Association of the self-reported socioeconomic and health status with untreated dental caries and the oral hygiene level in adult patients

Peršić Bukmir, Romana; Paljević, Ema; Pezelj-Ribarić, Sonja; Brekalo Pršo, Ivana

Original paper

Association of the self-reported socioeconomic and health status with untreated dental caries and the oral hygiene level in adult patients

Romana Peršić Bukmir[1,A–D], Ema Paljević[1,B,D,F], Sonja Pezelj-Ribarić[2,3,A,E,F], Ivana Brekalo Pršo[1,3,A,E,F]

[1] Department of Endodontics and Restorative Dentistry, Faculty of Dental Medicine, University of Rijeka, Croatia
[2] Department of Oral Medicine and Periodontology, Faculty of Dental Medicine, University of Rijeka, Croatia
[3] Department of Dental Medicine, Faculty of Dental Medicine and Health, J.J. Strossmayer University of Osijek, Croatia

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
D – writing the article; E – critical revision of the article; F – final approval of the article

Dental and Medical Problems, ISSN 1644-387X (print), ISSN 2300-9020 (online) *Dent Med Probl*. 2022;59(4):539–545

Address for correspondence
Romana Peršić Bukmir
E-mail: rpersic@gmail.com

Funding sources
Funding grant from the University of Rijeka, Croatia (grant No. 818101218).

Conflict of interest
None declared

Acknowledgements
None declared

Received on March 22, 2021
Reviewed on June 7, 2021
Accepted on June 14, 2021

Published online on December 7, 2022

Abstract

Background. Dental caries is a multifactorial disease and its management requires a thorough analysis of its etiological factors.

Objectives. The present study used a multivariate approach to investigate the associations of socioeconomic and health-related determinants with untreated tooth decay and level of oral hygiene in adult individuals.

Material and methods. A cross-sectional study involved 597 adult patients. Health and socioeconomic status were assessed using a self-administered structured questionnaire. The presence of decayed teeth was recorded clinically using the World Health Organization diagnostic thresholds. Oral hygiene level was estimated using the plaque index. Multiple linear regression analysis was used to explore the associations of socioeconomic and health-related variables with the number of decayed teeth and level of oral hygiene.

Results. Socioeconomic and health-related variables explained 34.1% of the observed variation in the number of decayed teeth ($p < 0.001$) and 19.2% of the observed variation in the plaque index ($p < 0.001$). Analysis revealed several significant associations for both decayed teeth and plaque index scores. Males had 2.3 more untreated decayed teeth than women and an increased plaque index score of 0.3 units (unique contributions of 6.6 and 4.2%, respectively). An increase in self-assessed household economic status decreased the average number of decayed teeth by 1.3 and the plaque level score by 0.13 (unique contributions of 3.13% and 1.46%, respectively). Smokers presented with 1.78 more decayed teeth than non-smokers (unique contribution of 2.1%) and an increase in the plaque index by 0.48 units (unique contribution of 8.5%).

Conclusions. Untreated dental caries and dental plaque severity share the same socioeconomic and health-related determinants.

Keywords: smoking, dental caries, oral hygiene, dental plaque index, socioeconomic factors

Cite as
Peršić Bukmir R, Paljević E, Pezelj-Ribarić S, Brekalo Pršo I. Association of the self-reported socioeconomic and health status with untreated dental caries and the oral hygiene level in adult patients. *Dent Med Probl.* 2022;59(4):539–545. doi:10.17219/dmp/138908

DOI
10.17219/dmp/138908

Introduction

The World Health Organization (WHO) defines dental caries or tooth decay as a significant public health problem and the most widespread noncommunicable disease worldwide.[1] The general level of caries varies significantly between European countries, and its prevalence in Croatia is high. The decayed, missing and filled teeth (DMFT) index of both 12-year-old children and adults in this country significantly exceeds the average DMFT index of the European population.[2] A recent study conducted on Croatian schoolchildren reported that one third of participants had gingivitis, while half of them had caries.[3] The consequences of a high caries prevalence are severe and can have a cumulative effect in adulthood. Dental caries and its potential consequences, endodontic and periapical disease, were shown to be the most frequent causes of permanent tooth loss in Croatia.[4] Although the loss of teeth can also be attributed to the treatment approach of dentists, views of patients, and accessibility and standard of dental care, it is important to treat teeth with active caries as early as possible.

Dental caries in adults is a multifactorial disease and its management requires thorough identification of its etiological factors, as well as recognition of its cumulative nature.[1,5] A growing amount of evidence indicates that general and oral health are influenced by socioeconomic status (SES). It seems that socioeconomic factors have an indirect influence through environmental factors and impact disease processes through psychosocial stress and health-related habits.[6] Educational background, SES and gender have already been identified as factors influencing oral health.[7,8] Previous investigations have reported that level of education, employment status, household income, smoking habits, dental service usage, gender, daily medications, and marital status seem to contribute to tooth decay in adults.[7–10] Also, a clear socioeconomic gradient in health behavior has been established, indicating that individuals with lower educational levels report a higher frequency of health-compromising behaviors.[11]

As a recent study showed that an absence of pain was the most common justification given for leaving decayed teeth (DT) untreated, it seems that the merits of treatment may be outweighed by other priorities.[12] Considering the detrimental effects of untreated caries not only on dentition, but on overall life quality as well, it is important to identify the reasons for leaving teeth with active caries untreated in adults.

Poor oral hygiene results in an accumulation of dental plaque, which harbors bacteria and their toxins. The role of dental plaque in dental caries disease is well known.[13] Age, gender, SES, and birth-rank were identified as significant predictors of oral hygiene status in schoolchildren.[14] Considering the cumulative effects of poor oral hygiene on caries status, it may be presumed that similar social predictors can be significant in adulthood. Furthermore, a recent study identified oral hygiene, education and employment status as significant predictors for untreated decay, indicating the need to pay attention to oral hygiene in socially vulnerable groups in order to promote oral health.[15] The connection between oral and systemic health is one of the most significant problems faced by the medical and dental scientific community.[16] A recent study reported a significant association of self-reported health with dentate status, and confirmed the connection between oral and systemic health. These results emphasize the importance of preserving natural dentition as a global goal to improve systemic health.[17]

The hypothesis of the present study was that untreated dental caries and dental plaque severity share the same socioeconomic and health-related determinants. Therefore, this research used a multivariate approach to investigate and quantify the associations of self-reported socioeconomic and health status with the number of untreated DT and the level of oral hygiene in adult individuals.

Material and methods

The present investigation is a part of a larger cross-sectional study on apical periodontitis risk indicators and their influence on periapical status in adult patients. It received approval from the institutional Ethical Committee of the Clinical Hospital Center, Rijeka, Croatia (No. 003-05/13-01/03).

The sample for the present survey was drawn from 1072 eligible patients older than 18 years who attended the University Dental Clinic at Rijeka Clinical Hospital Centre, Rijeka, Croatia, for the first time and presented consecutively within a 2-year period. General practitioners from 3 counties referred these patients to the Dental Clinic since it is the only healthcare institution in the area providing full specialist dental care through the health insurance system.

The sample and the criteria for inclusion and exclusion were previously described by Peršić Bukmir et al.[18] Patients were excluded if they refused to take part in the study, received endodontic treatment within previous 2 years, had seven or fewer remaining teeth, and/or suffered from periodontal disease. Additionally, 2 patients who did not complete the questionnaire were excluded. Criteria developed by Machtei et al. were used for establishing the presence of periodontal disease.[19] Application of the exclusion criteria provided a sample comprised of 597 participants – 190 males (31.8%) and 407 females (68.2%). All participants agreed to be included in the study by signing an informed consent form. The investigation was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki.

Data was acquired through clinical examination and a self-administered questionnaire filled in by the participants. The structured questionnaire was used to obtain

data on participant health condition, health-related habits and SES. Clinical examinations were carried out in a dental chair under standard light. Oral hygiene levels were assessed utilizing the plaque index (PI) in accordance with the Sileness and Löe criteria.[20] Four surfaces of 6 teeth were examined (16, 12, 24, 36, 32, and 44). No disclosing solution or tablets were used in order to avoid interference with caries registration. After cleaning and drying with compressed air, teeth were examined using a dental mirror and a community periodontal index (CPI) probe. All teeth, with the exception of impacted teeth and third molars, were recorded. To avoid uncertainties regarding early caries detection, diagnostic thresholds according to the WHO were applied. A diagnosis of caries was established only in the presence of cavitated lesions.[21]

One of the authors who underwent calibration for the clinical diagnosis of dental caries and PI collected the clinical data. The calibration was performed according to WHO recommendations.[21] An evaluation of diagnostic intra-examiner reliability was performed through double scoring of 30 randomly selected participants with a 1-week time interval for dental caries and 1 h for dental plaque. The intra-examiner agreement scores produced kappa values of 0.92 for the clinical diagnosis of dental caries and 0.85 for plaque assessment.

To explore the associations of socioeconomic and health-related variables with untreated DT and the level of oral hygiene, 2 multiple linear regression models were employed. The 1st used DT as an outcome variable, as it provides a measure of more recent untreated disease experience. This variable was also used in a previous study.[22] In the 2nd model, PI was used as an outcome variable. An overview of the socioeconomic and health-related predictor variables tested in both models is presented in Table 1.

Table 1. Predictor variables tested in multivariate regression analysis and distribution of 597 participants according to observed variables

Variable		Registration and codes	*n* (%)
Socioeconomic variables	age	continuous variable	–
	gender	0 = female	407 (68.2)
		1 = male	190 (31.8)
	level of education	1 = low	19 (3.2)
		2 = medium	343 (57.4)
		3 = high	235 (39.4)
	self-assessed economic status of household	1 = below the average	98 (16.4)
		2 = average	369 (61.8)
		3 = above the average	130 (21.8)
	residency	0 = urban	134 (22.4)
		1 = rural	463 (77.6)
	marital status	0 = single	298 (49.9)
		1 = cohabiting	299 (50.1)
Health-related variables	smoking behavior	0 = no, occasionally	473 (79.2)
		1 = everyday smoker	124 (20.8)
	complementary health insurance	0 = no	125 (20.9)
		1 = yes	472 (79.1)
	number of dental visits during the last year	1 = <2	225 (37.7)
		2 = 3–10	257 (43.0)
		3 = >10	115 (19.3)
	number of visits to family doctor during the last year	1 = <2	359 (60.1)
		2 = 3–10	179 (30.0)
		3 = >10	59 (9.9)
	dental visit to private practice during the last year	0 = no	418 (70.0)
		1 = yes	179 (30.0)
	dentist providing dental care through health insurance system	0 = no	25 (4.2)
		1 = yes	572 (95.8)
	family doctor providing care through health insurance system	0 = no	15 (2.5)
		1 = yes	582 (97.5)
	self-perceived general health	1 = excellent	114 (19.1)
		2 = very good	230 (38.5)
		3 = good	150 (25.1)
		4 = satisfying	103 (17.3)

Statistical analysis

Statistica, v. 13.0 software (StatSoft Inc., Tulsa, USA) was used to perform the statistical analysis. The level of statistical significance was set at $p < 0.05$. Testing for a normal distribution was accomplished with the Lilliefors test. Considering that the data was not distributed normally, median and interquartile range (IQR) were used as measures of central tendency and dispersion. To test for differences between the groups in continuous variables, the Mann–Whitney U test was chosen. To examine the associations between the dependent variables (number of DT and PI) and predictor variables, multiple linear regression analysis (backward model) was used.

Results

The median age for all participants was 34 years, with an IQR of 24.0–47.0. Most of the sample consisted of females (68.2%). No significant age difference between male and female participants was found (Mann–Whitney test, $p = 0.511$). The median number of teeth present in the sample was 26 per person, with an IQR of 24–28. The average values for DT and PI were 5.0 (IQR 2.0–8.0) and 0.8 (IQR 0.4–1.25), respectively. Figure 1 shows the distribution of the number of DT per person. Only 69 participants (11.6%) had no teeth with untreated decay.

Multiple linear regression analysis was applied to identify possible socioeconomic and health-related determinants associated with the DT and PI scores. The variables demonstrating the best fit are presented in Tables 2 and 3.

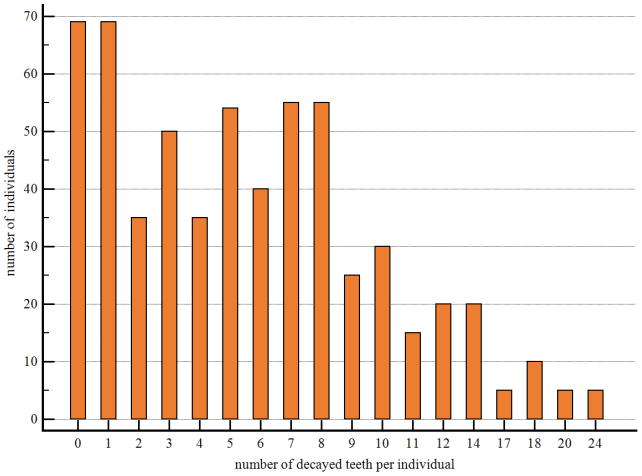

Fig. 1. Distribution of the number of decayed teeth per person

Socioeconomic and health-related variables explained 34.1% of the observed variation in the number of untreated DT (Table 2; $p < 0.001$) and 19.2% of the observed variation in PI (Table 3; $p < 0.001$). Seven variables were significantly associated with DT scores, and the most important was a dentist providing dental care through the health insurance system, followed by the number of dental visits during the last year, gender, and a dental visit to a private practice during the last year. These variables accounted for 6–9% of the variability (Table 2). Six variables were significantly associated with PI scores. In this case, smoking behavior and a dental visit to a private practice during the last year accounted for a major part of variability with unique contributions of 8.5% and 7.7%, respectively (Table 3). Analysis revealed the same 5 significant associations for both DT and PI scores.

It was observed that an increase in self-assessed household economic status was related to a decrease the average number of DT by 1.3 and the PI score by 0.13 (unique contributions of 3.13% and 1.46%, respectively). Participants who visited the dentist more often presented with more DT. However, they had lower PI scores. Although the number of dental visits during the previous year accounted for a major part of the variability in DT scores

Table 2. Association of socioeconomic and health-related variables with the number of decayed teeth (DT)

Independent variables	B	*SE*	*p*	Sr
Constant	11.935	–	–	–
Age	–0.003	0.013	0.817	–0.010
Self-assessed economic status of household (1 = below average; 2 = average; 3 = above the average)	–1.296	0.299	<0.001	–0.177
Self-perceived general health (1 = excellent; 2 = very good; 3 = good; 4 = satisfying)	–0.357	0.185	0.054	–0.080
Number of dental visits during the last year (1 = less than 2; 2 = 3–10; - 3 = more than 10)	1.657	0.230	<0.001	0.286
Number of visits to family doctor during the last year(1 = less than 2; 2 = 3–10; 3 = more than 10)	0.472	0.299	0.116	0.065
Family doctor providing care through health insurance system (0 = no; 1 = yes)	–1.531	1.612	0.343	–0.039
Dentist providing dental care through health insurance system (0 = no; 1 = yes)	–3.784	0.494	<0.001	–0.302
Dental visit to private practice during the last year (0 = no; 1 = yes)	–2.362	0.380	<0.001	–0.249
Residency (0 = rural; 1 = urban)	–2.008	0.380	<0.001	–0.213
Gender (0 = female; 1 = male)	2.310	0.360	<0.001	0.256
Smoking behavior (0 = no or occasionally; 1 = yes, every day)	1.782	0.501	<0.001	0.145

Explained variance (R^2-adjusted) = 0.341; B – regression coefficient; *SE* – standard error of B coefficient; Sr – semi partial correlation indicates the unique contribution to number of decayed teeth.

Table 2. Association of socioeconomic and health-related variables with plaque index

Independent variables	B	*SE*	*p*	Sr
Constant	1.212	–	–	–
Self-assessed economic status of household (1 = below average; 2 = average; 3 = above the average)	–0.130	0.044	0.003	–0.121
Level of education (1 = low; 2 = medium; 3 = high)	–0.125	0.047	0.008	–0.110
Number of dental visits during the last year (1 = less than 2; 2 = 3–10; 3 = more than 10)	–0.075	0.035	0.032	–0.089
Dentist providing dental care through health insurance system (0 = no; 1 = yes)	0.217	0.126	0.087	0.071
Dental visit to private practice during the last year (0 = no; 1 = yes)	–0.398	0.057	<0.001	–0.278
Residency (0 = rural; 1 = urban)	0.110	0.061	0.073	0.074
Gender (0 = female; 1 = male)	0.298	0.059	<0.001	0.205
Smoking behavior (0 = no or occasionally; 1 = yes, every day)	0.477	0.065	<0.001	0.291

Explained variance (R^2-adjusted) = 0.192. B – regression coefficient; *SE* – standard error of B coefficient; Sr – semi partial correlation indicates the unique contribution to plaque index.

(unique contribution of 8.17%), it accounted for a low proportion of the variability in PI scores (unique contribution of 0.79%).

A visit to a private dental practice during the previous year reduced the number of teeth with untreated caries as well as the PI. Participants who visited a private dentist had on average 2.4 less DT and their PI was reduced by 0.4 units (unique contributions of 6.2% and 7.7%, respectively). Males were associated with a higher number of DT and a higher PI level (unique contributions of 6.6% and 4.2%, respectively). On average, males had 2.3 more untreated DT than women and their PI score was increased by 0.3 units. Everyday smokers presented with 1.78 more DT than persons who did not smoke or smoked occasionally (unique contribution of 2.1%). Smoking on daily basis resulted in an increase in the PI by 0.48 units and accounted for major part of the variability (unique contribution of 8.5%).

Level of education was identified as a significant predictor only for oral hygiene. A negative association was established between education and PI, implying that participants with a higher education level have lower plaque levels. However, this variable accounted for a lower proportion of variability (unique contribution of 1.2%). Participants who did not have access to a dentist providing dental care through the health insurance system had on average 3.8 more DT (unique contribution of 9.1%). Participants living in urban areas had significantly fewer untreated carious teeth than participants living in rural areas (on average 2 teeth less; unique contribution of 4.5%).

Discussion

The present study identified the same 5 socioeconomic and health-related predictors for the severity of untreated dental caries and oral hygiene level: gender, self-assessed household economic status, number of dental visits during the last year, a dental visit to a private practice during the last year, and smoking behavior.

A commonly used measure for dental caries is the DMFT index. This is a sum of the number of decayed (D), missing (M) and filled (F) teeth (T), and is a relevant tool for the assessment of caries status in a population.[2] In the present study, the number of DT was used as an outcome variable for several reasons. First, in a cross-sectional design, it is impossible to be sure that all presently filled and missing teeth were preceded by tooth decay. Furthermore, while the M and F components reflect a consequence of disease and its treatment outcome, the number of DT may be a better measure of disease without the influence of dental treatment.[22] In the present study, caries was recorded according to the WHO criteria, which means that it was diagnosed at advanced stage and a possible underestimation of untreated disease in the surveyed sample should be considered.

One of the main limitations of this study is that, unlike the community-based studies where samples are drawn from randomly selected residents of a certain area, our sample comprised of patients referred by their general practitioners to a dental clinic. The high active caries prevalence can be attributed to the clinic-based design of the study. Therefore, the present results should be interpreted carefully regarding general population. Nonetheless, as to our knowledge, no similar study has been conducted in Croatia or in the neighboring countries. Thus, these results can make a contribution to the planning of public dental health measures.

Our results demonstrated a difference in active caries disease prevalence across gender. Men experienced a significantly higher burden of untreated dental decay and had on average 2.3 more DT than women. Also, male participants had a significantly lower level of oral hygiene. There is a plethora of studies reporting more positive dental attitudes and habits in female than male participants, namely more regular visits to the dentist, and more frequent brushing and use of dental floss.[23,24] The fact that the present sample comprised of a considerably smaller proportion of male participants can be attributed to the lower utilization of dental services by males.

The influence of social gradient on dental caries prevalence has been previously reported.[6,25] It is assumed that socioeconomic factors can affect the disease process indirectly through behavioral patterns and lifestyle.[26] Many variables have been used in studies in this field to describe socioeconomic differences in various populations. However, no consensus regarding which variables are most valid for describing SES has been reached. In the present study, self-assessed household economic status was used as an indicator of socioeconomic well-being. An increase in self-assessed household economic status was significantly associated with a decreased average number of DT and better oral hygiene. Our results also revealed an association between educational background and oral hygiene – participants with a higher education level had better oral hygiene. Several studies have reported that a lower educational level is a risk factor for DT.[7,8,27] Although the present study did not demonstrate an association between education and the severity of active caries, it is possible that educational background may influence caries prevalence indirectly through dental habits, such as oral hygiene.

Participants who visited the dentist more often presented with more DT and better oral hygiene. It is possible that persons with more carious teeth seek dental care more often, but also may adopt a higher standard of oral hygiene. The variable of a dentist providing dental care through the health insurance system was the most significant predictor for active caries severity, accounting for 9.1% of the variability in the number of DT. Participants who did not have access to a dentist providing dental care through the health insurance system had on average 3.8 more DT.

An interesting finding was that participants living in rural areas had on average 2 untreated carious teeth more than those living in urban areas. A survey investigating the reasons for permanent tooth extractions in urban and rural populations of Croatia reported that in rural areas, people more often lost teeth because of endodontic and periapical disease.[4] Therefore, more teeth were lost in the rural population due to the consequences of untreated dental caries. Even though we have no scientific explanation for this, it may be hypothesized that patients living in rural areas have lower accessibility to dental care or a lack of motivation for dental visits and treatments.

Smoking on a daily basis was a significant predictor for both untreated dental caries and plaque severity. Moreover, it accounted for major part of the variability in oral hygiene level (unique contribution of 8.5%). This is in line with previous reports. [9,10] Bernabé et al. reported the relationship between daily smoking and DT over a 4-year period. Smokers had poor dental attendance, and exhibited a high sugar consumption and infrequent tooth brushing.[10]

This study has several limitations, including its cross-sectional, clinic-based design and a lack of questionnaire validation. Cross-sectional studies do not allow for an estimation of the cause–effect relationship. Therefore, a conclusion that the relationships between socioeconomic and health status and untreated DT and level of oral hygiene are causal cannot be derived from the present data. Due to the clinic-based study design, it is likely that the prevalence of caries is higher than that expected for the general population. Another consequence of the clinic-based design is a greater prevalence of female participants in the sample. Although this may reflect the greater conscientiousness of women in the usage of dental care and attending check-ups,[28] it may also represent a study limitation. Different studies have used a plethora of variables to index socioeconomic and health status in various populations. In the present study, the data related to the health condition and SES of the participants was acquired using a structured questionnaire designed for this research. One of the limitations of this study is a lack of questionnaire validation. Such validation is related to its generalizability, adaptation and semantic equivalence. The lack of a cross-culturally validated research instrument can cause difficulties when comparing the results between studies.[29]

The intent of this study was to relate socioeconomic and health variables with the severity of untreated carious disease and the level of oral hygiene in adult users of specialist dental care. Bearing in mind the limitations of this study, the results should be carefully interpreted. However, our hypothesis that untreated dental caries and dental plaque severity share the same socioeconomic and health-related determinants can be confirmed. Dental caries in adults is a multifactorial disease and its management requires a thorough identification of its etiological factors. While the role of dental plaque in dental caries has been well established, understanding the etiology of caries demands information other than that merely related to the biological mechanisms in the individual.

Conclusions

The results revealed a socioeconomic gradient for untreated dental caries and oral hygiene level, indicating more untreated carious teeth and worse oral hygiene in the case of lower SES. This study emphasizes the need to educate adults on oral hygiene improvement and the early treatment of dental caries, as well as its associated diseases. These measures should particularly target socially vulnerable groups and the inhabitants of rural regions.

Ethics approval and consent to participate

The present study received approval from the institutional Ethical Committee of the Clinical Hospital Center, Rijeka, Croatia (No. 003-05/13-01/03).

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

ORCID iDs

Romana Peršić Bukmir https://orcid.org/0000-0002-5325-6726
Ema Paljević https://orcid.org/0000-0002-9900-8621
Sonja Pezelj-Ribarić https://orcid.org/0000-0003-1925-1531
Ivana Brekalo Pršo https://orcid.org/0000-0001-9303-0409

References

1. Sugars and dental caries. https://www.who.int/oral_health/publications/sugars-dental-caries-keyfacts/en. Published 2017. Accessed February 6, 2020.
2. Sharma S, Mishra SK, Mittal N. Influence of tobacco dependence on caries development in young male adults: A cross-sectional study. *J Conserv Dent*. 2018;21(6):597–601. doi:10.4103/JCD.JCD_218_18
3. Vidaković R, Špalj S, Šlaj M, Šlaj M, Katić V. Correlation between the DAI and ICON indices used for assessment of orthodontic treatment need in Croatian schoolchildren. *Zdr Varst*. 2018;57(4):218–226. doi:10.2478/sjph-2018-0027
4. Špalj S, Plančak D, Jurić H, Pavelić B, Bošnjak A. Reasons for extraction of permanent teeth in urban and rural populations of Croatia. *Coll Antropol*. 2004;28(2):833–839. PMID:15666618.
5. Baelum V, Heidmann J, Nyvad B. Dental caries paradigms in diagnosis and diagnostic research. *Eur J Oral Sci*. 2006;114(4):263–277. doi:10.1111/j.1600-0722.2006.00383.x
6. Adler NE, Ostrove JM. Socioeconomic status and health: What we know and what we don't. *Ann N Y Acad Sci*. 1999;896:3–15. doi:10.1111/j.1749-6632.1999.tb08101.x
7. Costa SM, Martins CC, Bonfim Mde L, et al. A systematic review of socioeconomic indicators and dental caries in adults. *Int J Environ Res Public Health*. 2012;9(10):3540–3574. doi:10.3390/ijerph9103540

8. Schwendicke F, Dörfer CE, Schlattmann P, Foster Page L, Thomson WM, Paris S. Socioeconomic inequality and caries: A systematic review and meta-analysis. *J Dent Res*. 2015;94(1):10–18. doi:10.1177/0022034514557546
9. Benedetti G, Campus G, Strohmenger L, Lingström P. Tobacco and dental caries: A systematic review. *Acta Odontol Scand*. 2013;71(3–4):363–371. doi:10.3109/00016357.2012.734409
10. Bernabé E, Delgado-Angulo EK, Vehkalahti MM, Aromaa A, Suominen AL. Daily smoking and 4-year caries increment in Finnish adults. *Community Dent Oral Epidemiol*. 2014;42(5):428–344. doi:10.1111/cdoe.12101
11. Singh A, Rouxel P, Watt RG, Tsakos G. Social inequalities in clustering of oral health related behaviors in a national sample of British adults. *Prev Med*. 2013;57(2):102–106. doi:10.1016/j.ypmed.2013.04.018
12. Yoshino K, Suzuki S, Ishizuka Y, Takayanagi A, Sugihara N, Kamijyo H. Relationship between amount of overtime work and untreated decayed teeth in male financial workers in Japan. *J Occup Health*. 2017;59(3):280–285. doi:10.1539/joh.16-0247-OA
13. Marsh PD, Nyvad B. The oral microflora and biofilms on teeth. In: Fejerskov O, Kidd EAM, eds. *Dental Caries: The Disease and its Clinical Management*. Hoboken, NJ: Wiley-Blackwell; 2003:29–48.
14. Oyedele TA, Folayan MO, Chukwumah NM, Onyejaka NK. Social predictors of oral hygiene status in school children from suburban Nigeria. *Braz Oral Res*. 2019;33:e022. doi:10.1590/1807-3107bor-2019.vol33.0022
15. Lambert M, De Reu G, De Visschere L, Declerck D, Bottenberg P, Vanobbergen J. Social gradient in caries experience of Belgian adults 2010. *Community Dent Health*. 2018;35(3):160–166. doi:10.1922/CDH_4254Lambert07
16. Segura-Egea JJ, Martín-González J, Castellanos-Cosano L. Endodontic medicine: Connections between apical periodontitis and systemic diseases. *Int Endod J*. 2015;48(10):933–951. doi:10.1111/iej.12507
17. Ranfl M, Zaletel-Kragelj L. Assessment of the association between dentate status and self-rated general health. *Zdr Varst*. 2017;56(2):131–139. doi:10.1515/sjph-2017-0017
18. Persic Bukmir R, Vidas J, Mance D, Pezelj-Ribaric S, Spalj S, Brekalo Prso I. Socio-economic and health status as a predictor of apical periodontitis in adult patients in Croatia. *Oral Dis*. 2019;25(1):300–308. doi:10.1111/odi.12981
19. Machtei EE, Christersson LA, Grossi SG, Dunford R, Zambon JJ, Genco RJ. Clinical criteria for the definition of "established periodontitis". *J Periodontol*. 1992;63(3):206–214. doi:10.1902/jop.1992.63.3.206
20. Silness J, Löe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand*. 1964;22:121–315. doi:10.3109/00016356408993968
21. World Health Organization. *Oral Health Survey: Basic Methods*. 4th ed. Geneva, Switzerland: World Health Organization; 1997. ISBN: 92 4 154493 7.
22. Aleksejuniene J, Eriksen HM, Holst D. Variation in caries and treatment experience in 35–44-year-old Lithuanians. *Community Dent Oral Epidemiol*. 2000;28(5):356–364. doi:10.1034/j.1600-0528.2000.028005356.x
23. Onyejaka NK, Folayan MO, Folaranmi N. Barriers and facilitators of dental service utilization by children aged 8 to 11 years in Enugu state, Nigeria. *BMC Health Serv Res*. 2016;16:93. doi:10.1186/s12913-016-1341-6
24. Mamai-Homata E, Koletsi-Kounari H, Margaritis V. Gender differences in oral health status and behavior of Greek dental students: A meta-analysis of 1981, 2000, and 2010 data. *J Int Soc Prev Community Dent*. 2016;6(1):60–68. doi:10.4103/2231-0762.175411
25. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KM. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. *Community Dent Oral Epidemiol*. 2004;32(5):345–353. doi:10.1111/j.1600-0528.2004.00173.x
26. Beck JD, Kohout F, Hunt RJ. Identification of high caries risk adults: Attitudes, social factors and diseases. *Int Dent J*. 1988;38(4):231–238. PMID:3063667.
27. Edman K, Öhrn K, Nordström B, Holmlund A. Prevalence of dental caries and influencing factors, time trends over a 30-year period in an adult population. Epidemiological studies between 1983 and 2013 in the county of Dalarna, Sweden. *Acta Odontol Scand*. 2016;74(5):385–392. doi:10.3109/00016357.2016.1163733
28. Peršić Bukmir R, Jurčević Grgić M, Brumini G, Spalj S, Pezelj-Ribaric S, Brekalo Pršo I. Influence of tobacco smoking on dental periapical condition in a sample of Croatian adults. *Wien Klin Wochenschr*. 2016;128(7–8):260–265. doi:10.1007/s00508-015-0910-8
29. Sousa VD, Rojjanasrirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: A clear and user-friendly guideline. *J Eval Clin Pract*. 2011;17(2):268–274. doi:10.1111/j.1365-2753.2010.01434.x