

# Tooth loss among adult rural and urban inhabitants of the Lublin Region

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## Abstract

Dental diseases and tooth loss result in various health, psychological, and even social problems. The objective of the study was determination of the number of missing teeth among adult rural and urban inhabitants of the Lublin Region, and whether or not there is a relationship between missing teeth and place of residence, and other socio-economic factors, such as: gender, age, education level and the occupation performed (farmer/non-farmer). Data concerning the number of missing teeth were collected from 3,388 individuals. The mean number of missing teeth among the respondents in the study was 13.6. This mean value was significantly higher among the rural than urban inhabitants. Tooth loss was significantly more often found among females than males, this relationship being statistically significant only in the subpopulation of rural inhabitants. According to expectations, the largest number of missing teeth was found in respondents aged over 60, among those aged 31–60 this number was nearly 2.5-fold smaller, while the smallest number of missing teeth was observed among respondents aged 18–30. The largest number of missing teeth was noted among respondents who possessed incomplete elementary or elementary education, followed by those with elementary vocational and secondary school/post-secondary school education, whereas this number was the smallest among respondents who had university education level. Farmers had a significantly larger number of missing teeth, compared to respondents who performed non-agricultural occupations. Using an analysis of regression, the relationship was confirmed between the number of missing teeth, and the respondents' gender, age, education level, place of residence, and occupation performed. Discrimination analysis was applied to show the relationship between the occurrence of total edentulism and the respondents' age, gender, education level and place of residence. It was observed that age was the variable which most strongly discriminated the occurrence of this characteristic, followed by education level, as well as gender and place of residence, which were the weakest discriminatory variables.

## Key words

tooth loss, edentulism, rural and urban inhabitants

## INTRODUCTION

Dental diseases and tooth loss result in various health, psychological, and even social problems. Individuals with unhealthy or missing teeth avoid social contacts, are more often absent from work or miss school classes. Tooth loss, especially total edentulism, decreases the quality of life and self-esteem, may cause disorders in the process of nutrition, leading to the development of obesity [1]. Simultaneously, nutritional deficiencies resulting from the poor state of dentition may cause iron-deficiency anaemia, as well as gastrointestinal diseases [1, 2]. Scientific reports indicate a relationship between the number of missing teeth and the occurrence of coronary heart disease (CHD) events, especially among males, also cerebral stroke, or even selected types of cancer [1, 3, 4]. Females with many missing teeth are at several times higher risk of delivering an underweight baby than those with healthy teeth [1]. Among young people, the primary cause of tooth loss is dental caries, whereas

among the older population periodontal diseases are mainly responsible for tooth loss.

The results of studies show that a greater tooth loss is observed among females than males [5, 6, 7, 8, 9, 10]. Scientific reports indicate the presence of a relationship between the number of missing teeth and the respondents' age [10, 11, 12, 13, 14]. Also, a greater tooth loss occurs among individuals who have a lower education level, compared to those better educated, and among those who have a lower material standard [5, 11, 15]. Studies conducted in Poland showed that the state of dentition of the population is among the poorest in Europe. The reports from both Poland and other European countries indicate a significantly worse state of oral hygiene and a larger number of missing teeth among rural than urban inhabitants [1, 6, 7, 8, 12, 16, 17, 18].

## OBJECTIVES

The objective of the study was determination of the number of missing teeth and the number of totally edentulous individuals among rural and urban inhabitants of the Lublin Region, and confirmation or not of the presence of a

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relationship between tooth loss and the respondents' place of residence and other socioeconomic factors, such as: gender, age education level and the occupation performed (farmer/non-farmer).

## MATERIAL AND METHODS

The main study was conducted during the period 1 January 2007 – 31 December 2008 within the statutory research problem: 'Health problems among the adult population in the Lublin Region', carried out at the Institute of Rural Health in Lublin. The sample for the study was selected by the method of double-sampling. Among all primary health facilities in the Lublin Region 51 units were selected- 32 rural and 19 urban, and a group of 2% of the adult population was selected who were provided with care by an individual facility. In Poland 97.25% of the population is registered with primary health care facilities: therefore, the selection of the sample based on patient lists from these facilities ensured that the study was representative.

The number of visible missing teeth was established during a medical examination, while the number of missing teeth which were replaced by total prostheses, partial prostheses, crowns, bridges, implants, etc., was determined based on a survey. For the purpose of the presented study, individually counted missing teeth in the mandible and maxilla were summed up.

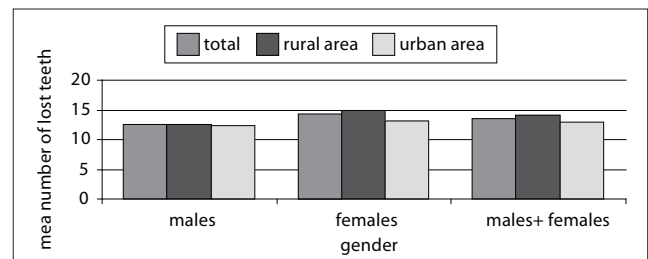
Statistical analyses of the data were carried out with the use of Stat Soft STATISTICA 8.0 PL software. Single-variable comparisons of discrete characteristics in the categories of gender, age, place of residence, level of education and occupation were performed by means of cross-tabulations with the use of Pearson  $\chi^2$  test. The relationships between the number of missing teeth and socio-economic factors were investigated with the use of linear multiple regression, with dichotomized discrete variables, such as gender and occupation (1 – males/0 – females; 1 – farmer/0 – non-farmer). The relationship between the occurrence of edentulism, and socio-economic factors was verified by means of discrimination analysis.

## RESULTS

A total number of 4,004 respondents participated in the study: 56.4% of rural and 43.6% of urban inhabitants. Males constituted 38.5% of the subpopulation of the rural inhabitants and 39.0% of the subpopulation of the urban population; while females – 61.5 and 61.0%, respectively. The mean age of the population in the study was 51.1. Mean age of the rural inhabitants was higher than that of the urban inhabitants (51.6 vs. 50.6); the difference observed, however, was not statistically significant. Also, the differences between mean age of rural and urban males (50.0 vs. 49.6) and females (52.5 vs. 51.2) were statistically insignificant. In the subpopulation of rural inhabitants, the percentage of those possessing incomplete elementary or elementary education was more than twice as high as among the urban inhabitants (36.7 vs. 15.2%), also the percentage of respondents who had elementary vocational education was significantly higher among the rural than urban population (26.1 vs. 20.5%). The percentage of respondents with secondary/post-secondary school education was significantly higher among the urban

than rural inhabitants (43.3 vs. 29.3%), and especially those with university education (21.0 vs. 7.9%). The mean age of respondents with incomplete elementary and elementary education (63.9) was significantly higher than the mean age of those with vocational elementary education level (48.1), secondary/post-secondary education (46.6) and university education (44.4). Mean age of respondents possessing incomplete elementary and elementary education was similar among the rural and urban inhabitants (64.0 vs. 63.4), whereas the mean age of respondents with vocational elementary (51.5 vs. 46.1), secondary/post-secondary (49.5 vs. 43.6) and university education level (45.1 vs. 42.3) was higher among the rural than urban population. The highest percentage of respondents performed occupations not related with agriculture (64.9%), followed by an almost twice lower percentage of farmers (28.6%), and those who did not perform any occupational activity (6.5%). The mean age of farmers (56.1) was significantly higher than that of respondents performing other occupations (50.3).

The data concerning the number of missing teeth was obtained from 3,388 individuals (83.4% of those qualified for the study).



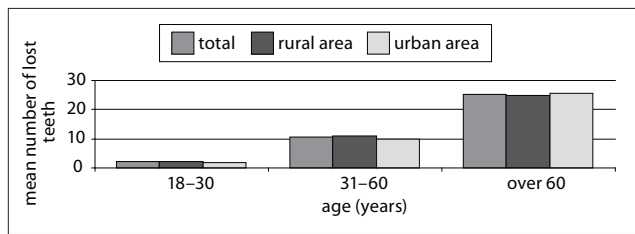
**Figure 1.** Mean number of lost teeth among respondents according to gender and place of residence.

The mean number of missing teeth among the respondents was 13.6. This mean value was significantly higher among rural than urban inhabitants (14.1 vs. 12.9) ( $p=0.0011$ ).

Tooth loss was significantly more frequent among females, compared to males (14.2 vs. 12.5) ( $p=0.0016$ ), this relationship being statistically significant only in the subpopulation of rural inhabitant. The mean number of missing teeth among males living in rural and urban areas was similar (12.6 vs. 12.4), whereas the mean number of missing teeth was higher among rural than urban females (15.0 vs. 13.1) (Fig. 1).

In the population examined, 16.9% of respondents were totally edentulous, with a significantly higher percentage observed among rural than urban inhabitants (17.6 vs. 16.2%) ( $p=0.016$ ). The percentage of people who were edentulous was significantly higher among females than males (19.3 vs. 13.0%) ( $p=0.0000$ ). A significantly higher percentage of males living in urban areas were toothless, compared to rural inhabitants (15.2 vs. 11.6%), whereas among females, a significantly higher percentage of those who had no teeth was noted among rural than urban inhabitants (21.1 vs. 16.4%).

As expected, the largest number of missing teeth was observed among respondents aged over 60 (25.2 on average), among those aged 31–60 this number was nearly 2.5 times smaller (10.6), and the smallest number of missing teeth (2.1 on average) was found among respondents aged 18–30. The differences were statistically significant ( $p=0.0000$ ). Both among respondents aged 18–30 (2.4 vs. 1.7) and those aged 31–60 (11.0 vs. 9.8) the largest number of missing teeth was



**Figure 2.** Mean number of lost teeth among respondents according to age and place of residence.

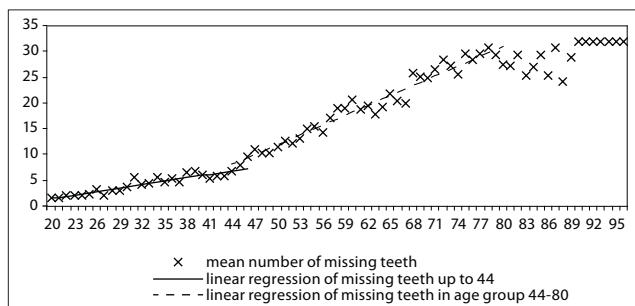
noted among rural than urban inhabitants, whereas among respondents aged over 60 urban inhabitants had a slightly larger number of missing teeth (25.6 vs. 25.0) (Fig. 2).

Among the respondents aged 18–30 there were no totally edentulous individuals, while the percentage of such respondents in the age group 31–60 was 4.4%, and among those aged over 60 practically every second respondent was toothless (49.9%) ( $p=0.0000$ ). In the population aged 31–60, the percentage of totally edentulous individuals was higher among rural than urban inhabitants (5.0 vs. 3.7%), while among respondents aged over 60, a higher percentage of respondents living in urban than rural areas had no teeth (50.9 vs. 49.3%).

In the age categories recommended by the WHO for the studies of the state of dentition, i.e. e age groups 35–44 and 65–74, the mean number of missing teeth was: 5.9 – for the first age interval, and 24.9 – for the second, whereas total edentulism was observed among 0.2 and 45.1% of respondents.

Regression curves were drawn for mean tooth loss according to the respondents' age. The respondents aged 18–19 were not considered due to the small sample size, and for the same reason and additionally because of the presence of only residual dentition, respondents aged over 80 were also not included. The regression curves had the following form (Fig.3):

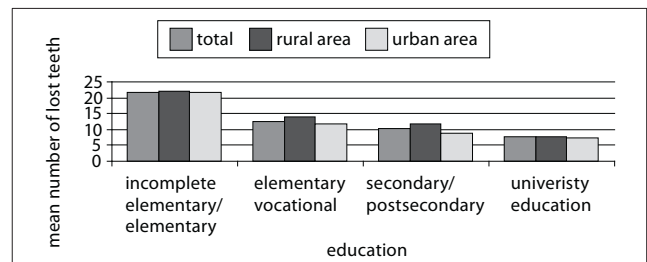
- mean number of missing teeth (up to 44) =  $-19.8728 + 0.636 \times \text{age}$ ;
- mean number of missing teeth (45–80) =  $-2.9215 + 0.233 \times \text{age}$ .



**Figure 3.** Regression curves of tooth loss according to age in the age group 20–80.

Based on formulas, it was found that among the population aged up to 44, the loss of one tooth occurred every 4.5 years, on average, while among those aged over 44 – every 1.5 years, on average.

The largest number of missing teeth was found in respondents who had incomplete elementary and elementary education level (21.8 on average), followed by – however, twice less – those with vocational elementary (12.6), and secondary/post-secondary education (10.2), and the least –



**Figure 4.** Mean number of lost teeth among respondents according to education level and place of residence.

7.5, respondents with university education. In the category of education, incomplete elementary and elementary education level, the mean number of missing teeth among rural and urban inhabitants was nearly the same (21.9 vs. 21.8), similar to respondents with university education (7.7 vs. 7.3), while the greatest tooth loss was observed among rural than urban inhabitants with vocational elementary (13.8 vs. 11.8) and secondary/post-secondary education (11.8 vs. 8.7) (Fig. 4).

As many as 38.8% of respondents who had incomplete elementary and elementary education were totally toothless, whereas in the remaining categories the percentages of such individuals were significantly lower: among respondents with vocational elementary education – 8.6%, among those with secondary/post-secondary education – 9.4%, and among respondents who possessed university education – 7.8%. In all education categories a higher percentage of urban than rural inhabitants were totally toothless, i.e. those with incomplete elementary and elementary education (41.4 vs. 38.0%), vocational elementary (12.3 vs. 6.7%), secondary/post-secondary (12.9 vs. 6.0%), and university education (8.3 vs. 7.1%).

The study confirmed that a significantly larger number of missing teeth was noted in farmers than non-farmers (17.0 vs. 12.6) ( $p=0.0000$ ). Also, significantly more farmers than non-farmers were totally toothless (24.0 vs. 16.4%).

**Table 1.** Analysis of regression of the number of missing teeth according to respondents' age, gender, education level, occupation performed and place of residence.

Independent variable	BETA	B	Standard deviation B	t	p level
Intercept		-6.323	0.910	-6.944	0.000
Age	0.652	0.469	0.010	46.181	0.000
Gender	-0.027	-0.665	0.301	-2.207	0.027
Education level	-0.138	-1.422	0.154	-9.224	0.000
Occupation performed	0.047	1.172	0.354	3.303	0.000
Place of residence	0.040	0.299	0.103	2.887	0.003

$R=0.446$ ,  $R^2=0.199$ , Corrected  $R^2=0.198$ ,  $F=182.71$ ,  $p<0.000$ , Estimation error=17,500

Using the analysis of regression, a relationship was confirmed between the number of missing teeth and the respondents' gender, age, education level, place of residence, and occupation performed. A higher tooth loss concerned females, the elderly, respondents who had low education level, rural inhabitants and farmers.

Using discriminative analysis, a relationship was confirmed between the occurrence of total edentulism and the respondents' age, gender, education level and place of residence. It was found that age was the variable which most

**Table 2.** Discriminative analysis of the presence of total edentulism according to respondents' age, education level, occupation performed and place of residence.

Independent variables	Wilks Lambda	Partial Wilks Lambda	F to remove	Level	Tolerance
Age	0.879	0.760	977.557	0.000	0.881
Gender	0.671	0.994	15.695	0.000	0.996
Education level	0.674	0.990	28.684	0.000	0.766
Occupation performed	0.668	0.999	2.119	0.145	0.789
Place of residence	0.669	0.997	6.973	0.008	0.820

Wilks Lambda: 0.668, F=307.36, p<0.00000

strongly discriminated the occurrence of this characteristic, followed by education level, while gender and place of residence exerted the weakest discriminatory effect.

## DISCUSSION

The study of the state of oral hygiene conducted in Poland in the 80s and 90s of the 20<sup>th</sup> century showed that dental caries occurred in the majority of the population. In 1987, dental caries was diagnosed in 99.6–100% of the population aged 35–44, whereas 99.3% suffered from periodontal diseases. The mean number of missing teeth in this population was 10.5 [13]. Considering the state of dentition, this placed Poland in one of the last places in Europe, and the occurrence of periodontal diseases was comparable to Bangladesh, Nepal and India [19].

Own studies showed that the mean number of missing teeth in the population examined was 13.6. In the age category 35–44 recommended by the WHO for studies of the state of dentition, the mean number of missing teeth was 5.9, and was almost by a half smaller than in 1987. Despite an improvement in the epidemiological situation it still remains very bad. A significantly lower tooth loss is observed, e.g. among the inhabitants of Brazil (9.5) [9]. Also, the percentage of totally edentulous individuals confirms the poor state of oral cavity hygiene (16.9%), while in Mexico in the population aged over 18 this percentage is 6.3% [11]. In 2003 in Sweden, the percentage of toothless respondents aged 40–70 was 1% [20]. In Brazil, the percentage of the toothless population is higher (19%), despite, as previously mentioned, the mean number of missing teeth is smaller than in Poland [5]. The state of oral hygiene is the result of many factors, among which should be mentioned prophylactic actions carried out at school age, hygienic habits acquired in childhood, an individual approach to matters of oral hygiene, as well as costs, accessibility and level of dental treatment. A high tooth loss among inhabitants of the Lublin Region most probably results from neglect of the principles of hygiene. A low economic status of the population may also play an important role, because dental treatment requires high financial outlays.

The presented study showed that among rural inhabitants the mean number of missing teeth was significantly higher than among the population living in the urban areas; similarly, the percentage of toothless rural inhabitants was significantly higher than that of urban inhabitants. These results are consistent with observations conducted in Poland and the results of studies in other countries. According to the above-quoted studies of 1987, in the population aged 35–44

the mean number of missing teeth among rural inhabitants (11.8) was significantly higher than among urban inhabitants (7.9) [7]. Similarly, in the Poznań Region (population at the same age) the number of missing teeth among rural inhabitants was higher than that among the urban population (9 vs. 7) [18]. Studies carried out in the Warsaw Region also showed a larger number of missing teeth and a worse state of the remaining dentition among rural than urban inhabitants [6]. In studies conducted, among others, in the Lublin Region, there was a larger number of missing molar and premolar teeth among rural inhabitants, and also a higher percentage of totally toothless individuals [12, 13, 21]. Similarly, in Greece and Brazil, a larger number of missing teeth was found among rural than urban inhabitants [5, 15]. In Mexico, in the states in which the population living in urban areas is dominant, the percentage of toothless individuals is three times lower than in the states where the rural population prevails [11].

The presented study demonstrates that the mean number of missing teeth is higher among females than males, and also the percentage of toothless females is higher than that of males. These results are in accordance with the results of other studies. At the beginning of the 90s of the 20<sup>th</sup> century in the Warsaw Region, a larger number of healthy teeth, as well as lower tooth loss, was observed among males, compared to females [6]. The study showed that women care more about their state of dentition; however, the number of missing teeth is higher among them than among males [8]. Higher tooth loss among females was also found in studies conducted in Canada, Hungary, and Brazil [5, 7, 9, 10]. Based on a literature review, the worse state of dentition in females is due to disorders in calcium metabolism in pregnancy, and after menopause [22, 23, 24].

In the presented study, a relationship was found between the number of missing teeth and age. The percentage of totally toothless individuals also increased with age. The state of dentition observed in younger age groups basically did not differ from the situation noted in previous years. At the end of the 80s and 90s of the 20<sup>th</sup> century, in the population aged 35–44 there were no toothless individuals, also in the presented study the percentage of total edentulism was small (0.2%) [12, 13]. In other countries, in this age group, the state of dentition is generally worse. In 2000 in Lithuania, in the population aged 35–44 there were as many as 1% of toothless individuals [25], while in 2003 in Hungary this percentage was 1.9%, in Mexico – 2.4%, and in Brazil – 9% [5, 10, 11]. In turn, in 1997 in France, there were no totally toothless individuals in this age category [14]. Comparisons of the state of dentition in the older age groups are definitely to the disadvantage of the Lublin Region. The state of dentition of the population examined (nearly 50% of totally toothless individuals in the population aged over 60), is significantly worse than the state of dentition of the inhabitants of the majority of West European countries in the 80s of the 20<sup>th</sup> century. At this time, among the population aged over 65, the totally toothless amounted to 30% of the inhabitants of the United Kingdom, 20% of inhabitants of Sweden, and 25% of inhabitants of Switzerland. During this period, only in Denmark and Island were there more toothless people than currently in the Lublin Region (60 and 72%, respectively) [26]. Nevertheless, the percentage of toothless individuals is lower than that observed in the Warsaw Region in the 1990s (62.8% of toothless population aged over 65) [6]. In own studies, the mean number of missing

teeth among those aged over 60 was 25.2, and the percentage of the toothless among the population aged 65–74 – 44.1%. In 2000, the inhabitants of Lithuania had a significantly better state of dentition (11% of toothless individuals aged 65–74) [25]. In 2003 in Hungary, 19.8% of the population aged over 65 were toothless, in Mexico – 25.5%, whereas in Spain – 34% were totally toothless [10, 11, 16]. In some states in the USA, as early as in 1997, the percentage of toothless population aged 65–74 was approximately 20%, and among the population aged over 75 – 26.7%. At the same time in the USA, significant differences were observed in the number of toothless people according to the place of residence. In West Virginia, Louisiana, and in Kentucky, 40% of the population aged over 65 were totally toothless, while in Arizona, California, Oregon, Wisconsin and in Hawaii this percentage was lower than 20% [27]. Based on the presented study it was found that the age of 44 delineated the border when the loss of subsequent teeth rapidly accelerated. Among individuals aged up to 44, the loss of one tooth took place every 4.5 years, on average, while at the age of over 44 the loss of one tooth occurred 1.5 years, on average.

The results of the study show that there is a relationship between the state of respondents' dentition and their education level [1, 5, 15]. The presented study confirmed this relationship; the mean number of missing teeth significantly decreased the higher with category of education. The largest number of missing teeth was observed among individuals with incomplete elementary and elementary education, which was also significantly influenced by the higher mean age of this subgroup. The best state of dentition was noted among the population possessing university education level. Similar results were obtained in the above-quoted study conducted in the USA, where the percentage of toothless individuals among the population with the lowest education level was 42%, while among those with a higher education level this percentage ranged from 10 – 25% [27]. A significant relationship between the number of missing teeth, and education level and material standard was found in studies conducted in Greece, Lithuania and Brazil [5, 15, 25].

The mean number of missing teeth among farmers was higher than among individuals performing other occupations, and this was due not only to a higher mean age in this occupational group. Using the analysis of regression, a relationship was confirmed between the number of missing teeth and the occupation performed. Also, the percentage of those who were toothless was significantly higher among farmers than non-farmers.

## CONCLUSIONS

1. The state of dentition of rural inhabitants, expressed by the number of missing teeth and the number of totally toothless individuals, was significantly worse than that among urban inhabitants, the differences concerning only the subpopulations of females.
2. A larger number of missing teeth concerned also the elderly, female gender, individuals with a low education level, and farmers.
3. Age was the factor which most strongly discriminated the occurrence of total edentulism, followed by education level, whereas gender and place of residence were the weakest variables.

## REFERENCES

1. Emami E, Feine JS. Focusing on oral health for the Canadian rural population. *CJRM* 2008; 13(1): 36–38.
2. Geissler CA, Bates JF. The nutritional effects of tooth loss. *Am J Clin Nutr*. 1984; 39: 478–489.
3. Hiraki A, Matsuo K, Kawase T, Tajima K. Teeth loss and risk of cancer at 14 common sites in Japanese. *Cancer Epidemiol Biomarkers Prev*. 2008; 17(5): 1222–1227.
4. Hung HC, Josphipura KJ, Colditz G, Manson JE, Rimm EB, Speizer FE, Willett WC. The association between tooth loss and coronary heart disease in men and women. *J Public Health Dent*. 2004; 64(4): 209–215.
5. Barbato PR. Tooth loss and associated socioeconomic, demographic, and dental-care factors in Brazilian adults: an analysis of the Brazilian Oral Health Survey, 2002–2003. *Cad. Saude Publica (online)*. 2007; 23(8): 1803–1814.
6. Juszczak-Popowska B, Chrupek B, Chruściel B, Rutkowski P, Guckler A. Evaluation of dentition condition in subjects aged 55–64, 65 and more, living in the province of Warsaw. *Czas Stom*. 1993; 9: 582–587.
7. Locker D, Ford J, Leake JL. Incidence of and risk factors for tooth loss in a population of older Canadians. *J Dental Res*. 1996; 75(2): 783–789.
8. Nowak A, Józefowicz W. Assessment of teeth state of the Polish population in the aspect of stomatological prosthetic rehabilitation on the basis of ICSI. II. The use of stomatological prosthetic rehabilitation. *Prot Stom*. 1991; 4: 168–170.
9. Corraini P, Baelum V, Pannuti CM, Pustiglioni AN, Romito GA, Pustiglioni FE. Tooth loss prevalence and risk indicators in an isolated population of Brazil. *Acta Odontol Scand*. 2009; 67(5): 297–303.
10. Madlena M, Hermann P, Jahn M, Fejerdy P. Caries prevalence and tooth lost in Hungarian adult population: results of a national survey. *BMC Public Health* 2008; 8: 364–371.
11. Medina-Solis CE, Perez-Nunez R, Maupome G, Avila-Burgos L, Pontigo-Loyola AP, Patino-Marin N, Villalobos-Rodelo J. National survey on edentulism and its geographic distribution, among Mexicans 18 years of age and older (with emphasis in WHO age groups). *J Oral Rehabil*. 2007; 35(4): 237–244.
12. Szymańska J, Fetkowska-Mielnik K. Aspects of dental health in adult rural population in Poland. *Ann Agric Environ Med*. 1998; 5: 103–108.
13. Jańczuk Z, Banach J. Results of entire epidemiological studies of masticatory organ. *Mag Stom*. 1991; 1: 28–31.
14. Hescot P, Bourgeois D, Doury J. Oral health in 35–44 year old adults in France. *Int Dent J*. 1997; 47: 94–99.
15. Skarmoutsos N. Reasons and factors which are causing tooth loss in the population of Greece. *Hell Stomatol Chron*. 1988; 32(3): 175–182.
16. Mack F, Mojon P, Budtz-Jorgensen E, Kocher T, Splieth C, Schwahn C, et al. Caries and periodontal disease of elderly in Pomerania, Germany: results of the Study of Health in Pomerania. *Gerodontology* 2004; 21: 27–36.
17. Pellowska-Piontek M, Kwapisz H, Witek E. Evaluation of teeth loss and prosthetic needs of inhabitants aged 35–44 and 60 and above, living in the rural areas of the Gdańsk province. *Czas Stom*. 1998; 7: 426–429.
18. Soboczyńska K, Włoch S, Kobyłańska M, Chmielnik M, Ruszyńska H, Stopa J. Requirements for prosthetic treatment of adults aged 35–44 years in the Province of Poznan. *Czas Stomatol*. 1990; 43(7): 426–429.
19. Genco RJ. Host response in periodontal disease. *Current Concepts*. *J Periodont*. 1992; 63: 338–355.
20. Hugoson A, Koch G, Göthberg C, Helkimo AN, Lundin SA, Norderyd O, Sjödin B, Sondell K. Oral health of individuals aged 3–80 years in Jököping, Sweden during 30 years (1973–2003) II. Review and clinical and radiographic findings. *Swed Dent J*. 2005; 29: 139–155.
21. Ilewicz L, Skowron J. Assessment of dental state and treatment needs in a selected group of residents of the Opole province. *Mag Stom*. 1996; 10: 9–12.
22. Inagaki K, Kurosu Y, Kamiya T, Kondo F, Yoshinari N, Noguchi T, Krall EA, Garcia RI. Low metacarpal bone density, tooth loss, and periodontal disease in Japanese woman. *J Dental Res*. 2001; 80(9): 1818–1822.
23. Russell SL, Ickovics JR, Yaffee RA. Exploring potential pathways between parity and tooth loss among American woman. *Am J Public Health*. 2008; 98(7): 1263–1270.
24. Taguchi A, Suei Y, Otsuka M, Tanimoto K, Hollender LG. Relationship between bone mineral density and tooth loss in elderly Japanese woman. *Dentomaxillofac Radiol*. 1999; 28: 4219–4223.
25. Skudutyte R, Aleksejuniene J, Eriksen H. Dental caries in adult Lithuanian. *Acta Odontol Scand*. 2000; 58(4): 143–147.
26. WHO Country Profiles on Oral Health in Europe 1986.
27. Morbidity and Mortality Weekly Report. USA.Gov. Department of Health and Human Services: Total tooth loss among persons aged greater than or equal to 65 years-selected states, 1995–1997. 1999, 48(10): 206–210.