Caries Prevalence in the Primary and Permanent Dentition of Rural And Urban Children in the Municipality of Banja Luka, Bosnia and Herzegovina

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Abstract

Aims: The aims of this study were to evaluate dental health status and caries prevalence in six-year and 12-year-olds in urban and rural populations in Banja Luka, and to determine possible risk factors for the formation and development of dental caries in the post-war and transition period. ***Methods:*** The study population comprised a random sample from two age groups—six-year-olds (n=372) and 12-year-olds (n=495)—from the rural and urban region of Banja Luka, Bosnia and Herzegovina. Dental examinations were performed in daylight and using dental mirror and probe using the World Health Organization 1997 methodology. All the 12-year-old children completed a questionnaire. The parents of the six-year-olds completed the questionnaire for them. It included questions on their sociodemography, use of dental services, oral hygiene habits and dietary habits. DMFT/dmft were calculated for each child and statistically analysed. Statistical significance of the data was determined using the chi-square test. ***Results:*** The results showed that the mean DMFT was higher in rural six-year-old boys and girls—1.26(±0.16) and 1.34(±0.19), respectively—than in urban ones—0.68(±0.07) and 0.66(±0.06), respectively). At age 12 years, the mean DMFT for boys was 5.49(±0.61) from rural areas and 4.29(±0.35) from urban areas and for girls 5.72(±0.55) and 4.98 (±0.39), respectively. Data from the questionnaires showed statistically significant differences regarding dental visits. It was found that there were insufficient dental services and a very high frequency of sugar intake. ***Conclusion:*** The present results confirmed high caries prevalence in all the groups that were examined, with a higher level among children from rural areas. It is essential to implement a long-term oral health education programme in Banja Luka.

Key Words: Caries Experience, Epidemiology, Children, Sociodemographic, Oral Hygiene and Dietary Habits

Introduction

Dental caries and periodontal disease are the most frequent oral diseases in children [1]. Tinanoff (1995) combines biological, social and psychological factors as risk factors for dental caries and periodontal disease [1]. Dental diseases are associated with lifestyle and many risk factors can affect the maintenance of oral health habits [1-3].

The prevalence of child dental caries in developed countries has decreased markedly in the last half century. The reasons for this change are complex but may involve extensive use of fluoridated toothpaste, a more sensible approach to sugar consumption, improved oral hygiene practices, topical application of fluorides and fluoride rinsing. Successful preventive programmes, which have increased awareness, knowledge and attitudes toward oral health, have also played a role [4-7]. On the other hand, non-developed and developing countries, such as Bosnia and Herzegovina and the

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Republic Srpska, are still facing high caries prevalence in school children [8-12].

Since 1986, no systematic studies have been conducted in Banja Luka to provide information on the oral health status of schoolchildren and to assist the planning and evaluation of school oral health programmes. There have been many problems such as war, stress, migration, irregular and poor nutrition, and family breakdown that could significantly affect oral health.

Aims

Against this background, the aims of this study were to:

- Evaluate caries prevalence in 6- and 12-year-old children in urban and rural populations in Banja Luka.
- Determine the behaviour of the study population in relation to possible risk factors for the development of caries.

Methods

The present survey was carried out in 2006 as a cross-sectional survey. The study sample comprised a random sample of two age groups—six-year-olds (n=372) and 12-year-olds (n=495)—from randomly selected schools in Banja Luka, Bosnia and Herzegovina. Banja Luka is the second largest city in Bosnia and Herzegovina. In 2006, Banja Luka and its surrounding rural area had a total population of 250,000, of whom 1788 were six years old and 2098 were 12 years old. Ten schools were selected from the lists of all schools in Banja Luka by simple random sample selection. Five schools were from urban area and five schools were from rural area. From all classes, in these schools every second name on lists of six-year-olds as well as 12-year-olds was chosen. Ethical approval for the study was obtained from The Research Ethics Committee of Faculty of Medicine, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina. Parental consent was obtained before children were examined.

Data were collected by means of clinical examinations and questionnaires. The dental examinations were conducted at the schools, using portable equipment in a room with the subject seated on the chair. Clinical examination for recording dental caries was carried out by two investigators, previously trained in using the dmft/DMFT on 30 six-year-old and 30 12-year-old subjects not included in the final sample. Kappa statistics was used to test the inter-investigator reliability. The kappa values estimated from repeat examination for the intra-consistency of the fieldwork investigators was kappa >0.87 for both of them. The examination for dental caries was carried out according to WHO criteria (World Health Organization Criteria 1997) in daylight using plain dental mirrors and probe. Clearly visible lesions with cavities on tooth surfaces were classified as dental caries (i.e. d3-level cavities), whereas changes in transparency, initial enamel demineralisation with intact surfaces and no cavitations were noted as intact teeth. The teeth were not professionally cleaned. The children brushed their teeth before the examination. No radiographs were taken.

The DMFT Index for the permanent teeth and the decayed, missing, and filled teeth (dmft) Index for the primary teeth were calculated together with the percentage of cavity-free children.

A structured questionnaire was used in this survey. All 12-year-old children completed questionnaire before the dental examination under the supervision of the person who had performed their clinical examination. Parents of the six-year-old children completed the questionnaire for their children. All questions were multiple choice, where the children made a tick or a circle around the most appropriate answer. The questionnaire included questions on sociodemography, use of dental services, oral hygiene and dietary habits. The sociodemographic variables were gender, age and place of domicile (rural or urban). The questions on attendance for dental care asked when the child had had his/her first visit, most recent visit, the frequency of and the reasons for dental visits. Oral hygiene habits of the children were assessed by several questions, including frequency of tooth-brushing, age when children had begun tooth-brushing and the use of fluoride supplements. The questions on dietary habits asked about the frequency of consumption of sweets and sugar-containing drinks.

Simple descriptive statistical tests were used in the form of percentage and frequency distribution. Chi-square test was used to assess differences statistically between groups and the level of significance was set at 5% ($P<0.05$).

Results

All parents consented to their children's inclusion in the survey. The studied sample was born, raised and lived in an area with a low level of natural fluoride. The fluoride concentration of the tap water was lower than 0.30 mg/l.

The sociodemographic characteristics, the

mean dmft/DMFT of the sample, percentage of cavity-free children, and median dmft/DMFT scores are presented in *Table 1*. The study of the caries prevalence of primary teeth involved only six-year-old children. In total, 372 children were examined, 105 (58 boys and 47 girls) from the rural area and 267 (126 boys and 141 girls) from the urban area. The caries prevalence in permanent teeth was evaluated for all children. Also, the caries prevalence of permanent teeth was examined for 495 children aged 12 years, 184 of them (79 boys and 105 girls) living in the rural area and 311 of them (149 boys and 162 girls) in the urban area.

The epidemiological status of primary teeth in six-year-olds and permanent teeth in 6- and 12-year-olds was not significantly different between boys and girls. However, there were statistically significant differences in the epidemiological status of these children in relation to their place of residence.

Table 1. *Caries Prevalence in Primary and Permanent Dentition in 6-and 12-Year Old Children From Urban and Rural Areas in the Municipality of Banja Luka*

PRIMARY DENTITION	**N**	**mean ages**	**mean dmft (±SD)**	**cavity-free %**	**range (minimum -maximum)**	**lower quartile**	**median**	**upper quartile**	**interquartile range**
6-year-old girls									
rural	47	6 year 4 month	8.08 (±3.47)	2.00%	16(0-16)	7	8	11	4
urban	141	6 year 3 month	6.30 (±4.23)	0.05%	18(0-18)	3	7	9	6
Chi-square test			p<0.001						
6-year-old boys									
rural	58	6 year 6 month	8.34 (±4.48)	0.03%	18(0-18)	5	8	12	7
urban	126	6 year 4 month	6.50(±4.24),	0.05%	17(0-17)	3	7	9	6
Chi-square test			p<0.001						
PERMANENT DENTITION	**N**	**mean ages**	**mean dmft (±SD)**	**cavity-free %**	**range (minimum -maximum)**	**lower quartile**	**median**	**upper quartile**	**interquartile range**
6-year-old girls									
rural	47	6 year 4 month	1.34 (±1.83)	0.02%	6(0-6)	0	2	4	4
urban	141	6 year 3 month	0.66(±1.40)	0.05%	8(0-8)	0	0	1	1
Chi-square test			p<0.01						
6-year-old boys									
rural	58	6 year 6 month	1.26 (±1.42)	0.03%	5(0-5)	0	1	2	2
urban	126	6 year 4 month	0.68(±0.35).	0.05%	4(0-4)	0	0	1	1
Chi-square test			p<0.01						
12-year-old girls									
rural	105	12 year 2 month	5.72(±3.34)	1.00%	16(0-16)	4	5	8	4
urban	162	11 year 11 month	4.98 (±3.12)	4.40%	18(0-18)	3	4	6	3
Chi-square test			p<0.001						
12-year-old boys									
rural	79	12 year 3 month	5.49(±3.32)	2.50%	16(0-16)	3	5	8	5
urban	149	12 year 1 month	4.29(±3.20)	4.70%	20(0-20)	3	4	6	3
Chi-square test			p<0.001						

SD-standard deviation

In primary teeth, the mean dmft values in six-year-old boys from rural and urban areas were 8.34(±4.48) and 6.5(±4.24), respectively ($P<0.001$). The mean dmft values in six-year-old girls from rural and urban area were 8.08(±3.47) and 6.3(±4.23), respectively ($P<0.001$).

In the permanent teeth, the mean DMFT for six-year-old boys from the rural area was 1.26(±1.42) and from the urban area it was 0.68(±0.35) ($P<0.01$). The mean DMFT values in six-year-old girls from rural and urban areas were 1.34(±1.83) and 0.66(±1.40), respectively ($P<0.01$).

Analysis of data for the rural and urban populations of 12-year-old boys in Banja Luka region showed that the mean DMFT was 5.49(±3.32) (rural) and 4.29(±3.20) (urban) respectively; for 12-years-old girls, mean DMFT was 5.72(±3.34) (rural area) and 4.98 (±3.12) (urban area). A chi-square test showed that there was statistically significant difference for this index between 12-year-old children from rural and urban regions ($P<0.001$ for boys and girls).

Only 2.5% of 12-year-old boys from the rural area and 4.7% of their peers from the urban areas were cavity-free. Among 12-year -old girls, 1.0% from rural and 4.4% of them from urban areas were cavity-free. In six-year-olds from rural and urban areas, 0.03% and 0.05% of boys and 0.02% and 0.05% of girls were cavity-free.

Median dmft indexes in six-year-old boys and girls from rural and urban area were 8 and 7, respectively for both genders. Median DMFT indexes in six-year-old boys from rural and urban areas were 1 and 0 and in girls for the same age were 2 and 0. Median DMFT indexes in 12-year-olds in rural and urban areas were 5 and 4, for both genders.

Data from the questionnaire were grouped in two tables. Because there was no statistically significant difference in caries prevalence between the sexes, in questionnaire analysis data were grouped according to place of residence for both sexes together.

Table 2 lists the results associated with dental visits. In answer to the question about the children's age at first visit, there were no statistically significant differences for any of the four possible answers, between rural and urban six-year-olds. However, for 12-year-olds, there was a statistically highly significant difference between the groups for the answer "less than four years" (21 [11.4%] rural vs. 86 [27%] urban, $P<0.001$) and for the answer "when enrolled at school" (89 [48.4%] rural vs. 73 [23.5%] urban, $P<0.001$).

In answer to the question on the reason for the children's first visit, there were no statistically significant differences between the answers from the 6- and 12-years-olds, other than in six-year-olds for the response "pain" (32 [30.5%] rural vs. 39 [14.6%] urban, $P<0.01$) and in the 12-year-olds for the response "review" (49 [26.6%] rural vs. 140 [45.0%] urban, $P<0.01$).

In answer to the question about the frequency of dental visits, there was only a statistically significant difference between the 6- and 12-years-olds for the same answers "when had a toothache" (for six-year-olds, 20 [19.0%] rural vs. 16 [6.0%] urban, $P<0.001$, and for 12-year-olds 47 [25.5%] rural vs. 37 [11.9%] urban, $P<0.01$) and for the answer "never" (11 [10.5%] rural vs. 10 [3.7%] urban, $P<0.05$, for six-year-olds and 12 [6.5%] rural vs. 5 [1.6%] urban, $P<0.05$, for 12-year-olds).

In answer to the question about the reason for the children's most recent visit, there were no statistically significant differences between the answers from the 6- and 12-years-olds, other than in the six-year-olds for the response "fitting an appliance/prosthesis" (5 [4.8%] rural vs. 0 [0%] urban, $P<0.01$) and in the 12-year-olds for the response "control, check-up" (42 [24.4%] rural vs. 116 [37.3%] urban, $P<0.05$) and for the response "extraction of teeth due to pain" (21 [11.4%] rural vs. 14 [4.5%] urban, $P<0.05$).

In answer to the question on the reason why children had not visited the dentist, there were no statistically significant differences between the answers from the 6- and 12-years-olds, other than for the same response for both ages "there is no dentist in the vicinity" (26 [24.8%] rural vs. 2 [0.7%] urban, $P<0.001$, for six-year-olds and 14 [7.6%] rural vs. 5 [1.6%] urban, $P<0.01$, for 12-year-olds). Also for 12-year-olds, there was a statistically significant difference between the groups for the answer "fear" (72 [39.1%] rural vs. 82 [26.4%] urban, $P<0.05$).

Table 3 presents the results in relation to oral hygiene and dietary habits. In answer to the question about the frequency of tooth-brushing, there were no statistically significant differences for any of the five possible answers between rural and urban six-year-olds. However, for 12-year-olds, there was a statistically significant difference between the groups for the answer "once a day" (34 [18.5%] rural vs. 30 [9.6%] urban, $P<0.05$) and for the answer "after every meal" (33 [17.9%] rural vs. 105 [33.8%] urban, $P<0.01$).

Table 2. *The Use of Dental Services Among 6- and 12-Year-Olds with Respect to Urban/Rural Place of Domicile*

	6 year olds					12 year olds				
	rural	**urban**	**rural %**	**urban %**	**χ2**	**rural**	**urban**	**rural %**	**urban %**	**χ2**
How old was your child when she/he visited the dentist for the first time?/ How old were you when you visited the dentist for the first time?										
less than 4 years	13	56	12.4%	21.0%	*NSD	21	86	11.4%	27.0%	P<0.001
4 to 6 years	51	133	48.6%	49.8%	*NSD	64	146	34.8	47.0%	*NSD
when enrolled in school	34	73	32.4%	27.3%	*NSD	89	73	48.4%	23.5%	P<0.001
never	7	5	6.7%	1.9%	*NSD	10	6	5.4%	1.9%	*NSD
What was the reason for your child's first visit to dentist?/ What was the reason for your first visit to dentist?										
pain	32	39	30.5%	14.6%	P<0.01	34	36	18.5%	11.6%	*NSD
dental injuries	4	7	3.8%	2.6%	*NSD	5	13	2.7%	4.2%	*NSD
extraction of primary teeth	9	36	8.6%	13.5%	*NSD	46	59	14.8%	19.0%	*NSD
extraction of permanent teeth	4	2	3.8%	0.7%	*NSD	5	5	2.7%	1.6%	*NSD
repair of teeth	11	54	10.5%	20.2%	*NSD	45	58	24.5%	18.6%	*NSD
review	45	129	42.9%	48.3%	*NSD	49	140	26.6%	45.0%	P<0.01
Has your child visited the dentist?/ Have you visited the dentist?/										
every 3 months	1	8	1.0%	3.0%	*NSD	19	37	10.3%	11.9%	*NSD
every 6 months	6	11	5.7%	4.1%	*NSD	4	18	2.2%	5.8%	*NSD
once a year	2	10	1.9%	3.7%	*NSD	8	11	4.3%	3.5%	*NSD
whenever necessary, without a specific schedule	65	212	61.9%	79.4%	*NSD	94	203	51.1%	65.3%	*NSD
when have a toothache	20	16	19.0%	6.0%	P<0.001	47	37	25.5%	11.9%	P<0.01
never	11	10	10.5%	3.7%	P<0.05	12	5	6.5%	1.6%	P<0.05
What was the reason for your child's latest visit to the dentist?/ What was the reason your latest visit to the dentist?										
control, check-up	42	123	40.0%	46.1%	*NSD	42	116	24.4%	37.3%	P<0.05
repair of teeth	22	78	21.0%	29.2%	*NSD	77	112	41.8%	36.0%	*NSD
extraction of primary teeth	18	47	17.1%	17.6%	*NSD	20	25	10.9%	8.0%	*NSD
extraction of teeth due to pain	2	1	1.9%	0.4%	*NSD	21	14	11.4%	4.5%	P<0.05
pain	11	15	10.5%	5.6%	*NSD	11	18	6.0%	5.8%	*NSD
dental injuries	3	1	2.9%	0.4%	*NSD	7	4	3.8%	1.3%	*NSD
treatment of gum disease	2	2	1.9%	0.7%	*NSD	1	6	0.5%	2.0%	*NSD
Fitting an appliance/prosthesis	5	0	4.8%	0.0%	P<0.01	5	16	2.7%	5.1%	*NSD
Why hasn't your child visited the dentist?/ Why haven't you visited the dentist?/										
fear	35	100	33.3%	37.5%	*NSD	72	82	39.1%	26.4%	P<0.05
No need because nothing hurts	38	141	36.2%	52.8%	*NSD	81	182	44.0%	58.5%	*NSD
It is not important to us	3	2	2.9%	0.7%	*NSD	10	23	5.4%	7.4%	*NSD
Does not like him	2	14	1.9%	5.2%	*NSD	3	7	1.6%	2.2%	*NSD
There is no dentist in the vicinity	26	2	24.8%	0.7%	P<0.001	14	5	7.6%	1.6%	P<0.01
It is too expensive	1	8	1.0%	3.0%	*NSD	4	12	2.2%	3.8%	*NSD
***NSD-no statistical difference**										

In answer to the question about means for oral hygiene maintenance, there were no statistically significant differences between the answers from the 6- and 12-year-olds, other than in 12-year-olds for the response about the use of dental floss (12 [6.5%] rural vs. 53 [17%] urban, $P<0.01$).

In answer to the question about the age at which children had begun tooth-brushing, there were no statistically significant differences between the answers from the six-year-olds, other than for the response "when went to school" (10 [9.5%] rural vs. 2 [0.7%] urban, $P<0.001$). For 12-year-olds, there was a highly statistically significant difference between the groups for the answer "in the second year" (40 [21.7%] rural vs. 134 [43.1%] urban, $P<0.001$) and for the answer "when

Table 3. *Oral Hygiene and Dietary Habits Among 6- and 12-Year Olds With Respect to Urban/Rural Place of Living*

	6 year olds					12 year olds				
	rural	**urban**	**rural %**	**urban %**	**χ2**	**rural**	**urban**	**rural %**	**urban %**	**χ2**
How often does your child brush their teeth?/ How often do you brush your teeth?										
never	1	0	1.0%	0.0%	*NSD	0	1	0.0%	0.3%	*NSD
sometimes (irregular)	11	14	10.5%	5.2%	*NSD	8	9	4.3%	2.9%	*NSD
once a day	41	86	39.0%	32.2%	*NSD	34	30	18.5%	9.6%	P<0.05
twice daily (morning and evening)	46	150	43.8%	56.2%	*NSD	109	166	59.2%	53.4%	*NSD
after every meal	6	17	5.7%	6.4%	*NSD	33	105	17.9%	33.8%	P<0.01
For hygiene of mouth and teeth does your child use / For hygiene of mouth and teeth do you use										
toothbrush	104	260	99.0%	97.4%	*NSD	168	296	91.3%	95.1%	*NSD
toothpaste	100	256	95.2%	95.9%	*NSD	163	286	88.6%	92.0%	*NSD
dental floss	1	8	1.0%	3.0%	*NSD	12	53	6.5%	17.0%	P<0.01
solutions for rinsing the mouth and teeth (eg Fluorogal)	7	18	6.7%	6.7%	*NSD	13	39	7.1%	12.5%	*NSD
toothpicks	19	29	18.1%	10.9%	*NSD	13	37	7.1%	11.9%	*NSD
none	0	1	0.0%	0.4%	*NSD	0	1	0.0%	0.3%	*NSD
The age when your child began tooth brushing/ The age when you began tooth brushing:										
in the 2nd year	16	73	15.2%	27.3%	*NSD	40	134	21.7%	43.1%	P<0.001
from 2 to 4 year	47	135	44.8%	50.6%	*NSD	53	110	28.8%	35.4%	*NSD
from 4 to 6 year	32	56	30.5%	21.0%	*NSD	54	53	29.3%	17.0%	P<0.05
when she/he went to school	10	2	9.5%	0.7%	P<0.001	37	13	0.2%	4.2%	P<0.001
do not wash their teeth	0	1	0.0%	0.4%	*NSD	0	1	0.0%	0.3%	*NSD
How often does your child use fluorides (besides toothpaste)?/ How often do you use fluorides (besides toothpaste)?										
yes, every day	4	18	3.8%	6.7%	*NSD	12	31	6.5%	10.0%	*NSD
sometimes	28	68	26.7%	25.5%	*NSD	29	87	15.8%	28.0%	P<0.05
that, in school	7	149	6.7%	55.8%	P<0.001	30	55	16.3%	17.7%	*NSD
never	66	32	62.9%	12.0%	P<0.001	113	138	61.4%	44.4%	P<0.05
What does your child usually consume to drink?/ What do you usually consume to drink?										
water from the tap	75	119	71.4%	44.6%	P<0.05	118	162	64.1%	52.1%	*NSD
water from wells	8	2	7.6%	0.7%	P<0.001	18	11	9.8%	3.5%	P<0.05
bottled water	2	42	1.9%	15.7%	P<0.001	11	49	6.0%	15.8%	P<0.01
juices	20	104	19.0%	39.0%	P<0.05	37	89	20.1%	28.6%	*NSD
When does your child usually consume sweets?/ When do you usually consume sweets?										
every day with the main meal	25	106	23.8%	39.7%	*NSD	61	85	33.2%	27.3%	*NSD
every day (always consumed "them")	58	138	55.2%	51.7%	*NSD	63	137	34.2%	44.1%	*NSD
once a week	21	18	20.0%	6.7%	P<0.01	46	79	25.0%	25.4%	*NSD
once a month	1	2	1.0%	0.7%	*NSD	13	7	7.1%	2.3%	P<0.05
never	0	3	0.0%	1.1%	*NSD	1	3	0.5%	1.0%	*NSD
What kind of bread does your child usually consume?/ What kind of bread do you usually consume?										
white	63	101	60.0%	37.8%	P<0.05	123	167	66.8%	53.7%	*NSD
half-white	15	27	14.3%	10.1%	*NSD	17	32	9.2%	10.3%	*NSD
black, rye, etc..	1	19	1.0%	7.1%	P<0.05	18	56	9.8%	18.0%	P<0.05
mixed	26	120	24.8%	44.9%	P<0.05	26	56	14.1%	18.0%	*NSD

*NSD-no statistical difference

went to school" (37 [0.2%] rural vs. 13 [4.2%] urban, $P<0.001$). Also for 12-year-olds, there was a statistically significant difference between the groups for the answer "from the fourth to the sixth year" (54 [29.3%] rural vs. 53 [17%] urban, $P<0.05$)

In answer to the question about frequency of use fluoride supplements, there was a statistically significant difference between the six-year-olds for the response "in the school" (7 [6.7%] rural vs. 149 [55.8%] urban, $P<0.01$) and for the response "never" (66 [62.9%] rural vs. 32 [12%] urban, $P<0.001$). For 12-year-olds, there was a statistically significant difference between the groups for the answer "sometimes" (29 [15.8%] rural vs. 87 [28.0%] urban, $P<0.05$) and for the answer "never" (113 [61.4%] rural vs. 138 [44.4%] urban, $P<0.05$).

In answer to the question about what the children usually drank, there was a statistically significant difference for all answers between rural and urban six-year-olds: for the response "water from the tap" (75 [71.4%] rural vs. 119 [44.6%] urban, $P<0.05$); for the response "water from the wells" (8 [7.6%] rural vs. 2 [0.7%] urban, $P<0.001$); for the response "bottled water" (2 [1.9%] rural vs. 42 [15.7%] urban, $P<0.001$); for the response "juices" (20 [19.0%] rural vs. 104 [39.0%] urban, $P<0.05$). For 12-year-olds, there was a statistically significant difference between the groups for the answer "water from the wells" (18 [9.8%] rural vs. 11 [3.5%] urban, $P<0.05$) and for the answer "bottled water" (11 [6.0%] rural vs. 49 [15.8%] urban, $P<0.01$).

In answer to the question about frequency of sweets consumption, there were no statistically significant differences between the answers from the 6- and 12-years-olds, other than in six-year-olds for the response "once a week" (21 [20.0%] rural vs. 18 [6.7%] urban, $P<0.01$) and in the 12-year-olds for the response "once a month" (13 [7.1%] rural vs. 7 [2.3%] urban, $P<0.05$).

In answer to the question what kind of bread the children usually consumed, there were no statistically significant differences between the answers from the 12-year-olds, other than for the response "black, rye, etc" (18 [9.8%] rural vs. 56 [18.0%] urban, $P<0.05$). For six-year-olds, there was a statistically significant difference between the groups for the answer "white" (63 [60.0%] rural vs. 101 [37.8%] urban, $P<0.05$), for the response "black, rye, etc" (1 [1.0%] rural vs. 19 [7.1%] urban, $P<0.05$) and for the answer "mixed" (26 [24.8%] rural vs. 120 [44.9%] urban, $P<0.05$).

Discussion

In this study, representative for 6- and 12-year-old children in Banja Luka region, high caries prevalence was found in both rural and urban children, especially in the rural areas, which contributes to the opinion that life environment affects oral health.

The mean dmft values (6.3 to 8.34) in six-year-olds in Banja Luka are very high especially if compared with other countries, for example in Hungary 4.5 dmft [13], Estonia 4.2 dmft [14], Denmark 2.7 dmft [14], Portugal 1.9-2.6 dmft [15], France, 1.05 dmft [16]. Also, the mean DMFT for six-year-olds (0.66-1.34) observed in this study is high compared with similar data for this age in Europe. A study conducted in 1997 in Estonia and Denmark showed that the DMFT of seven-year-old children in these countries was 0.3 (Estonia) and 0.2 (Denmark), which is two to six times less than in our study. [14]. Even in studies that were performed in the former Yugoslavia, the values of DMFT for six-year-olds were much smaller. For example, 90% of children, at the age of six years were caries-free in Slovenia in 1998, and DMFT was 0.2 [17].

The actual level of dental caries in 12-year-olds (4.29 to 5.72 DMFT) was one of the highest in Europe if compared with the results reported by the Council of European Chief Dental Officers [18]. The mean DMFT for 12-year-olds in the former Yugoslav republics of Slovenia 1.7 (2003) and Macedonia 3.03 (2001) were lower than in our study [18]. Our results of mean DMFT for 12-year-olds was similar to those observed in other East European countries in 1998; for example Latvia 5.8, Lithuania 4.9, and Estonia 4.6 [19]. Recent data reported the mean DMFT decline in these countries: Latvia 3.5 (2003), Lithuania 2.4 (2001), and Estonia 2.8 (2003) [18]. Data from one study in 1999 (Almieda *et al.* 2003) indicated a mean DMFT for Portugal of 1.5 [20]. However, a second national study, commissioned by the General Directorate of Health in the same year found a national mean DMFT for 12-year-olds in Portugal of 3.08 [21]. In general, many of the so-called national mean DMFT scores for 12-year-olds cannot be compared reliably due to the wide variation in sampling, the use of different methodologies and the fact that there is often over ten years' difference in the dates when they were performed [22]. At best, all that they show are trends.

A large number of studies have confirmed that there is connection between socio-economic status and health, as well as a relationship between socio-

economic status and the incidence and prevalence of caries. Therefore, a high caries risk is associated with socio-economic factors, such as low quality of life, low educational level, and the impact of cultural life on the promotion of oral health. Traditionally, there have always been lower economic and educational levels in rural populations as well as lower accessibility to dental services [20,23].

Statistically significant differences were not found in all answers relating to dental visits between rural and urban 6- and 12-years olds in the present study. But a majority of the 6- and 12-year-old children from both regions visited the dentist for the first time after they were four years of age. Results of this survey showed that visiting the dentist on regular basis (once or twice per year) was low in 6- and 12-year-old rural and urban children. There were 6- and 12-year-old children who had never visited the dentist. Pain and/or symptoms of dental health problems were the main reasons for seeking professional help.

We found that more children from both age groups living in rural regions had not visited a dentist because there was none in the vicinity than had children living in urban regions ($P<0.001$ for six-year-olds, $P<0.01$ for 12-year-olds). Possible reasons for lower accessibility to dental services were lower socio-economic status and most of the other factors that stem from socio-economic status, such as the lack of paediatric dental offices in schools in rural regions, the lack of properly organised school dental care, and a lower level of knowledge about oral health in a rural population.

There were no statistically significant difference between urban and rural six-year-olds in the frequency of tooth-brushing. Reported tooth-brushing frequency seemed to be at a relatively high level in 6- and 12-years-olds, because large numbers of children stated that they brushed their teeth two or more times a day. Many subjects use a toothbrush as a main tool for oral hygiene, but a small number of them use additional tools, especially dental floss ($P<0.01$ for 12-year-olds). In Kuwait, more frequent tooth-brushing is correlated with a greater number of visits to the dentist [24]. However, this information should be considered with care because it is possible that subjects gave answers according to what they considered to be more appropriate than what were their actual oral hygiene habits.

Reported dietary habits were similar in both groups and no statistically significant difference was found in all answers. A large number of subjects consumed sweets on a daily basis, several times a day or always had some snacks, and a statistically significant difference was not present between 6- and 12-year-old rural and urban children. The consumption of various types of sweets and sugary drinks was high among these children and it was found that almost one half of all these children consume sugary snacks and drinks several times a day. A North African study of 12-year-olds in Gambia showed increasing caries prevalence with urbanisation and western dietary habits, and a higher caries prevalence in urban (5.8%) than rural regions (3.0%), where food was still prepared in a traditional way [25].

A large percentage of 6- and 12-year-old children in rural regions have never used additional fluoride products, and there was a statistically significant difference between those rural and urban children. Furthermore, the use of fluoride supplements in schools in urban six-year-olds was statistically significantly higher than in their rural peers ($P<0.001$).

The fact that a small number of respondents reported using additional fluoride products together with increased frequency of the intake of carbohydrates leads to the conclusion that this is one of the most important factors for the poor condition of teeth in these age groups.

Oral health education is very important to achieve satisfactory oral hygiene habits, but relation between knowledge and behaviour was found to be unsatisfactory.

Although caries is a multi-causal disease, it seems that the level of professional engagement affects oral health improvements more than patients' knowledge [26].

Studies have also shown that urban children who seek professional dental help more frequently are better informed about oral health. However, the implementation of this knowledge is largely affected by patients' motivation to maintain their own oral health as well as knowledge, motivation and engagement of parents.

Conclusions

WHO European goals for oral health by the year 2000 was that at least 50% of 5-6-year-olds should be caries-free and that the population of 12-year-olds should have a mean DMFT of no more than 2 [27]. It is apparent that these goals had not been achieved in Banja Luka and, therefore, further

emphasis should be given to implementing community-based oral health promotion and applying modern principles in preventive oral care. The present study has demonstrated that the achievement of oral health in children is threatened unless the health authorities of Republic of Srpska take action towards re-establishing preventive services. High caries occurrence is a result of bad habits and the lack of an organised preventive programme and primary health care system that would provide the most optimal results according to socio-economic, cultural and demographic conditions.

Therefore, it is to be recommended that for future oral health education programmes, information given to school children and their parents should aim at improving knowledge about the negative effect of high sugar intake and eating between meals in the development of dental caries and obesity. In general, more accurate information on preventive measures is needed, especially for schoolchildren. Therefore, it is essential to consider social, cultural and economic aspects of life because these are the main determinants of one's behaviour, as well as illness.

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