Caries prevalence and oral hygiene in Lithuanian children and adolescents

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Contrary to what is observed in many Western societies, the caries prevalence among children and adolescents in the Baltic States remains high. The aims of the present study were to describe the caries prevalence and oral hygiene among 7-, 12-, and 15-year-old Lithuanians and to correlate the caries prevalence with fluoride content in the drinking water, oral hygiene, gender, ethnicity, and pattern of sugar consumption. The investigation was based on cluster samples, and the clinical investigation was performed in accordance with criteria defined by WHO. High DMFT values were registered (mean DMFT = 1.3 among 7-year-olds; DMFT = 4.9 among 12-year-olds and 7.0 among 15-year-olds) and were associated with low fluoride content in the drinking water and poor oral hygiene. Girls showed higher DMFT values than boys. No correlation between pattern of sugar consumption and caries prevalence could be disclosed.
☐ *Dental caries; epidemiology; fluoride; Lithuania*

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During the past 25 years a gradual decrease in caries prevalence has been reported among children and adolescents in many industrialized countries (1, 2). The almost universal use of fluoride dentifrices is assumed to be the single most important factor explaining this decrease (3). However, it is important both for theoretic purposes and for promotion of rational preventive programs also to acknowledge the relative contribution of other determinants directly or indirectly related to dental caries (4, 5).

A classical model for dental caries development was suggested by Keyes in 1962 on the basis of experimental investigations in animals and man (6). This model, including the biologic factors host with teeth, microflora, and substrate (sugar), is still valid to understand the etiology and initiation of a carious lesion.

Sugar consumption pattern has an obvious effect on dental caries activity and prevalence. This has been shown experimentally and has frequently been documented by epidemiologic studies (for a review, see Ref. 7).

Acidogenic microorganisms colonizing on tooth surfaces are necessary for caries development. Professional oral hygiene regimens have a well-documented preventive effect on caries development (8), whereas the effect of self-administered oral hygiene has been uncertain (9, 10). However, more recently published investigations have concluded that there is a well-established relation between oral hygiene and dental caries (11–13). However, this may also in part be a consequence of regular fluoride exposure from fluoridated dentifrices (11, 14, 15) and rapid plaque accumulation caused by frequent sucrose consumption (16, 17).

Contrary to what is observed in many Western societies, the caries prevalence among children and adolescents in the Baltic states is not decreasing and is higher than in many other European countries (18) (Table 1). Until now, limited data have been obtained from randomized samples. The information available should therefore be interpreted with care. Only the investigation by Milciuviene (19) presents empiric data explaining the level and distribution of dental caries among children and adolescents in this region. The aims of the present investigation were therefore to 1) describe the caries prevalence of 7-, 12-, and 15-year-old Lithuanians, and 2) correlate caries prevalence with variation in fluoride content in the drinking water, level of oral hygiene, gender, ethnicity, and pattern of sugar consumption.

Materials and methods

The present study was cross-sectional and based on cluster samples representing 7-, 12-, and 15-year-old Lithuanians. The cluster sampling included 17 selected schools from a total of 6 regions throughout Lithuania. In Lithuania school attendance is mandatory for 7- to 16-year-old children, and a representative sampling of these age cohorts was therefore possible. There was, however, a systematic loss of males among the 15-year-olds, probably due to vocational training and/or job-seeking among boys. Variation in place of residence (rural/urban), fluoride content in the drinking water, and ethnic background (Lithuanian, Polish, or Russian) was considered in the cluster sampling process to ensure

Table 1. Caries prevalence among children and adolescents in Baltic region, Scandinavia, and Eastern Europe recorded as DMFT scores. Mean values are given when more than one investigation was available (sources: Ref. 1 and WHO (18))

Region	Year	Age			
		5–7 years	12 years	15 years	18 years
Baltic States					
Estonia	1988		4.1		
Latvia	1985	0.4	6.6	9.9	
Lithuania	1983	1.1	4.5	6.3	
Scandinavia					
Denmark	1988/90	0.2	1.3	3.5	
Finland	1990		1.2	4.3	7.3
Norway	1990		2.4		8.1
Sweden	1990		2.2		6.8
East Europe					
Belorussia	1986/90		3.2		5.6
Bulgaria	1983/90	0.3	3.1		9.8
Czechoslovakia	1989		3.7		8.4
Hungary	1985/90	1.1	5.0		
Poland	1987/90	1.0	4.4		7.5
Romania	1990		3.1		
Ukraine	1986/90		3.2		5.6
Yugoslavia	1986/90	0.8	5.9		10.9

representativity. The total sample comprised 1801 participants: 551 7-year-olds, 735 12-year-olds, and 515 15-year-olds, and the investigation was performed by one investigator during 1993–94.

Dental health data were collected through a clinical examination recording dental caries prevalence by means of the DMFT index as defined by WHO (20). Oral hygiene was registered in accordance with the simplified oral hygiene index (OHI-S) as defined by Greene & Vermillion (21). Clinical registration training and calibration were performed at The Faculty of Odontology in Oslo before the investigation. Fluoride content in the drinking water was based on data from Lithuanian Health Ministry, Nutrition Centre. Natural daylight was used for clinical examination. The subjects were seated near the window, the chair facing the opening through which light entered (WHO recommendations, 1987) (20). The data were recorded by a dental

Table 2. Caries prevalence (DMFT) of 7-, 12-, and 15-year-old Lithuanians on the basis of ethnicity and gender (analysis of variance)

	7-year-olds			12-year-olds			15-year-olds		
	n	DMFT	SD	*n*	DMFT	SD	*n*	DMFT	SD
Lithuanian									
Boys	132	1.3	1.4	176	5.6	3.6	107	6.6	5.3
Girls	123	1.3	1.4	186	5.6	3.6	153	7.4	4.9
Total	255	1.3	1.4	362	5.6	3.6	260	7.1	5.1
Polish									
Boys	53	1.7	1.6	62	5.0	3.3	34	7.6	4.1
Girls	54	1.6	1.4	72	5.8	3.8	60	9.8	4.8*
Total	107	1.8	1.5	134	5.4	3.6	94	9.0	4.6
Russian									
Boys	93	0.8	1.3	106	3.0	3.1	60	3.8	3.1
Girls	96	1.1	1.2	133	4.0	4.0*	101	6.9	4.8***
Total	189	1.0	1.3	239	3.6	3.6	161	5.7	4.5
Total									
Boys	278	1.2	1.4	344	4.7	3.6	201	5.8	4.8
Girls	273	1.4	1.3	389	5.1	3.9	314	7.7	5.0***
Sum total	551	1.3	1.4	733	4.9	3.7	515	7.0	5.0

Statistical significance of gender: *** $p < 0.001$; ** $0.01 > p > 0.001$; * $0.05 > p > 0.01$.

Table 3. Oral hygiene scores (OHI-S) of 7-, 12-, and 15-year-old Lithuanians on the basis of ethnicity and gender (analysis of variance)

	7-year-olds			12-year-olds			15-year-olds		
	n	OHI-S	SD	*n*	OHI-S	SD	*n*	OHI-S	SD
Lithuanian									
Boys	132	2.4	0.6	176	2.4	0.9	107	2.0	1.0
Girls	123	2.5	0.7	186	2.1	0.9**	153	1.7	0.9*
Total	255	2.5	0.7	368	2.2	0.9	260	1.8	1.0
Polish									
Boys	53	2.6	0.9	62	2.6	0.9	34	2.1	1.3
Girls	54	2.4	0.8	72	2.2	1.1**	60	2.1	1.1
Total	107	2.5	0.8	134	2.4	1.0	94	2.1	1.2
Russian									
Boys	93	2.5	0.8	106	2.5	0.9	60	1.9	1.1
Girls	96	2.6	0.8	133	1.9	0.9***	101	1.6	0.9*
Total	189	2.5	0.8	239	2.2	0.9	161	1.7	1.0
Total									
Boys	278	2.5	0.8	344	2.4	0.9	201	2.0	1.0
Girls	273	2.5	0.8	391	2.0	0.9***	314	1.7	1.0*
Sum total	551	2.5	0.8	735	2.2	0.9	515	1.8	1.0

Statistical significance of gender: *** $p < 0.001$; ** $0.01 > p > 0.001$; * $0.05 > p > 0.01$.

assistant seated close to the examiner. Regular probes and mirrors were used for clinical registrations.

The dependent variable was DMFT scores, and the independent variables used in the present investigation were as follows: Age = 7-, 12-, and 15-year-olds according to age at last birthday; gender = boys/girls; residence = urban/rural; fluoride = ppm F in the drinking water; sugar consumption = frequency of intake of sugar-containing food the day before examination; and ethnicity = Polish/Russian/Lithuanian.

The results have been analyzed by means of the SPSS-PC program, utilizing analysis of variance and multiple classification analyses (MCA). Correlation between oral hygiene and dental caries prevalence was assessed by calculating Spearman rank correlation coefficients.

Results

The caries data recorded from the 7-, 12-, and 15-year-olds are presented in Table 2. As can be seen, the mean DMFT scores increased to 1.3, 4.9, and 7.0 in the 7-, 12-, and 15-year-olds, respectively. Girls showed a higher caries prevalence than boys, particularly among the 15-year-olds. With regard to ethnicity, the highest caries scores were found for the Polish, whereas the Russians had the lowest scores (Table 2). This difference was statistically significant for 15-year-olds ($p < 0.001$) in the bivariate analysis but disappeared when adjusting for variation in fluoride exposure, gender and oral hygiene (Table 8). The oral hygiene scores showed high amounts of plaque among the participants (Table 3). Only minor ethnic differences were found. Boys had more dental plaque than girls.

There was an inverse association between caries and fluoride content in the drinking water. This was observed for all age groups investigated and was statistically significant both for the 0.5–1 and >1 ppm F concentrations (Table 4).

Regional differences in DMFT scores were observed,

Table 4. Caries prevalence (DMFT) of 7-, 12-, and 15-year-old Lithuanians on the basis of water fluoride content (analysis of variance)

	7-year-olds			12-year-olds			15-year-olds		
F content	*n*	DMFT	SD	*n*	DMFT	SD	*n*	DMFT	SD
<0.5 ppm F	384	1.6	1.4	531	5.8	3.7	371	8.0	5.0
0.5–1 ppm F	81	0.6	0.9	81	2.9	3.0	63	5.1	4.0
>1 ppm F	86	0.5	1.0***	124	2.4	2.6***	81	3.9	3.6***
Total	551	1.3	1.4	735	4.9	3.7	515	7.0	5.0

Statistical significance: *** $p < 0.001$.

Table 5. Caries prevalence on the basis of residence (urban/rural) among 7-, 12-, and 15-year-old Lithuanians. The statistically significant difference observed disappeared when adjusting for other independent variables (analysis of variance)

	7-year-olds			12-year-olds			15-year-olds		
Residence	*n*	DMFT	SD	*n*	DMFT	SD	*n*	DMFT	SD
Urban	250	1.2	1.3	371	4.3	3.6	253	6.2	4.5
Rural	301	1.4	1.4	366	5.5	3.7***	262	7.8	5.3**
Total	551	1.3	1.4	735	4.9	3.7	515	7.0	5.0

Statistical significance: *** $p < 0.001$; ** $0.01 > p > 0.001$.

Table 6. The contribution of DT, MT, and FT to the total DMFT scores

	7-year-olds, $n = 551$		12-year-olds, $n = 735$		15-year-olds, $n = 515$	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
DT	1.1	1.3	3.3	3.1	3.9	3.6
MT	0.0	0.0	0.2	0.7	0.4	1.1
FT	0.2	0.5	1.4	1.7	2.7	2.6
DMFT	1.3	1.4	4.9	3.7	7.0	5.0

mainly due to differences in water fluoride content. A consistent difference related to urban and rural background could also be observed (Table 5), but this effect also disappeared when adjusting for the effect of other independent variables.

As the dental treatment provided for the present age cohorts has been limited, it might also be of interest to note the relative contribution of the different components of the DMFT scores (Table 6). As can be seen, decayed teeth is the major contributor to the total scores in all age groups.

There is a consistent and statistically significant but weak correlation between oral hygiene levels and dental caries prevalence for all age cohorts (Fig. 1). Since 12- and 15-year old girls tended to have higher DMFT values than their male age mates despite better oral hygiene, the correlation between oral hygiene and caries prevalence increased when the results from boys and girls were analyzed separately. No correlation between sugar consumption pattern and dental caries prevalence could be detected (Table 7).

When introducing the independent variables in an MCA, a strong and independent effect could be observed for variation in water fluoride content. Oral hygiene and gender also showed independent effects, whereas the effect of ethnicity disappeared when adjusting for the impact of other variables, mainly fluoride. Residence (urban/rural) did not increase the explained variance and was therefore not included in the final multivariate model. The total explained variance was low ($R^2 = 0.17$ for the 15-year-olds, 0.16 for the 12-year-olds, and 0.13 for the 7-year-olds) (Table 8).

Discussion

The cluster sampling procedure used, taking into consideration both ethnicity, gender, differences in water fluoride content in the drinking water, and urban/rural background should ensure representativity related to Lithuanian society in general. This differs from most of previous epidemiologic dental health studies in Lithuania and other Baltic states (18).

There is a skewness in attendance of boys/girls among the 15-year-olds. This is due to some boys leaving school prematurely. The impact of this is uncertain.

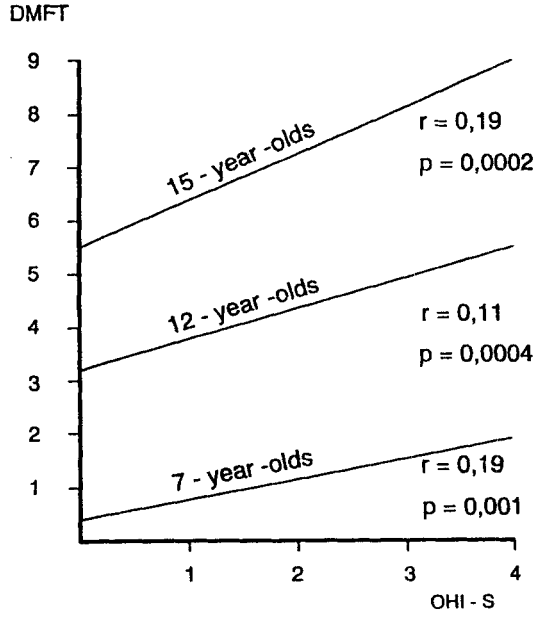

Fig. 1. The correlation between oral hygiene (OHI-S) (19) and caries prevalence among 7-, 12-, and 15-year-old Lithuanians (Spearman's rank correlation analysis).

Table 7. Caries prevalence related to variation in reported sugar consumption pattern: once (1), twice (2), or three times or more per day (3) measured the day before clinical examination

Frequency of sugar consumption	7-year-olds, $n = 551$		12-year-olds, $n = 735$		15-year-olds, $n = 515$	
	DMFT	SD	DMFT	SD	DMFT	SD
1	1.2	1.3	4.7	3.4	7.5	5.2
2	1.1	1.3	4.7	3.6	6.8	4.8
3	1.2	1.4	5.3	4.3	6.8	4.8
Total	1.2	1.3	4.9	3.7	7.0	5.0

The recording of oral health data was performed under field conditions aided by natural light (20). This might result in an underestimation of the real caries prevalence, but the values are probably comparable to other WHO-initiated studies (18).

As can be seen from Table 1, the previously reported caries data from the Baltic countries are among the highest in Europe. Combined with our present results the data do not indicate a reduction in caries prevalence, as seen in many of the industrialized countries in northwest Europe (Table 1) (1, 18). The present caries data are slightly higher than previously reported from Lithuania (19) (Table 1), supporting the impression of a consistent and high caries prevalence.

The decayed (D) component is the major contributor to the total DMFT scores, indicating insufficient caries treatment capacity in Lithuania (Table 6). The data (Table 2) further indicate differences between girls and boys. This cannot be explained by level of oral hygiene (Table 3). The oral hygiene level was poor for a large majority of the children and adolescents investigated (Table 3). It should be noted that the ethnic differences appearing in the bivariate analyses (Table 2) disappeared when adjusting for fluoride exposure from the drinking water.

There is a statistically significant association between fluoride content in the drinking water and caries prevalence (Table 4). Compared with the low-fluoride areas (<0.5 ppm F) there is 50% less caries in the 0.5- to 1-ppm F region and 60% less in the >1-ppm F region. This is in accordance with generally accepted knowledge (22, 23).

There is a difference in caries prevalence related to place of residence (urban/rural), with the highest values found in the rural regions (Table 5). However, the difference disappeared when adjusting for other independent variables, mainly fluoride content in the drinking water.

There is a consistent and statistically significant correlation between caries prevalence and oral hygiene levels in all age cohorts. However, high number of participants and low values of the correlation coefficients indicate that this correlation is not strong (Fig. 1). Whether this is a direct effect or an indirect effect of other factors influencing the rate of plaque formation should be further explored in clinical trials (8, 14). No correlation could be detected between sugar consumption pattern and caries prevalence. The finding was surprising, considering the extensive scientific documentation in support of this correlation (7). The reason might either be low reliability of the self-reported sugar consumption pattern or the universally high consumption of sugar-containing products among the participants (24) (Table 7). However, some recently published investigations have concluded with no or only weak correlation between food habits and dental caries (25, 26).

Finally, a multivariate analysis (MCA) was applied, using DMFT scores as the dependent variable to estimate the relative contribution to the total explained variance in caries prevalence from selected independent variables (Table 8).

As can be seen, there is an independent and statistically significant effect of water fluoride content, oral hygiene, and gender, whereas a marked covariance between fluoride content and ethnicity eliminated ethnic

Table 8. A multiple classification analysis (MCA) entering the most influential independent variables and using DMFT as the dependent variable. Seventeen per cent of the total variation in caries prevalence could be explained for the 15-year-olds ($R^2 = 0.17$), whereas 16% could be explained for the 12-year-olds ($R^2 = 0.16$) and 13% for the 7-year-olds ($R^2 = 0.13$). Statistical significance is indicated only for beta values

Independent variable	7-year-olds, $n = 551$		12-year-olds, $n = 735$		15-year-olds, $n = 515$	
	Eta	Beta	Eta	Beta	Eta	Beta
Fluoride water content	0.34	0.29***	0.38	0.36***	0.84	0.30***
Gender	0.05	0.05*	0.04	0.08*	0.18	0.17***
Oral hygiene (OHI-S)	0.16	0.12	0.08	0.09*	0.17	0.15**
Ethnicity	0.20	0.08	0.27	0.07	0.23	0.09
	$R^2 = 0.13$		$R^2 = 0.16$		$R^2 = 0.17$	

Statistical significance: *** $p < 0.001$; ** $0.01 > p > 0.001$; * $0.05 > p > 0.01$.

background as an independent caries determinant. The effect of sugar consumption pattern and residence (urban/rural) was negligible, and these variables were therefore excluded from the final multivariate model.

The explained part of the total variance in caries prevalence was low (Table 8). This is a common finding in multivariate analyses of dental caries (5, 27). Additional information about saliva buffer capacity, sugar consumption, oral microbiology, and oral health behavior and attitudes might have increased the explained part of the variance in the present study.

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