Association of health determinants and depressive symptoms with tooth loss in the Serbian adult population: a cross-sectional study

Povezanost determinanti zdravlja i simptoma depresije sa nedostatkom zuba kod odraslog stanovništva Srbije: studija preseka

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Abstract

Background/Aim. Oral diseases appear to be the major risk factors for tooth loss, but social factors and other determinants could play an important role as well. The aim of this study was to determine whether the possible independent sociodemographic risk factors and depressive disorders could contribute to the tooth loss in the adult population of Serbia. **Methods.** This cross-sectional study analysed the 2013 National Health Survey results for the population of Serbia (without the data for Kosovo and Metohia population). The sample was selected to provide the statistically reliable estimates at the national level. Study included 13,519 adults of 20 years of age, or above. The mean age of participants was 49.9 years including 6,998 (51.8%) females and 6,518 (48.2%) males. The number of missing teeth was dependent variable while the independent variables were: gender, age, marital status, education, employment status, Wealth Index, smoking status, body mass index (BMI), milk and milk products intake, fruit intake excluding juices, vegetable and salad intake (excluding potato), and depression. To measure the current depression, the standardized and validated the Patient Health Questionnaire (PHQ)-8 score was used. Edentulism (complete or partial) was defined as a loss of natural teeth. In order to determine the predictors of tooth loss, the bivariate and multivariate logistic regression models were implemented for all types of tooth loss. **Results.** The significant differences were observed among the categories of edentulism in relation to independent variables except vegetable and salad intake. The prevalence of all missing teeth was highest in the females, the respondents with a low level of education, inactive, underweight (BMI < 18.5) and respondents with moderately severe depressive episodes (PHQ-8 score 15 to 19). In the multivariate model, we found that the demographic factors (age, living with a partner), socioeconomic factors (primary and secondary education, Wealth Index), smoking, BMI, the PHQ-8 score and the depressive symptoms were significantly associated with partial tooth loss. **Conclusion.** Study demonstrated that sociodemographic and lifestyle factors as well as the symptoms of depresssion are also important factors related to the tooth loss. This study can help to advance the need for health programs focusing on education, smoking cessation, dietary habits as well as regular visits to the dentist.

Key words:
adult; depression; jaw, edentulous; risk factors; socioeconomic factors; surveys and questionnaires.

Apstrakt

Uvod/Cilj. Bolesti usta i zuba su glavni faktor rizika od gubitka zuba, ali i socijalni faktori i druge determinante zdravlja takođe mogu imati važnu ulogu. Cilj istraživanja je bio da se utvrdi da li potencijalni nezavisni faktori, kao što su sociodemografski faktori, stil života i depresivni poremećaji, mogu doprineti gubitku zuba odraslog stanovništva Srbije. **Metode.** Analizirani su podaci dobijeni u okviru Nacionalnog istraživanja zdravlja stanovništva Srbije koje je sprovedeno 2013. godine kao studija preseka na reprezentativnom uzorku odraslog stanovništva Srbije (bez podataka o stanovništvu Kosova i Metohije). Uzorak je izabran da obezbedi statistički pouzdane procene na nacionalnom nivou. Studija je obuhvatila 13 519 odraslih osoba starosti 20 godina i više. Prosečna starost ispitanika, uključujući 6 998 (51,7%) žena i 6 517 (48,2%) muškaraca bila je 49,9 godina. Kao zavisna varijabla analiziran je broj zuba koji su nedostajali ispitanicima, dok su nezavisne varijable bile: pol, starost, bračno stanje, obrazovanje, radni status, Indeks blagostanja, pušački

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status, indeks telesne mase (BMI), unos mleka i mlečnih proizvoda, voća (isključujući voćne sokove), povrća i salata (isključujući krompir) i depresija. Za utvrđivanje prisustva depresivne epizode korišćen je standardizovan Upitnik o zdravlju pacijenata – *Patient Health Questionnaire* (PHQ)-8. Gubitak prirodnih zuba definisan je kao bezubost (potpuna ili delimična). Za određivanje prediktora gubitka zuba korišćeni su modeli bivarijantne i multivarijantne logističke regresije za sve kategorije gubitka zuba. **Rezultati.** Nađena je statistički značajna razlika između kategorije bezubosti u odnosu na sve nezavisne promenljive izuzev unosa povrća i salata. Prevalencija totalne bezubosti bila je najveća kod žena, niskoobrazovanog i neaktivnog stanovništva, pothranjenih (BMI < 18,5 kg/m²) i ispitanika sa umereno teškim depresivnim epizodama (PHQ-8 skor od 15 do 19). Multi-

varijantnim modelom je utvrđeno da su demografski faktori (životno doba, život sa partnerom), socijalnoekonomski faktori (niže i srednje obrazovanje, Indeks blagostanja), pušenje, BMI, PHQ-8 skor i prisustvo depresivnih simptoma bili statistički značajno povezani sa delimičnim gubitkom zuba. **Zaključak.** Ova studija ukazuje na to da sociodemografski faktori, stil života i depresivni simptomi predstavljaju faktore koji mogu biti povezani sa gubitkom zuba. Studija ukazuje na neophodnost donošenja programa koji su usmereni na obrazovanje, prestanak pušenja cigareta, navike u ishrani, kao i redovne posete stomatologu.

Ključne reči:
odrasle osobe; depresija; bezubost; faktori rizika; socijalno-ekonomski faktori; ankete i upitnici.

Introduction

Over the last few years, an increasing number of epidemiological studies were carried out around the world to determine the state of oral health [1, 2]. Complete or partial tooth loss has been recognized as the final outcome of the mouth and teeth diseases, health behavior, preferences, or professional intervention [3]. Burt et al. [4] concluded that the complete tooth loss is not just a disease-related extension of partial tooth loss, but rather a different phenomenon with the social and attitudinal factors playing a prominent part. It is well-known that the social factors and other determinants influence the health outcomes [5]. The results of studies of health inequalities showed that inequalities were most often related to education, occupational class, income and demographic characteristics such as gender and age [6, 7]. Oral diseases appear to be the major risk factors for partial tooth loss, suggesting that the sociodemographic and lifestyle factors and depressive disorders play an important role [8, 9]. Furthermore, the behavioral factors such as smoking, unhealthy dietary patterns and inadequate consumption of milk, fruit and vegetable are believed to contribute to tooth loss as well [3, 10, 11]. On the other hand, oral status may cause suffering and has a great impact on the general quality of life (dysfunction of the oral cavity and facial aesthetics, absenteeism, social isolation, etc.) [12].

Nowadays, the depressive disorders are one of the leading health challenges of the 21st century due to its high prevalence and constant growth [13]. Depressive symptoms have been correlated to the poorer self-assessed oral health and oral-health-related quality of life [14, 15]. It was estimated that one in five dental patients may have a depressive disorder [16].

Since 2005, there were significant changes in legal regulations, concerning that the Serbian adult population 18+ costs of dental services (with exception of pregnant women, new mothers and those over 65 years of age) influenced a lot the provision and use of dental health care. According to the National Health Survey of 2013, only 26.9% of respondents had their own dentist in the state-owned institution and 31% in private practice [17].

The aim of this study was to determine whether the possible independent sociodemographic, risk factors and depressive disorders could contribute to tooth loss in the adult population of Serbia.

Methods

This study represents an analysis of the 2013 National Health Survey for the population of Serbia (without the data on Kosovo and Metohia population), which was carried out by the Ministry of Health of the Republic of Serbia. The study protocol was approved by the Ethics Review Board of the Institute of Public Health of Serbia. A stratified two-stage representative sample of the Serbian population was used for this study. The sample was selected to provide the statistically reliable estimates at the national level and at the levels of 4 geographical regions of Serbia (Province of Vojvodina, Belgrade, Central and West Serbia, South and East Serbia).

Out of 10,089 households from all registered households in 2011 in the Republic of Serbia, 6,500 households were randomly selected for the sample (3,960 urban and 2,540 rural) and interviewed during October-December 2013. The interviews and measurements were carried out in each household by teams consisting of two trained interviewers and a healthcare worker. The informed written consent was obtained from all respondents. The household response rate was 64.4%. Of the total of 16,474 registered members of the household aged 15 years and above, 14,623 were interviewed, giving a response rate of 88.9%. Of this number of people who agreed to be interviewed, 13,756 of them accepted to fill a self-administered questionnaire (response rate 94.1%). All measurements were performed on 13,908 respondents aged 15 years and above (response rate 95.1%), and a partial measurement for another 534 respondents [17]. For the purpose of this study, we analyzed the data on participants aged 20 years or above, the total of whom was 13,519 adults. The mean age of participants was 49.9 years [including 6,998 (51.7%) females and 6,517 (48.3%) males].

Edentulism (complete or partial loss of natural teeth) is a debilitating and irreversible condition and is described as the "final marker of disease burden for oral health" [18]. The number of missing teeth was dependent variable, and it was assessed within 5 category items (no missing teeth, 1–5 missing teeth, 6–10 missing teeth, 10 or more missing teeth, and all teeth missing). In addition, a series of demographic and socioeconomic variables that could be related to edentulism were included: gender, age (20–34, 35–44, 45–54, 55–64 and 65 years and above), type of settlement (urban or rural), marital status (living with a partner or without partner), education (primary, secondary, or high), employment status (employed, unemployed, or inactive) and the Wealth Index (Demographic and Health Survey Wealth Index) according to which the households and respondents were classified into five socioeconomic categories (poorest, poorer, middle class, rich or the richest class). The Wealth Index was calculated using the data on a household ownership of selected assets, such as number of bedrooms per household member, materials used for housing construction, types of water access and sanitation facilities, possession of color TV, mobile phone, refrigerator, computer, washing machine, dishwasher, air conditioning, central heating, car and access to the internet [19]. The lifestyle variables included smoking status (never smoked, past smoker or smoker), body mass index (BMI; the weight and height were measured according to a defined protocol and used to calculate the BMI as weight in kilograms divided by height in meters squared within four categories (underweight < 18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25.0–29.9 kg/m^2 or obesity ≥ 30 kg/m^2) [20], milk and milk products intake (every day 1 cup or more, less than 1 cup every day), fruit intake excluding juices (1 or more times per day, less than 1 time per day) and vegetable and salad intake excluding potato (1 or more times per day, less than 1 times per day). The independent variable also was standardized and validated by The Patient Health Questionnaire (PHQ-8) score, which was used to measure current depression on a 4-point (0–3) scale for each item. The questions were tallied to produce a total score of 0–24 points. The PHQ-8 score was treated as a continuous and as a categorical variable with 5 categories (a total score of 0 to 4 represented no significant depressive symptoms; 5 to 9 represented mild depressive symptoms; 10 to 14, moderate; 15 to 19, moderately severe; and 20 to 24, severe depressive episode). For our analysis, the current depression was defined as: a PHQ-8 score ≥ 10, and this score had the sensitivity and specificity of 88% for a diagnosis of major depression and regardless of diagnostic status, it typically represened the clinically significant depression [21, 22].

The data were analyzed by the methods of descriptive statistics, bivariate and multivariate logistic regressions. The variables were examined for each type of edentulism using the ANOVA and χ^2 analyses. Prevalence of edentulism with 95% confidence intervals (CI) adjusted on age were also obtained. In order to determine the possible predictors of edentulism, the multivariate logistic regression model was implemented for all types of edentulism. All selected independent variables were included into the model. The probability of $p < 0.05$, was taken as the minimum level of significance. The analyses were done by using the statistical software package SPSS 21, including the weight factor ("weight on"), which was used for correction of disproportionate size of the sample and adjustment of the data collected.

Results

The mean age was significantly higher among the respondents with more missing teeth. The prevalence of edentulism was the highest in the age group of 65 years and above. Only 7% of respondents who lived with a partner had no missing teeth compared to 19.1% of respondents who lived without a partner. According to the region, out of Belgrade, almost every fourth respondent was in the category of 10 or more missing teeth. The highest percentage of respondents with lower education (40.6%), one in three who were considered to be obese (32.0%), and the highest percentage of respondents with the depressive episodes, according to the PHQ-8, were in the category 10 or more missing teeth. The significant differences were observed among categories of edentulism and all independent variables except vegetable in relation to salad intake (excluding potato) (Tables 1, 2 and 3).

The highest prevalence of no missing teeth was among the respondents who lived without a partner, with high education and underweight. The prevalence rates of 1–5 missing teeth were higher than in two other categories (6–10 missing teeth, 10, or more missing teeth) in relation to all independent variables. The prevalence of all missing teeth was highest in the females, participants with lower education, inactive, underweight (BMI < 18.5 kg/m^2), and respondents with moderately severe depressive episodes (Tables 4, 5 and 6).

The results of bivariate and multivariate logistic regression analyses on the associations between edentulism and sociodemographic, life style factors and PHQ-8 scores are presented in Tables 7, 8 and 9. In the bivariate analysis, we observed that demographic factors (age, living with partner, rural areas), socioeconomic factors (lower and secondary education, unemployment, Wealth Index), life style (smoking, BMI, milk and milk products intake, fruit intake) and mental health (PHQ-8 scores and PHQ-8 depression categories) were significantly associated with edentulism, both partial and total. In the multivariate model, we found that the demographic factors (age, living with a partner), socioeconomic factors (lower and secondary education, Wealth Index), life style (smoking and BMI) and PHQ-8 score were significantly associated with edentulism. The results showed that the odds of more than 10 teeth vs no missing teeth were in favour of the older respondents, females, those who lived with a partner, with the lower or secondary education, the lower class, ex-smokers and smokers, the respondents with the higher BMI and the ones who belonged to the category of repondents with mild depressive symptoms (5-9 points on the scale PHQ-8).

Table 1

Sociodemographic characteristics of adult population in Serbia across categories of missing teeth

Variable (%)	Total	No	Missing teeth (number)				p
			1–5	6–10	10 or more	All	
Total number of patients	13,519 (100)	1,528 (11.3)	4,900 (36.2)	2,207 (15.3)	3,323 (24.6)	1,561 (11.6)	*
Sex, n (%)							
female	6,998 (51.7)	754 (10.8)	2,284 (32.6)	1,084 (15.5)	1,827 (26.1)	1,049 (15.0)	
male	6,517 (48.3)	773 (11.9)	2,616 (40.1)	1,122 (17.2)	1,495 (22.9)	512 (7.9)	
Age in years; mean ± SD	49.9 ± 17.4	31.4 ± 11.7	40.6 ± 13.2	52.6 ± 12.7	61.6 ± 12.6	68.7 ± 11.1	*
20–34	3,233 (23.9)	1,127 (34.9)	1,852 (57.3)	180 (5.6)	65 (2.0)	9 (0.3)	*
35–44	2,280 (16.8)	220 (9.6)	1,376 (60.4)	419 (18.4)	242 (10.6)	23 (1.0)	
45–54	2,379 (17.6)	87 (3.7)	886 (37.2)	644 (27.1)	627 (26.4)	135 (5.7)	
55–64	2,665 (2.1)	56 (21.0)	529 (19.8)	591 (22.2)	1,101 (41.3)	388 (14.6)	
> 65	2,960 (22.0)	38 (1.3)	257 (8.7)	372 (12.6)	1,288 (43.5)	1005 (34.0)	
Marital status, n (%)							*
living with partner	8,698 (64.3)	605 (7.0)	3,245 (37.3)	1,686 (19.4)	2,288 (26.3)	874 (10.0)	
living without partner	4,819 (35.7)	922 (19.1)	1,655 (34.3)	521 (10.8)	1,035 (21.5)	686 (14.2)	
Type of settlement, n (%)							*
urban	8027 (59.4)	1078 (13.4)	3137 (39.1)	1247 (15.5)	1685 (21.0)	880 (11.0)	
rural	5489 (40.6)	449 (8.2)	1763 (32.1)	959 (17.5)	1637 (29.8)	681 (12.4)	
Region, n (%)							*
Belgrade	3,170 (24.4)	485 (15.3)	1,247 (39.3)	437 (13.8)	649 (20.5)	352 (11.1)	
Vojvodina	3,609 (27.7)	389 (10.8)	1,249 (34.6)	638 (17.7)	875 (24.2)	458 (12.7)	
Šumadija and West Serbia	3,793 (29.0)	363 (9.6)	1,341 (35.4)	628 (16.6)	1018 (26.8)	443 (11.7)	
South and East Serbia	2,946 (18.9)	291 (9.9)	1,062 (36.0)	504 (17.1)	781 (26.5)	308 (10.5)	
Education, n (%)							*
low	3,614 (26.7)	90 (2.5)	641 (17.7)	601 (16.6)	1,469 (40.6)	813 (22.5)	
middle	7,540 (55.7)	976 (12.9)	3,141 (41.7)	1,303 (17.3)	1,520 (20.2)	600 (8.0)	
high	2,363 (17.6)	461 (19.5)	1,117 (47.3)	303 (12.8)	334 (14.1)	148 (6.3)	
Employment, n (%)							***
employed	4,857 (36.0)	734 (15.1)	2,554 (52.6)	814 (16.8)	629 (13.0)	126 (2.6)	
unemployed	3,230 (23.9)	409 (12.7)	1,442 (44.6)	569 (17.6)	658 (20.4)	152 (4.7)	
inactive	5,428 (40.1)	384 (7.1)	903 (16.6)	823 (15.2)	2035 (37.5)	1283 (23.6)	
Wealth Index, n (%)							*
poorest class	2,595 (19.1)	533 (20.5)	1,204 (46.4)	382 (14.7)	338 (13.0)	138 (5.3)	
poorer class	2,600 (19.2)	356 (13.7)	1,090 (41.9)	392 (15.1)	505 (19.4)	257 (9.9)	
middle class	2,684 (19.8)	257 (9.6)	1,034 (38.5)	471 (17.5)	602 (22.4)	320 (11.9)	
richer class	2,808 (20.7)	220 (7.8)	895 (31.9)	487 (17.3)	840 (29.9)	366 (13.0)	
richest class	2,830 (21.2)	161 (5.7)	677 (23.9)	474 (16.7)	1038 (36.7)	480 (17.0)	

SD – standard deviation; *p < 0.05; ***p < 0.001.

Table 2

The impact of life style of adult population in Serbia on categories of missing teeth

Variable expressed by the number (%) of patients	Total respondents	Missing teeth (number)					p
		No	1–5	6–10	10 or more	All	
Smoking status, n (%)							***
never smoked	5,577 (44.7)	728 (13.1)	2,038 (36.5)	804 (14.4)	1,296 (23.2)	711 (12.7)	
past smoker	2,326 (18.7)	202 (8.7)	802 (34.5)	437 (18.8)	598 (25.7)	287 (12.3)	
smoker	4,546 (36.5)	505 (11.1)	1,783 (39.2)	802 (17.6)	1,086 (23.9)	370 (8.1)	
BMI (kg/m²); mean ± SD	26.6 ± 5.0	24.3 ± 4.2	25.9 ± 4.8	27.4 ± 4.9	27.8 ± 5.3	27.6 ± 5.0	***
BMI (kg/m²), n (%)							***
underweight (<18.5)	314 (2.4)	76 (24.2)	121 (38.5)	35 (11.1)	53 (16.9)	29 (9.2)	
normal (18.5–24.9)	4,991 (38.4)	838 (16.8)	2,100 (42.1)	661 (13.2)	949 (19.0)	443 (8.9)	
overweight (25–29.9)	4,767 (36.6)	437 (9.2)	1,699 (35.6)	828 (17.4)	1,222 (25.6)	581 (12.2)	
obesity (> 30)	2,934 (22.6)	147 (5.0)	846 (28.8)	587 (20.0)	939 (32.0)	415 (14.1)	
Milk and milk products intake, n (%)							***
every day 2 or more cups	1,477 (10.9)	230 (15.6)	531 (36.0)	204 (13.8)	324 (21.9)	188 (12.7)	
every day 1 cup	5,425 (40.2)	681 (12.6)	2,068 (38.1)	830 (15.3)	1,203 (22.2)	643 (11.9)	
sometimes, not every day	6,006 (44.4)	564 (9.4)	2,122 (35.3)	1070 (17.8)	1,604 (26.7)	646 (10.8)	
never	610 (4.5)	53 (8.7)	178 (29.2)	103 (16.9)	192 (31.5)	84 (13.8)	
Fruit intake excluding juice, n (%)							**
1 or more times per day	6,157 (45.5)	664 (10.8)	2,180 (35.4)	983 (16.0)	1,555 (25.3)	775 (12.6)	
4–6 times per week	3,666 (27.1)	450 (12.3)	1,363 (37.2)	609 (16.6)	864 (23.6)	380 (10.4)	
1–3 times per week	2,770 (20.5)	308 (11.1)	1,055 (38.1)	463 (16.7)	666 (24.0)	278 (10.0)	
less than 1 time per week	760 (5.7)	92 (12.1)	251 (33.0)	120 (15.8)	194 (25.5)	103 (13.6)	
never	162 (1.2)	13 (8.0)	50 (30.9)	31 (19.1)	44 (27.2)	24 (14.8)	
Vegetable and salad intake, n (%) (excluding potato)							ns
1 or more times per day	7,776 (57.5)	843 (10.8)	2,860 (36.8)	1,226 (15.8)	1,927 (24.8)	920 (11.8)	
4–6 times per week	3,933 (29.0)	468 (11.9)	1,401 (35.5)	657 (16.7)	979 (24.9)	428 (10.9)	
1–3 times per week	1,505 (11.1)	178 (11.8)	542 (36.0)	260 (17.3)	352 (23.4)	173 (11.5)	
less than 1 time per week	219 (1.6)	28 (12.8)	74 (33.8)	41 (18.7)	51 (23.3)	25 (11.4)	
never	83 (0.8)	10 (12.0)	23 (27.7)	22 (26.5)	14 (16.9)	14 (16.9)	

BMI – body mass index; SD – standard deviation; $***p < 0.001$; $**p < 0.01$; ns – non-significant.

Table 3

Distribution of the Patient Health Questionnaire (PHQ)-8 scores of adult population in Serbia across categories of missing teeth

Variable	Total	Missing teeth (number)				All	p
		No	1–5	6–10	10 or more		
PHQ-8, mean ± SD	1.9 ± 3.5	0.7 ± 2.1	1.1 ± 2.3	1.8 ± 3.2	3.1 ± 4.3	3.5 ± 4.7	***
PHQ-8 score, n (%) of patients							
none (0 to 4)	1,1591 (85.7)	1,455 (12.6)	4,577 (39.5)	1,915 (16.5)	2,515 (21.7)	1,129 (9.7)	***
mild (5 to 9)	1,306 (9.6)	50 (3.8)	252 (19.3)	218 (16.7)	524 (40.1)	262 (20.1)	
moderate (10 to 14)	373 (2.8)	14 (3.8)	46 (12.3)	43 (11.5)	173 (46.4)	97 (26.0)	
moderately severe (15 to 19)	161 (1.2)	5 (3.1)	14 (8.7)	20 (12.4)	74 (46.0)	48 (29.8)	
severe (20 to 24)	86 (0.7)	3 (3.5)	10 (11.6)	11 (12.8)	37 (43.0)	25 (29.1)	

SD – standard deviation; *** $p < 0.001$.

Table 4

Prevalence of edentulism according to the sociodemographic characteristics of adult population in Serbia

Variables (expressed by patients)	Missing teeth (number)				All teeth
	No	1–5	6–10	10 or more	
Total, % (95% CI)	10.3 (9.8–10.7)	34.3 (33.6–35.0)	16.4 (15.8–17.1)	26.2 (25.5–26.9)	12.8 (12.3–13.3)
Sex, % (95% CI)					
female	10.3 (9.6–10.9)	31.9 (30.9–32.9)***	15.6 (14.8–16.5)**	26.8 (25.8–27.7)	15.5 (14.8–16.2)***
male	10.3 (9.6–10.9)	36.9 (35.9–38.0)	17.3 (16.4–18.2)	25.6 (24.6–26.6)	9.9 (9.1–10.6)
Marital status, % (95% CI)					
living with partner	6.8 (6.2–7.4)***	36.3 (35.4–37.2)***	19.3 (18.6–20.1)***	27.0 (26.2–27.9)**	10.5 (9.9–11.1)***
living without partner	16.5 (15.8–17.3)	30.6 (29.4–31.8)	11.2 (10.2–12.2)	24.7 (23.6–25.9)	17.0 (16.1–17.9)
Type of settlement, % (95% CI)					
urban	11.8 (11.2–12.4)***	36.0 (35.1–37.0)***	15.8 (14.9–16.6)	23.3 (22.4–24.2)***	13.1 (12.4–13.8)
rural	8.2 (7.5–8.9)	32.0 (30.9–33.1)	17.3 (16.4–18.3)	30.0 (29.0–31.0)	12.4 (11.6–13.2)
Region, % (95% CI)					
Vojvodina	10.2 (9.3–11.1)***	32.0 (30.6–33.4)***	17.2 (16.0–18.4)**	25.9 (24.6–27.2)***	14.7 (13.7–15.7)***
Belgrade	13.5 (12.5–14.6)	36.6 (35.1–38.2)	13.9 (12.6–15.3)	22.6 (21.1–24.1)	13.3 (12.2–14.4)
Sumadija and West Serbia	8.6 (7.8–9.5)	33.6 (32.3–34.9)	16.9 (15.8–18.0)	28.2 (27.0–29.5)	12.6 (11.7–13.6)
South and East Serbia	9.4 (8.4–10.4)	35.5 (34.0–37.0)	17.3 (16.0–18.6)	27.3 (25.9–28.7)	10.5 (9.5–11.6)
Education, % (95% CI)					
low	9.0 (8.0–9.9)***	27.4 (26.0–28.8)***	14.9 (13.7–16.1)***	32.5 (31.2–33.9)***	16.2 (15.2–17.2)***
middle	9.1 (8.4–9.7)	35.1 (34.2–36.1)	18.1 (17.3–19.0)	25.5 (24.5–26.4)	12.2 (11.5–12.9)
high	16.4 (15.2–17.5)	43.4 (41.7–45.2)	13.6 (12.1–15.1)	17.7 (16.0–19.3)	8.9 (7.7–10.2)
Employment, % (95% CI)					
employed	6.7 (5.8–7.5)***	43.8 (42.5–45.1)***	19.2 (18.1–20.4)***	21.7 (20.5–23.0)***	8.5 (7.6–9.5)***
unemployed	4.6 (3.6–5.7)	36.0 (34.5–37.6)	20.0 (18.7–21.4)	29.0 (27.5–30.5)	10.3 (9.2–11.4)
inactive	15.9 (15.1–16.7)	26.1 (24.8–27.3)	12.4 (11.4–13.5)	28.2 (27.0–29.3)	17.4 (16.5–18.3)
Social class, % (95% CI)					
poorest class	16.0 (14.9–17.2)***	39.4 (37.7–41.1)***	15.8 (14.3–17.2)	18.9 (17.2–20.5)***	10.0 (8.7–11.2)***
poorer class	11.4 (10.3–12.5)	37.8 (36.1–39.5)	15.6 (14.1–17.0)	22.6 (21.0–24.1)	12.6 (11.5–13.8)
middle class	8.4 (7.4–9.4)	35.9 (34.3–37.5)	17.8 (16.4–19.2)	24.2 (22.7–25.7)	13.6 (12.5–14.8)
richer class	7.9 (6.9–8.9)	31.4 (29.9–32.9)	17.0 (15.7–18.3)	30.3 (28.9–31.8)	13.4 (12.3–14.5)
richest class	8.8 (7.8–9.7)	28.7 (27.2–30.2)	16.0 (14.6–17.3)	32.7 (31.3–34.2)	13.9 (12.8–14.9)

Note: Prevalence is given with 95% confidence interval (CI) adjusted on age; ***$p < 0.001$; **$p < 0.01$.

Table 5

Prevalence of edentulism according to the life style of adult population in Serbia

Variables (expressed by patients)	Missing teeth (number)				
	No	1–5	6–10	10 or more	All
Smoking status, % (95% CI)					
never smoked	13.2 (12.4–13.9)***	36.9 (35.8–38.0)***	14.4 (13.4–15.3)***	23.1 (22.0–24.1)***	12.5 (11.7–13.2)
past smoker	10.4 (9.3–11.6)	36.3 (34.6–38.1)	18.3 (16.8–19.7)	23.8 (22.2–25.5)	11.1 (9.9–12.3)
smoker	7.0 (6.2–7.8)	32.5 (31.2–33.8)	18.4 (17.3–19.5)	29.7 (28.5–30.8)	12.5 (11.6–13.4)
BMI (kg/m²), % (95% CI)					
underweight (<18.5)	16.5 (13.3–19.7)***	26.2 (21.4–31.1)***	12.1 (8.0–16.3)***	27.5 (23.0–32.1)**	17.6 (14.2–21.0)***
normal BMI (18.5–24.9)	12.4 (11.6–13.2)	35.0 (33.8–36.2)	13.9 (12.9–14.9)	25.1 (23.9–26.2)	13.7 (12.8–14.5)
overweight (25–29.9)	9.8 (9.0–10.6)	35.8 (34.6–37.0)	17.4 (16.3–18.4)	25.3 (24.1–26.4)	11.9 (11.0–12.7)
obesity (≥ 30)	7.9 (6.9–8.9)	33.3 (31.7–34.8)	19.3 (18.0–20.6)	28.2 (26.8–29.7)	11.3 (10.2–12.4)
Milk and milk products intake, % (95% CI)					
every day 2 or more cups	13.4 (12.0–14.8)***	33.0 (30.9–35.2)**	14.1 (12.3–16.0)**	24.3 (22.2–26.3)***	15.1 (13.6–16.7)**
every day 1 cup	11.4 (10.7–12.2)	35.9 (34.8–37.0)	15.6 (14.6–16.5)	23.9 (22.8–25.0)	13.2 (12.4–14.0)
sometimes, not every day	8.5 (7.8–9.2)	33.5 (32.4–34.5)	17.8 (16.9–18.7)	28.3 (27.3–29.4)	11.9 (11.1–12.6)
never	9.7 (7.6–11.9)	30.8 (27.5–34.2)	16.4 (13.5–19.3)	30.2 (27.1–33.4)	12.8 (10.4–15.2)
Fruit intake excluding juice, % (95% CI)					
1 or more times per day	10.8 (10.1–11.5)*	35.1 (34.1–36.2)**	15.9 (15.0–16.8)	25.4 (24.4–26.4)*	12.7 (12.0–13.5)*
4–6 times per week	10.6 (9.7–11.5)	34.4 (33.1–35.8)	17.0 (15.8–18.2)	25.8 (24.5–27.1)	12.1 (11.2–13.1)
1–3 times per week	8.8 (7.7–9.8)	33.6 (32.0–35.2)	16.9 (15.5–18.2)	27.8 (26.3–29.3)	12.9 (11.8–14.1)
less than 1 time per week	10.2 (8.3–12.2)	30.1 (27.0–33.1)	15.7 (13.1–18.3)	28.3 (25.4–31.2)	15.7 (13.5–17.8)
never	6.7 (2.6–10.9)	28.6 (22.1–35.0)	19.7 (14.2–25.2)	29.2 (23.1–35.3)	15.8 (11.2–20.4)
Vegetable and salad intake excluding potato, % (95% CI)					
1 or more times per day	10.1 (9.5–10.7)	35.3 (34.4–36.2)**	15.8 (15.0–16.6)**	26.0 (25.2–26.9)	12.6 (12.1–13.5)
4–6 times per week	10.8 (10.0–11.7)	33.5 (32.2–34.8)	16.9 (15.8–18.1)	26.6 (25.3–27.8)	12.2 (11.2–13.1)
1–3 times per week	9.7 (8.3–11.1)	32.4 (30.2–34.6)	17.7 (15.8–19.5)	26.3 (24.3–28.4)	13.9 (12.4–15.5)
less than 1 time per week	9.8 (6.1–13.5)	27.5 (21.8–33.2)	18.6 (13.7–23.5)	28.5 (23.1–33.9)	15.5 (11.5–19.6)
never	9.4 (3.7–15.2)	26.5 (17.7–35.3)	27.2 (19.7–34.8)	19.0 (10.7–27.4)	17.8 (11.5–24.1)

Note: Prevalence is given with 95% confidence interval (CI) adjusted on age.
BMI – body mass index; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 6

Prevalence of edentulism according to the Patient Health Questionnaire (PHQ)-8 scores of adult population in Serbia

PHQ-8 (depression severity categories/expressed by patients)	Missing teeth (number)				
	No	1–5	6–10	10 or more	All
None-minimal (0 to 4) % (95% CI)	10.3 (9.8–10.8)***	35.7 (34.9–36.5)***	17.0 (16.3–17.7)***	24.9 (24.2–25.6)***	12.1 (11.6–12.7)***
Mild depression (5 to 9), % (95% CI)	9.3 (7.8–10.7)	27.7 (25.4–29.9)	15.3 (13.3–17.2)	32.7 (30.6–34.9)	15.1 (13.5–16.7)
Moderate depression (10 to 14), % (95% CI)	11.2 (8.4–13.9)	24.0 (19.8–28.2)	9.4 (5.8–12.9)	36.7 (32.8–40.7)	18.7 (15.8–21.7)
Moderately severe depression (15 to 19), % (95% CI)	11.8 (7.6–15.9)	22.7 (16.3–29.0)	10.1 (4.6–15.5)	34.4 (28.4–40.4)	21.1 (16.5–25.6)
Severe depression (20 to 24), % (95% CI)	12.9 (7.3–18.5)	25.9 (17.3–34.4)	9.6 (2.3–17.0)	32.4 (24.3–40.5)	19.2 (13.1–25.4)

Note: Prevalence is given with 95% confidence interval (CI) adjusted on age; *** $p < 0.001$.

Table 7

Sociodemographic factors associated with edentulism – bivariate[#] and multivariate logistic regression analysis

Variables/ Type of logistic regression analysis	1–5 missing teeth vs. no missing teeth (4,900 vs. 1,528) OR (95% CI)	6–10 missing teeth vs. no missing teeth (2,207 vs. 1,528) OR (95% CI)	≥10 missing teeth vs. no missing teeth (3,323 vs. 1,528) OR (95% CI)	All missing teeth vs. no missing teeth (1,561 vs. 1,528) OR (95% CI)
Age in years				
bivariate	1.07 (1.06–1.08)***	1.14 (1.13–1.15) ***	1.18 (1.17–1.19)***	1.19 (1.17–1.21)***
multivariate	1.06 (1.05–1.07)***	1.14 (1.13–1.15)***	1.18 (1.17–1.20)***	1.18 (1.16–1.20)***
Sex				
bivariate				
female	0.90 (0.80–1.02); ns	0.95 (0.80–1.13); ns	1.18 (0.96–1.45); ns	1.97 (1.45–2.67)***
male	1.00	1.00	1.00	1.00
multivariate				
female	0.98 (0.85–1.13); ns	1.20 (0.96–1.50); ns	1.42 (1.10–1.84)**	1.83(1.25–2.67)**
male	1.00	1.00	1.00	1.00
Marital status				
bivariate				
living with partner	1.87 (1.64–2.14)***	2.54 (2.09–3.07) ***	1.99 (1.59–2.48) ***	1.35 (0.98–1.86); ns
no partner	1.00	1.00	1.00	1.00
multivariate				
living with partner	1.58 (1.36–1.84) ***	2.14 (1.70–2.69) ***	1.99 (1.51–2.63) ***	1.34 (0.90–2.00); ns
no partner	1.00	1.00	1.00	1.00
Type of settlement				
bivariate				
urban	1.00	1.00	1.00	1.00
rural	1.44 (1.27–1.65)***	2.26 (1.87–2.72)***	2.62 (2.11–3.26) ***	2.11 (1.53–2.90)***
multivariate				
urban	1.00	1.00	1.00	1.00
rural	1.00 (0.84–1.91); ns	1.06 (0.81–1.38); ns	1.09 (0.80–1.50); ns	1.01 (0.64–1.59); ns
Education				
bivariate				
low	2.79 (2.15–3.60) ***	11.03 (7.79–15.63)***	18.10 (12.35–26.51) ***	10.06 (6.18–16.37) ***
middle	1.76 (1.51–2.02) ***	4.52 (3.54–5.76) ***	5.81 (4.36–7.74) ***	5.51 (3.66–8.30) ***
high	1.00	1.00	1.00	1.00
multivariate				
low	1.98 (1.45–2.69) ***	4.89 (3.18–7.51) ***	5.45 (3.37–8.81) ***	4.20 (2.23–7.93) ***
middle	1.54 (1.31–1.81) ***	3.06 (2.32–4.030) ***	3.29 (2.37–4.56) ***	3.41 (2.08–5.59) ***
high	1.00	1.00	1.00	1.00

Table 7 (continued)

Variables/ Type of logistic regression analysis	1–5 missing teeth vs. no missing teeth (4,900 vs. 1,528) OR (95% CI)	6–10 missing teeth vs. no missing teeth (2,207 vs. 1,528) OR (95% CI)	>10 missing teeth vs. no missing teeth (3,323 vs. 1,528) OR (95% CI)	All missing teeth vs. no missing teeth (1,561 vs. 1,528) OR (95% CI)
Employment				
bivariate				
employed	1.00	1.00	1.00	1.00
unemployed	1.23 (1.07–1.42) **	1.73 (1.40–2.12)***	2.34 (1.84–2.97)***	2.44 (1.66–3.60)***
inactive	0.60 (0.51–0.71)***	0.73 (0.56–0.93) *	1.12 (0.84–1.49); ns	2.22 (1.52–3.25)***
multivariate				
employed	1.00	1.00	1.00	1.00
unemployed	1.06 (0.90–1.24); ns	1.08 (0.84–1.40); ns	1.23 (0.91–1.67); ns	1.44 (0.90–2.30); ns
inactive	0.60 (0.50–0.73) ***	0.50 (0.36–0.69) ***	0.72 (0.50—1.04); ns	1.43 (0.89–2.31); ns
Wealth Index				
bivariate				
poorest class	1.97 (1.60–2.44) ***	5.61 (4.14–7.61) ***	10.52 (7.40–14.97)***	9.39 (5.53–15.94)***
poorer class	2.02 (1.67–2.44)***	4.14 (3.12–5.49)***	7.37 (5.27–10.31)***	6.44 (3.95–10.52)***
middle class	1.89 (1.58–2.26)***	3.20 (2.43–4.21)***	4.00 (2.86–5.60)***	6.68 (4.10–10.89)***
richer class	1.41 (1.20–1.67)***	1.88 (1.43–2.45)***	2.74 (1.97–3.80) ***	3.71 (2.29–6.03)***
eichest class	1.00	1.00	1.00	1.00
multivariate				
poorest class	1.44 (1.08–1.91)*	3.01 (1.96–4.61)***	4.88 (2.95–8.08) ***	5.21 (2.49–10.91)***
poorer class	1.59 (1.26–2.01) ***	2.48 (1.72–3.57)***	3.73 (2.42–5.75)***	3.15 (1.66–5.98) **
middle class	1.56 (1.27–1.91)***	1.96 (1.40–2.73)***	2.52 (1.69–3.76)***	3.65 (2.05–6.51)***
richer class	1.27 (1.06–1.53) **	1.48 (1.09–2.01) *	2.01 (1.38–2.91)***	2.27 (1.28–4.02) **
richest class	1.00	1.00	1.00	1.00

#Adjusted on age.
OR – odds ratio; CI – confidence interval.
*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns – non-significant.

Table 8

Life style factors associated with edentulism – bivariate# and multivariate logistic regression analysis

Variables (expressed by patients)/ Type of logistic regression analysis	1–5 missing teeth vs. no missing teeth (4,900 vs. 1,528) OR (95% CI)	6–10 missing teeth vs. no missing teeth (2,207 vs. 1,528) OR (95% CI)	≥10 missing teeth vs. no missing teeth (3,323 vs. 1,528) OR (95% CI)	All missing teeth vs. no missing teeth (1,561 vs. 1,528) OR (95% CI)
Smoking status				
bivariate				
never smoked	1.00	1.00	1.00	1.00
past smoker	1.07 (0.88–1.29); ns	1.46 (1.12–1.90) **	1.33 (0.97–1.83); ns	1.02 (0.66–1.57); ns
smoker	1.27 (1.10–1.45) **	2.04 (1.66–2.51); ***	3.16 (2.46–4.07); ***	1.76 (1.23–2.53) **
multivariate				
never smoked	1.00	1.00	1.00	1.00
past smoker	0.96 (0.79–1.17); ns	1.33 (0.99–1.79); ns	1.43 (1.00–2.03) *	1.13 (0.69–1.85); ns
smoker	1.09 (0.94–1.26); ns	1.60 (1.26–2.02) ***	2.80 (2.08–3.76); ***	1.74 (1.14–2.65) **
BMI				
bivariate	1.03 (1.02–1.05)***	1.06 (1.04–1.08)***	1.04 (1.01–1.07)**	1.04 (1.00–1.08)**
multivariate	1.02 (0.99–1.03); ns	1.05 (1.02–1.07)***	1.05 (1.00–1.09)*	1.03 (0.97–1.10); ns
BMI (kg/m^2) in categories				
bivariate				
underweight (<18.5)	0.84 (0.62–1.15); ns	1.25 (0.75–2.07); ns	1.15 (0.59–2.22); ns	1.17 (0.37–3.67); ns
normal BMI (18.5–24.9)	1.00	1.00	1.00	1.00
25 and more	1.16 (1.02–1.32)*	1.55 (1.29–1.86)***	1.23 (0.99–1.52); ns	1.24 (0.90–1.71); ns
multivariate				
underweight (<18.5)	1.00 (0.70–1.41); ns	1.23 (0.65–2.35); ns	1.12 (0.49–2.58); ns	1.32 (0.31–5.59); ns
normal BMI (18.5–24.9)	1.00	1.00	1.00	1.00
25 and more	0.82 (0.66–1.02); ns	0.91 (0.65–1.27); ns	0.85 (0.57–1.26); ns	1.02 (0.58–1.81); ns
Milk and milk products intake				
bivariate				
every day 1 cup or more	1.00	1.00	1.00	1.00
less than every day 1 cup	1.26 (1.11–1.43) ***	1.76 (1.47–2.10) ***	1.75 (1.43–2.15) ***	1.39 (1.03–1.87) *
multivariate				
every day 1 cup or more	1.00	1.00	1.00	1.00
less than every day 1 cup	1.09 (0.95–1.25); ns	1.16 (0.94–1.43); ns	1.21 (0.94–1.55); ns	1.09 (0.76–1.56); ns
Fruit intake excluding juice				
bivariate				
1 or more times per day	1.00	1.00	1.00	1.00
less than 1 time per day	1.14 (1.02–1.29)*	1.46 (1.21–1.74)***	1.48 (1.20–1.82)***	1.25 (0.92–1.68); ns
multivariate				
1 or more times per day	1.00	1.00	1.00	1.00
less than 1 time per day	1.07 (0.91–1.25); ns	1.19(0.93–1.53); ns	1.18 (0.87–1.59); ns	1.10 (0.72–1.69); ns

Table 8 (continued)

Variables (expressed by patients)/ Type of logistic regression analysis	1–5 missing teeth vs. no missing teeth (4,900 vs. 1,528) OR (95% CI)	6–10 missing teeth vs. no missing teeth (2,207 vs. 1,528) OR (95% CI)	≥ 10 missing teeth vs. no missing teeth (3,323 vs. 1,528) OR (95% CI)	All missing teeth vs. no missing teeth (1,561 vs. 1,528) OR (95%CI)
Vegetable and salad intake excluding potato and juice				
bivariate				
1 or more times per day	1.00	1.00	1.00	1.00
less than 1 times per day	1.02 (0.89–1.14); ns	1.30 (1.09–1.56) **	1.14 (0.92–1.40); ns	1.09 (0.80–1.48); ns
multivariate				
1 or more times per day	1.00	1.00	1.00	1.00
less than 1 times per day	0.90 (0.77–1.05); ns	1.13 (0.88–1.45); ns	1.04 (0.77–1.41); ns	1.10 (0.71–1.70); ns

#Adjusted on age.

BMI – body mass index; OR – odds ratio; CI – confidence interval; ***p < 0.001; ** p < 0.01; * p < 0.05; ns–non-significant.

Table 9

PHQ-8 scores and categories associated with dentulism – bivariate# and multivariate logistic regression analysis

Variables/ Type of logistic regression analysis	1–5 missing teeth vs. no missing teeth (4,900 vs. 1528) OR (95% CI)	6–10 missing teeth vs. no missing teeth (2,207 vs. 1,528) OR (95% CI)	≥10 missing teeth vs. no missing teeth (3,323 vs.1,528) OR (95% CI)	All missing teeth vs. no missing teeth (1,561 vs.1,528) OR (95% CI)
PHQ-8 depression score				
bivariate	1.04 (1.01–1.08)*	1.11 (1.07–1.15) ***	1.13 (1.08–1.17) ***	1.10 (1.05–1.15) ***
multivariate	1.03 (0.99–1.06); ns	1.08 (1.04–1.13) ***	1.06 (1.01–1.11)**	1.03 (0.97–1.08); ns
bivariate				
not currently depressed (0 to 4)	1.00	1.00	1.00	1.00
depressive symptoms (5–9)	1.12 (0.81–1.56); ns	1.78 (1.19–2.66)**	2.62 (1.73–3.98)***	1.91 (1.11–3.25) *
depressive episodes (10 to 24)	0.60 (0.36–0.99) *	1.60 (0.88–2.90); ns	1.90 (1.09–3.33)*	2.04 (1.03–4.05) *
multivariate				
not currently depressed (0 to 4)	1.00	1.00	1.00	1.00
depressive symptoms (5–9)	1.11 (0.75–1.57); ns	1.47 (0.93–2.32); ns	1.68 (1.02–2.77)*	1.08 (0.57–2.04); ns
depressive episodes (10 to 24)	0.58 (0.33–1.02); ns	1.59 (0.80–3.13); ns	1.03 (0.52–2.02); ns	1.19 (0.52–2.72); ns

#Adjusted on age.

OR – odds ratio; CI – confidence interval; ***p < 0.001; ** p < 0.01; * p < 0.05; ns – non-significant.

Discussion

The WHO data indicated that 15%–20% of the world midlife population (age 35–44 years) is at risk of tooth loss, and about 30% of the population aged 65–74 years has no teeth [23]. In the adult population aged 20 years, or older, the prevalence of complete loss of teeth is the lowest in Canada [24] and Mexico [25] (around 6%) while in Serbia it is almost two times higher (11.3%). Since 2000, the trend of complete tooth loss in the population of Serbia is in decline while the situation with the loss of 10, or more teeth, reversed [26].

It is noticed that women were at a greater risk of partial (10 or more missing teeth), or complete edentulism. The reasons for the increased chance for women to partially or completely lose their teeth are still unsolved and there are only assumptions [27]. Perhaps we should pay more attention to the period of pregnancy in women when there is a hormonal imbalance causing the teeth and gums become more sensitive to bacteria, which increase the chance of infection and tooth loss.

Examining the connection between marital status and a lack of teeth, we could observe that a life with a partner was in correlation with the partial lack of teeth (1-5, 6-10 and 10 teeth and more teeth, but not all). The respondents who lived with a partner had more than two times higher chance of a partial lack of teeth compared to those who lived alone. Conversely, the results of research carried out in Canada [28] and Sweden [29] indicated that life without a partner is a risk factor for tooth loss. This finding may be explained by poor relations between partners, socioeconomic situation and the lack of support.

Analyzing the socioeconomic factors, it was registered that there was a significant association between lower level of education and the Wealth Index with a partial and a complete lack of teeth. However, when we observed unemployment as a socioeconomic indicator, we noted that the inactive population inversely correlated with partial missing of teeth and had 40% lower chances of missing 1-5 teeth *vs* no missing teeth. This result could be explained by the structure of the inactive population, since the majority of respondents in this category are students and housewives who are younger, or middle age.

The respondents with the mild depressive symptoms were more likely to lose 10, or more teeth compared to those who were not depressed, which was in line with the increase in PHQ-8 score. However, Hybels et al. [30] did not confirm an association between the symptoms of depression and the lack of teeth. The depression symptoms can affect oral health in two ways. The first is by biological mechanism, by contributing to problems with the immune system. Depression can stimulate the production of proinflammatory cytokines that can influence the conditions that contribute to the development of periodontal disease [31]. Also, the use of certain antidepressants is associated with hyposalivation, which can affect the poor state of oral health, including dry mouth, burning sensation, the occurrence of periodontal disease and caries [32]. Another way is the impact of depression symptoms on the insufficient motivation for oral hygiene practice, and reduced frequency of tooth brushing and irregular dental visits [6]. Based on the perceived situation, we can say that the maintenance of depressive disorders under control, regular visits to the dentist and social support contribute to the prevention of tooth loss.

Smoking is a significant predictor of tooth loss [3]. Since 2000, the percentage of smokers in Serbia decreased significantly to the value of 36.5% in 2013 [17]. Compared to the prevalence of smoking in the European countries, we can say that Serbia is approaching the countries of Southeastern Europe with the highest prevalence (Greece 38.9%, Croatia 35%, Bulgaria 29.2%) compared to the countries of Northern Europe with the lowest prevalence (Belgium 18%, UK 19%) [33]. Regardless of the geographical position, this situation can be viewed from the aspect of history, tradition and culture.

Our study had several limitations. First, the independent variables including tooth loss are self-reported with possible bias. Second, we were unable to examine other factors associated with tooth loss, such as dental insurance, dental caries, periodontal disease, community water fluoridation, or antidepressant medications. Third, our study was cross-sectional. Therefore, we can not infer causality. The cross-sectional studies are not relational, and cannot determine causal relationships between the different variables. Mental health disorders coexisting with poor oral health, or other chronic conditions, contribute to the severity and progression of disease and poorer outcomes [34]. Conversely, the persons with tooth loss may have a lower socioeconomic status, lower self-esteem, lack of access to oral health services; also, they may practice other health-compromising behaviors, or have other health conditions that require greater resources and management. These factors may lead to depression, or contribute to the severity of depression as well [6]. It should be noted that in addition to the demographic, socioeconomic factors and lifestyle, there are other factors that are known or suspected to affect the state of oral health that could be subject to examination in future research. These are psychological factors (fear, stressful life events, psychosocial issues) and factors related to the community (relations between people, social support).

Conclusion

This study demonstrated that the sociodemographic and lifestyle factors and depressive symptoms are also important factors related to the tooth loss. The results from this study could serve as a platform for the health policy decision – making, planning and organizing health care in the field of oral health, and to promote the need for better accessibility to dental care as well as for the adoption of specific health promotion programs that can improve oral health of vulnerable categories of the population.

Acknowledgements

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