontal health as well as general well-being.

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References

Alhassani, A. A., & Al-Zahrani, M. S. (2020). Is inadequate sleep a potential risk factor for periodontitis? *Plos One*, *15*(6), e0234487. doi:10.1371/JOURNAL.PONE.0234487

Center of Excellence in Newcomer Health (n.d.). *Brief Overview for Clinicians Caring for Ukrainian New Arrivals.* Retrieved August 1, 2023, from: https://www.health.state.mn.us/communities/rih/about/ukrainianbrief.pdf

Chen, M. X., Zhong, Y. J., Dong, Q. Q., Wong, H. M., & Wen, Y. F. (2021). Global, regional, and national burden of severe periodontitis, 1990–2019: An analysis of the Global Burden of Disease Study 2019. *Journal of Clinical Periodontology*, *48*(9), 1165-1188. doi:10.1111/JCPE.13506

Corridore, D., Saccucci, M., Zumbo, G., Fontana, E., Lamazza, L., Stamegna, C., Di Carlo, G., Vozza, I., & Guerra, F. (2023). Impact of Stress on Periodontal Health: Literature Revision. *Healthcare*, *11*(10), 1516. doi:10.3390/HEALTHCARE11101516

GOV.UK. (2021, November 9). *Delivering better oral health: An evidence-based toolkit for prevention*. Office for Health Improvement and Disparities, Department of Health and Social Care, NHS England, & NHS Improvement. Retrieved August 1, 2023, from: https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention

Hlushchenko, T. A., Batig, V. M., Borysenko, A. V., Tokar, O. M., Batih, I. V., Vynogradova, O. M., & Boychuk-Tovsta, O. G. (2020). Prevalence and Intensity of Periodontal Disease in Individuals with Metabolic Syndrome. *Journal of Medicine and Life*, *13*(3), 289. doi:10.25122/JML-2020-0073

Humagain, M., & Kafle, D. (2013). The Evaluation of Prevalence, Extension and Severity of Gingival Recession among Rural Nepalese Adults. *Orthodontic Journal of Nepal*, *3*(1), 41-46. doi:10.3126/OJN.V3I1.9281

Humanitarian Data Exchange. (n.d.). *Oralhealth Indicators for Ukraine*. Retrieved July 28, 2023, from https://data.humdata.org/dataset/who-data-for-ukraine/resource/42648a25-c8db-4448-a3ca-3085ed81afc7

Kaminskyy, V., & Viesova, O. (2022). Innovative activities in healthcare institutions of the future: Models for overcoming dilemmas. *Futurity Medicine*, *1*(1), 17-26. Retrieved August 5, 2023, from: https://futurity-medicine.com/index.php/fm/article/view/2

Karobari, M. I., Siddharthan, S., Adil, A. H., Khan, M. M., Venugopal, A., Rokaya, D., Heboyan, A., Marya, C. M., & Marya, A. (2022). Modifiable and Non-modifiable Risk Factors Affecting Oral and Periodontal Health and Quality of Life in South Asia. *The Open Dentistry Journal*, *16*(1). doi:10.2174/18742106-V16-E2209270

Khalid, N. (2023). The role of artificial intelligence in the management of lung cancer: a narrative review. *Futurity Medicine*, *2*(1), 36-46. doi:10.57125/FEM.2023.03.30.04

Lorenzo-Erro, S. M., Andrade, E., Massa, F., Colistro, V., Asquino, N., & Moliterno, P. (2022). Periodontitis prevalence and associated factors: a comparison of two examination protocols. *Acta Odontoloógica Latinoamericana*, *35*(3), 178. doi:10.54589/AOL.35/3/178

Ludvigsson, J. F., & Loboda, A. (2022). Systematic review of health and disease in Ukrainian children highlights poor child health and challenges for those treating refugees. *Acta Paediatrica*, *111*(7), 1341-1353. doi:10.1111/APA.16370

Mazur, I., Suprunovych, I., & Novoshytskyy, V. (2020). Prevalence, extent, severity and intraoral distribution of gingival recession in patients with periodontitis in Ukrainian population. *Modern Science. Moderní věda, 2020*(4), 122-130. https://www.researchgate.net/profile/Volodymyr-Novoshytskyy-2/publication/355980212_PREVALENCE_EXTENT_SEVERITY_AND_INTRAORAL_DISTRIBUTION_OF_GINGIVAL_RECESSION_IN_PATIENTS_WITH_PERIODONTITIS_IN_UKRAINIAN_POPULATION/links/6187d4cc3068c54fa5ba29a5/PREVALENCE-EXTENT-SEVERITY-AND-INTRAORAL-DISTRIBUTION-OF-

GINGIVAL-RECESSION-IN-PATIENTS-WITH-PERIODONTITIS-IN-UKRAINIAN-POPULATION.pdf

Rakhimov, T., & Mukhamediev, M. (2022). Implementation of digital technologies in the medicine of the future. *Futurity Medicine*, *1*(2), 12-23. Retrieved August 5, 2023, from: https://www.futurity-medicine.com/index.php/fm/article/view/7

Salari, N., Darvishi, N., Heydari, M., Bokaee, S., Darvishi, F., & Mohammadi, M. (2022). Global prevalence of cleft palate, cleft lip and cleft palate and lip: A comprehensive systematic review and meta-analysis. *Journal of Stomatology, Oral and Maxillofacial Surgery*, *123*(2), 110-120. doi:10.1016/J.JORMAS.2021.05.008

Sofy, A. A. (2023). An overview of artificial intelligence use in diabetic retinopathy treatment: a narrative review. *Futurity Medicine*, *2*(1), 4-13. Retrieved August 5, 2023, from https://www.futurity-medicine.com/index.php/fm/article/view/21

Varma, S. V, Varghese, S., & Nair, S. V. (2023). Prevalence of Chronic Periodontitis and Chronic Stress in the South Indian Population. *Cureus*, *15*(1). doi:10.7759/CUREUS.33215

World Health Organization. (2023, March 14). *Oral health.* Retrieved August 1, 2023, from: https://www.who.int/news-room/fact-sheets/detail/oral-health

World Health Organization. *Oral health.* Retrieved July 28, 2023, from: https://www.who.int/health-topics/oral-health#tab=tab_1

Ziuzin, V., Cherno, V., Cherno, S., Zyuzin, D. V., & Muntian, L. (2021a). The Incidence of the Population of Ukraine of Inflammatory Periodontal Diseases, Prediction and Prevention of Pathology in Modern Conditions. *Ukraïns'kij Žurnal Medicini, Biologìï Ta Sportu*, *6*(2), 125-132. doi:10.26693/JMBS06.02.125

Ziuzin, V., Cherno, V., Cherno, S., Zyuzin, D. V., & Muntian, L. (2021b). The Incidence of the Population of Ukraine of Inflammatory Periodontal Diseases, Prediction and Prevention of Pathology in Modern Conditions. *Ukraïns'kij Žurnal Medicini, Biologìï Ta Sportu*, *6*(2), 125-132. doi:10.26693/JMBS06.02.12