

Caries and its risk factors in young children in five different countries

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SUMMARY

The state of oral health plays an essential role in human comprehensive health. Nevertheless, although considerable improvement in oral health caries has been noted in both developed and newly developing countries, caries is still widespread among children. Although it can be monitored, caries cannot be properly eliminated.

Materials and methods. This investigation, performed in cooperation with Jena Hospital in Germany, was conducted in five countries from 2002-2008. The cities Riga (Latvia), Ouro Preto (Brazil), Erfurt (Germany), Volgograd (Russia) and Minsk (Belorus) were engaged in this investigation. Children at the age of 26-34 months were surveyed. Consistent with the research design, the mothers filled out questionnaires about the children's health, and an examination of the children's oral health was performed. The statistics program SPSS 15.0 was used to analyze the obtained data, and the correlations between changing findings were expressed by the Spearman rank correlation coefficient (r).

Results. In this study, 472 children were observed: 179 from Riga, 152 from Erfurt, 62 from Ouro Preto, 116 from Minsk and 84 from Volgograd. A direct correlation existed between the country and plaque ($r=0.16$) and caries (dmft) ($r=-0.11$). The direct correlation between dmft and *Streptococcus mutans* ($r=-0.36$) was characteristic of children from Erfurt. The lowest dmft index (0.62) was present in children from Erfurt, and the highest (1.57) in children from Ouro Preto.

Conclusions. The frequency and prevalence of caries in young children in Riga is high; it was the lowest in Erfurt and the highest – in Brazil. Plaque and dt were one of the indices with a direct relationship in Riga, Brazil and Minsk. Poor oral hygiene, irregular tooth brushing and the consumption of cariogenic foods and drinks are the most important caries risk factors among children at the age of 2-3 years. The mother's knowledge and attitude affect the child's oral health.

Key words: early childhood caries, deciduous dentition, multi-center study.

INTRODUCTION

Oral health is of vital importance to general health in humans. Nevertheless, despite the marked

improvement in oral health, caries occurs in the world in both developed and developing countries

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(1). It is still widespread among children, and it can be controlled but not eliminated (2).

Several authors have previously emphasized that caries is an illness caused by a number of factors and that one specific method for its assessment, which includes all of the factors, of caries etiology, does not exist (3). These factors include the consumption of sugar and sugar-containing foods (4), plaque (5, 6), inflammation of the gums (7), high salivary counts of *Streptococcus mutans* in the children and mothers (6, 8, 9), and the parents' attitude towards health (7). The oral health of the children is considered to be related to their families – their socioeconomic status and the parents' education level, occupation and attitude towards health (10-13).

Studying a complicated interaction among the risk factors that are involved in caries etiology, recent research in the world has been aimed at socioeconomic and behavioral factors, because they may act as caries-promoting factors (7).

The World Health Organization (WHO) has proposed that until 2020, the impact of oral and craniofacial illnesses on an individual's health and psychosocial development should be decreased, emphasizing the significance of the promotion of oral health and decreasing illnesses of the oral cavity, which are affected by diseases or disease-promoting conditions. To assess the usefulness and appropriateness of the implementation of a prophylactic strategy for any pathology, including caries, finding the answers to several questions is necessary – to determine the effect of the risk factors on the prevalence of the disease (14).

In Latvia, caries is a national problem, affecting the population of all age groups (15). Research conducted in the seventies and eighties suggested that 2% of the children at the age of 1 year had caries (16). In the period of 1989-2000 in Latvia, the prevalence of caries among 2-year-old children increased from 17.3% to 20.3% (17), and in 2001, 48% of children at the age of 2-3 years had caries (18).

Aim of the study. To assess and compare the oral health condition and caries risk factors in young children in five different countries.

MATERIAL AND METHODS

The study, in cooperation with the WHO Collaborating Centre 'Prevention of Oral Diseases' (WHOC) of the Centre of Dentistry at the University Hospital of Jena, was performed in five countries from 2002-2008. In the regional study, Riga (Latvia), Ouro Preto (Brazil), Erfurt (Germany), Volgograd

(Russia) and Minsk (Belorussia) participated. The study involved children at the age of 26-34 months. The examination of the oral cavity was conducted under, as much as possible, equal conditions in kindergartens – in groups of children of the corresponding age. It was performed by dentists who trained at Jena University Hospital visually using a probe. The acquired data were recorded in the WHO Oral Health Assessment Forms. X-ray examination was not used. To characterize the caries, the frequency and prevalence were used. The caries prevalence was expressed as a percent (%): the proportion of the persons with decayed teeth among the total number of examined persons, multiplied by 100. The caries frequency in children having deciduous occlusion (dmft) shows the caries experience in one person or a group of children. The caries decay (dmft) in children for one person is the sum of carious and filled teeth (d – carious, f – filled). The mean value of dmft is the sum of the children group divided by the number of examined children. To assess oral hygiene, an explorer was used. Plaque was determined using the probe on the vestibular surfaces of the anterior teeth. The acquired results were recorded as follow: 2 – no plaque and 1 – plaque seen on the probe. For the assessment of the degree of gingivitis, the SBI (Sulcus Bleeding Index) was used, where 1 – is marginal color changes of the gums (inflammation) and 2 – is no pathology. In children and their mothers, the *Streptococcus mutans* counts in saliva was determined using the chair side test CRTbacteria (Ivoclar Vivadent, Liechtenstein). Saliva was collected with a dropper separately from the oral cavity of the child and his/her mother. Saliva was spread onto the culture media of the chair side test, and the CRTs were inserted in the incubator for 48 hrs at 37°C. Afterwards, the scores of the *Streptococcus mutans* were evaluated semi-quantitatively by comparing the density of the colonies on the culture medium with the CRT bacteria map. According to the unified study design, the mothers filled in a questionnaire on the child's health, and the examination of the child's oral cavity was performed. The questionnaire used was adapted and validated for the joint study in 5 countries (Latvia, Germany, Brazil, Russia, Belorussia) – "Oral health of young children". The questionnaire contained the following questions: general data (child's gender, age, number of siblings, family status of the parents, education level, and occupation), the child's care and upbringing, nutrition habits, case history, dental hygiene and prophylaxis, attitude towards dental health, and oral health condition. The questionnaires were filled out by the mothers/parents at home and were received back after a week.

To analyze the acquired data, the statistical package SPSS (15.00) was used. The standard deviation and correlation between the variables were expressed by Spearman's rank correlation coefficient (r) and graphically.

RESULTS

The study involved 472 children from Riga (179), Erfurt (152), Ouro Preto (62), Minsk (116) and Volgograd (84). The caries decay (dmft) in 26-34 month old children was the lowest in children from Erfurt (0.62) and the highest in children from Ouro Preto (1.57). It was 1.16 dmft in children from Riga, 1.02 dmft in children from Volgograd, and 1.28 dmft in children from Minsk (Table 1).

Caries – free children accounted for 83% of the children from Erfurt, 78% of the children from Ouro Preto, 75% of the children from Minsk, 74% of the children from Riga and 69% of the children from Volgograd. Plaque was found on the maxillary anterior teeth (Table 2).

Plaque and dmft were one of the main indices with a direct relationship in Riga ($r=-0.24$), Ouro Preto ($r=-0.24$), and Minsk ($r=-0.26$). Inflammation of the gums (gingivitis) in the study group was found in 33.6% of children in Erfurt, 9.7% of children in Ouro Preto and 9.5% of children in Riga, Volgograd and Minsk (Table 3).

The *Streptococcus mutans* counts in the saliva were determined in 3 countries – Latvia, Germany and Brazil (Table 3). Examining the acquired data on these counts revealed that *Streptococcus mutans* <100 000 CFU was present in 84.3% of the children and 71.7% of the mothers in Riga, in 80.7% of the children and 77.4% of the mothers in Ouro Preto, and in 77.5% of the children and 35.8% of the mothers in Erfurt. *Streptococcus mutans* counts >100 000 CFU were estimated in 22.5% of the children in Erfurt, 19.3% in Ouro Preto, and 15.7% in Riga and in 64.2% of the mothers in Erfurt, 28.3% in Riga and 22.6% in Ouro Preto.

Asking the children's mothers about the frequency of meals, 99% of the children from Erfurt, 58% of the children from Riga, 54% of the children from Volgograd and 11% of the children from Minsk have 3 main meals per day. However, 58% of the children from Ouro Preto have 2 main meals, and 89% of the children from Minsk, 35% of the children from Volgograd, 32% of the children from Riga, 1% of the children from Erfurt, and 8% of the children from Ouro Preto have more than 3 main meals. In addition, 49% of the children from Erfurt, 40% of the children from Ouro Preto, 36% of the children from Riga, and 28% of the children from Minsk have at least one cariogenic meal.

Asking the mothers about the consumption of sweets revealed that 59% of the children from

Table 1. Number of children and their caries status (dmft)

Country (city)	Number of children	Average age of children (months)	Dmft	Standard deviation
Latvia (Riga)	179	31	1.16	2.8
Germany (Erfurt)	152	31	0.62	1.8
Brazil (Ouro Preto)	62	30	1.57	3.3
Russia (Volgograd)	84	30	1.02	1.0
Belorussia (Minsk)	116	30	1.28	2.5

Table 2. Plaque on the maxillary anterior teeth of children (%)

Country (city)	Plaque (%)	No plaque (%)
Latvia (Riga)	19	81.0
Germany (Erfurt)	42.1	57.9
Brazil (Ouro Preto)	22.6	77.4
Russia (Volgograd)	32.1	67.9
Belorussia (Minsk)	56.9	43.1

Table 3. Caries risk factors in the study population (SM=salivary *S. mutans*)

City	Gingivitis		SM>105 child		SM<105 child		SM>105 mother		SM<105 mother	
	N	%	N	%	N	%	N	%	N	%
Riga	17	9.5	25	15.7	134	84.3	45	28.3	114	71.7
Erfurt	51	33.6	34	22.5	117	77.5	88	64.2	49	35.8
Ouro Preto	6	9.7	12	19.3	50	80.7	14	22.6	48	77.4
Volgograd	8	9.5	-	-	-	-	-	-	-	-
Minsk	11	9.5	-	-	-	-	-	-	-	-

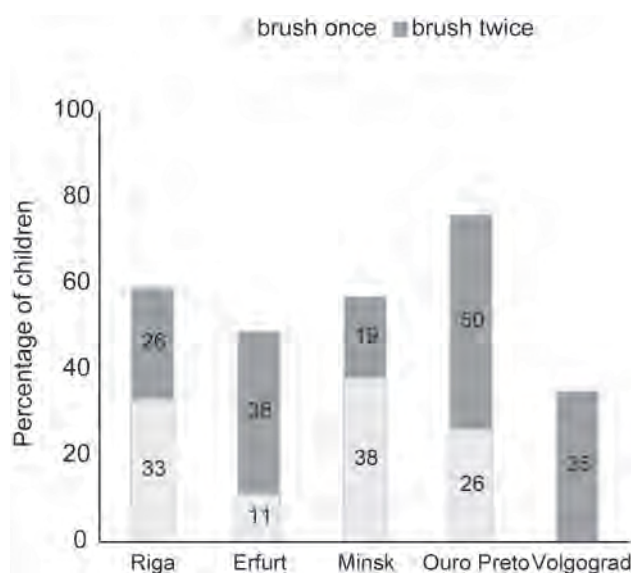


Fig. 1. Frequency of tooth brushing

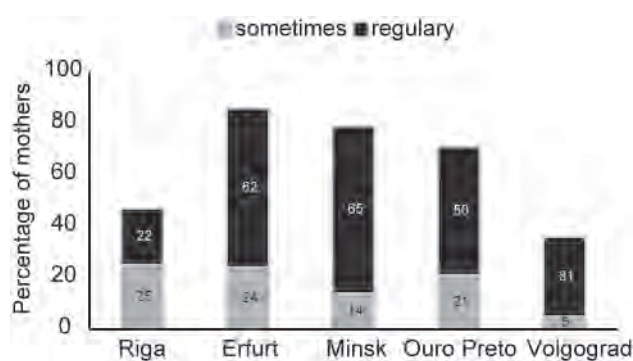


Fig. 2. Control by mothers after tooth brushing

Erfurt, 58% of the children from Volgograd, 34% of the children from Ouro Preto and 24% of the children from Riga consume fruit yogurt several times a week. Chocolate is consumed by 50% of the children from Minsk, 46% of the children from Volgograd, 44% of the children from Riga, 30% of the children from Erfurt, and 23% of the children from Ouro Preto.

Most commonly, the children received sweets from their mothers and fathers – 40% in Volgograd.

Table 4. Giving of sweets

	Riga (%)	Erfurt (%)	Minsk (%)	Volgograd (%)	Ouro Preto (%)
Both partners	15	28	32	40	8
Mother	19	20	17	18	11
Father	6	6	3	1	19
Grandparents	16	27	26	9	7
Acquaintances/ friends	3	3	11	0	2
Siblings	2	3	6	1	2

In Erfurt, 28% received sweets from mothers, fathers and grandparents. In Minsk 26% received sweets from grandparents. In Riga, 19% received sweets from mothers. In Ouro Preto, 19% received sweets from fathers (Table 4).

Sweet drinks are consumed several times a week by 35% of the children from Erfurt, 34% from Volgograd, 24% from Riga, 23% from Ouro Preto, and 16% from Minsk.

Asking the mothers revealed that 11% of the mothers from Volgograd, 10% each from Riga and Ouro Preto, 7% from Erfurt, and 5% from Minsk prepared food for their children. In addition, 75% of the mothers from Minsk, 72% from Volgograd, 41% from Erfurt, 40% from Riga, and 26% from Ouro Preto selected food and drinks for their children and paid attention to the names of additives written on the packages.

Teeth are regularly (twice a day) brushed by 50% of the children from Ouro Preto, 35% from Volgograd, 38% from Erfurt, 26% from Riga, and 19% from Minsk (Figure 1). In addition, 72% of the children from Erfurt and 41% from Riga brushed their teeth themselves. The parents brushed their children's teeth in 79% of the children from Ouro Preto and 52% Volgograd. With respect to brushing, 62% of the children from Ouro Preto, 60% from Erfurt, 59% from Riga, and 56% from Volgograd willingly brushed their teeth. 65% of the parents from Minsk, 62% from Erfurt, 50% from Ouro Preto, 31% from Volgograd, and 22% from Riga regularly checked their child's teeth (Figure 2). A dentist was visited by 86% of the children from Volgograd, 63% from Riga, 52% from Ouro Preto, and 45% from Erfurt.

The inquiry revealed the mothers' opinion – that the main person who should inform the parents about the children's dental care and healthy foods was a dentist: – 56.4% in Riga, 71.7% – in Erfurt, 88.1% – in Volgograd, 80.6% – in Ouro Preto, and 87.3% – in Minsk. A dental hygienist was mentioned as the next candidate: – 36.9% in Riga, 19.4% – in Ouro Preto, 9.9% – in Erfurt and 0.8% – in Minsk. However, 62% of mothers from Ouro Preto, 34.1% from Riga, 5.3% from Erfurt and 3.6% from Volgograd believed that this person should be a family doctor.

Studying the mothers' knowledge of deciduous teeth revealed that 74.9% from Riga, 70.2% from Volgograd, 53.2% from Ouro Preto, 38.8% from Erfurt and 29.3% from Minsk were insufficiently informed

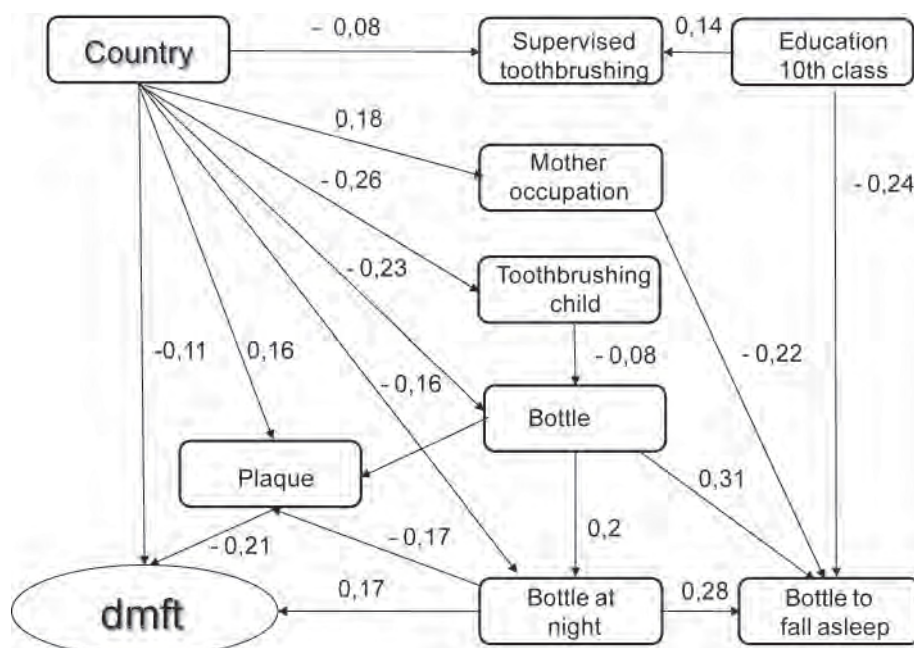


Fig. 3. Graphical model with the mean parameters and coefficients of correlations (r) for the development of caries in the young children of five different countries

on deciduous occlusion but that 69.8% of mothers from Riga, 95.2% from Ouro Preto, 87.5% from Erfurt, 83.3% from Volgograd and 77.6% from Minsk believed that deciduous teeth should be treated. In addition, 63.6% of mothers from Riga, 77.6% from Minsk, 65.5% from Volgograd, 44.7% from Erfurt and 30.6% from Ouro Preto believed that good or bad teeth are inherited. The belief that children can grow up with entirely healthy teeth was held by 79.3% of the mothers from Riga, 99.1% from Minsk, 93.5% from Ouro Preto, 82.2% from Erfurt, and 60.7% from Volgograd.

Concerning the relationship between food and dental health, 84.4% of mothers from Riga, 98% from Erfurt, 90.5% from Volgograd, and 88.7% from Ouro Preto recognized this relationship. However, 13.4% of mothers from Riga, 9.5% from Volgograd, 4.2% from Minsk, 3.2% from Ouro Preto, and 0.7% from Erfurt did not change their habits to maintain the health of their children's teeth as much as possible. Fluoridated table salt was used by 8.9% of the mothers in Riga, 27.7% in Minsk, 7.9% in Erfurt, and 7.1% in Volgograd. To maintain healthy teeth, 57% of the mothers from Riga, 90.3% from Ouro Preto, 66.7% from Volgograd, 13.2% from Erfurt, and 10.1% from Minsk restricted the consumption of sweets.

Asking the mothers about how they prepare their children for visits to the dentist, we found that 24.6% of mothers from Riga, 56.3% from Minsk, 19.1% from Erfurt and 6% from Volgograd read books on the topic to their child, and 29.6% of the

mothers from Riga, 39.3% from Volgograd, 32.3% from Ouro Preto, 25% from Erfurt and 0.8% from Minsk tried to calm their children by saying that the dentist will only examine their teeth. In addition, 11.2% of the mothers from Riga, 39.3% from Volgograd, 14.3% from Minsk, 13.8% from Erfurt, and 8.1% from Ouro Preto told their children about their own experience with a dentist. When visiting the dentist themselves, 8.9% of the mothers from Riga, 25% from Erfurt, 9.5% from Volgograd, 5% from Minsk, and 4.8% from Ouro Preto took their children with them.

Additionally, 6.7% of the mothers from Riga, 4.8% from Ouro Preto, 4.6% from Erfurt, 4.2% from Minsk, and 2.4% from Volgograd promised a good reward for good behavior in the dentist's office. Finally, 10.6% of the mothers from Riga, 14.3% from Volgograd, 6.5% from Ouro Preto, 4.2% from Minsk, and 3.3% from Erfurt believed that a visit to a dentist does not require any special preparation.

The results of this study revealed that the interaction of several factors can be considered to be caries risk-modifying factors. They include plaque, inflammation of the gums, salivary counts of *Streptococcus mutans* and attitude towards the child's care (Figure 3).

DISCUSSION

Dental caries is an international health problem among different populations, especially in young children. In young children, caries progresses rapidly and causes severe pain, anxiety and sleep loss (19). In Europe, during the last 30 years, caries has rapidly decreased in all age groups, especially in children (20). The studies of Marthaler, conducted in the period of 1990-1995, showed that in all European countries, the frequency of caries had a tendency to decrease in children and adolescents. Nevertheless, in a number of countries with an already low caries frequency in deciduous teeth, such a decrease was not observed. A high frequency of caries among children has been observed in some Central and Eastern Europe countries (21).

Based on data of Beltran-Aguilar in 2005, the intensity of early childhood caries has actually in-

creased in 2-5 year old children in the United States of America (22). In Latvia, there is little information on children at the age of 2-3, and most commonly, such information is episodic. In the study conducted in Latvia in 2001, the dmft for 2-year-old children was 0.7 (18), but in another study conducted in Latvia in 2006-2008, – the dmft in 6-year-old children was 0.12 (23).

In this study in Latvia, the caries frequency in children at the age of 26-34 months was 1.16, which was one of the worst indices. The lowest dmft index was in Erfurt – (0.62), and it was 1.02 – in Volgograd and 1.28 – in Minsk. However, the highest-dmft, 1.57, was – in Brazil.

According to the reported data, the caries prevalence among children aged 2-4 years in 2006 was 41.6% in Estonia (24). In Sweden in 2007, 38% of children at the age of 2-5 had caries (25). In Germany (Erfurt) in 2001, 14.7% of children at the age of 2-3 years had caries (26). In 2002 in Poland, 43.8% of 3-year-old children had caries (27). In 2009 in Lithuania, 50.6% of 3-year-old children had caries (28).

The interaction of a number of factors can be considered to be caries risk-modifying factors, including plaque, inflammation of the gums, counts of *Streptococcus mutans* and attitude towards the child's care (29). Dental plaque is considered to be one of the factors that promote caries development (30). In this study, plaque and dmft were one of the main indices showing a direct relationship in Riga ($r=-0.4$), Brazil ($r=-0.4$), and Minsk ($r=-0.26$). This relationship can be explained by the fact that parents do not pay sufficient attention to brushing the deciduous teeth. However, the deciduous teeth should be brushed as carefully as the permanent teeth – twice a day. The age of the involved children was 2-3 years, and such a young child is not able to brush their teeth properly; therefore, the parents should pay more attention to their child's oral hygiene, and the teeth should be brushed by the parents. Saporito (2000) indicated that for children younger than 2 years, brushing the teeth twice a day significantly prevented caries (31). A number of researchers, analyzing the level of oral hygiene as a caries risk factor, have proven the facilitating effect of poor oral hygiene on the further development of caries (32). Inflammation of the gums most commonly occurred in children from Erfurt (33.6 %), and the frequency of gingivitis did not differ (9.5%) in the other countries. The dmft in Erfurt was the lowest, which suggested that in Germany, prophylaxis was the optimum choice for the preventive strategy to decrease the incidence of caries. In the

study conducted in 2001 in Latvia among 3-year-old children, gingivitis was present in 3.8% (18). This study determined that gingivitis in children suggests insufficient oral hygiene. In the eighties, the *Streptococcus mutans* counts in saliva, as a risk factor, was shown to have the greatest effect when acting together with other caries causing factors, thereby furthering the development of caries (33-35).

In this study, the counts of *Streptococcus mutans* in saliva were determined because it is widely recognized as the main etiological factor in the development of caries. Early colonization can increase the caries risk. *Streptococcus mutans* transmission to an infant is most commonly possible through the mother's saliva (36, 37). By determining the salivary concentration of *Streptococcus mutans*, there is the possibility to foresee the development of caries (38). In the study conducted by Caufield, *Streptococcus mutans* was found in 25% of children at the age of 19 months, and the amount of *Streptococcus mutans* in the saliva was shown to increase with the child's age (39). In this study, a direct correlation between dmft and *Streptococcus mutans* was found in the children from Erfurt ($r=0.36$). In the other countries, this correlation was not found.

Negligence towards health may be the main reason for poor oral hygiene. According to the data in this study, many mothers did not know about maintenance of deciduous occlusions, but the majority believed that deciduous teeth should be treated. The survey data indicated that approximately 70% of the mothers from Volgograd and Minsk thought that good or bad teeth are inherited, indicating that the mothers are insufficiently informed. However, the majority of mothers from the countries studied had the opinion that a child can grow up with completely healthy teeth. Most commonly, mothers believed that there is a positive relationship between food and dental health. The mothers from Ouro Preto, Riga and Volgograd wanted to restrict the consumption of sweets to maintain the healthiness of the children's teeth healthy, which should be positively evaluated. Pine and others indicated that experience with disease determined the parents' attitude towards their children's health. Based on the parents' attitude, the development of a disease could be foreseen (7). Only a small percentage of the surveyed mothers prepared their children for visits to a dentist, which may be explained by the lack of time and by ignorance. Dental caries serves as an indicator of the socioeconomic development of a country (20, 40), but this is only a regional study and thus cannot characterize the socioeconomic development of a country.

CONCLUSIONS

1. The frequency and prevalence of caries in young children in Riga is high.
2. The lowest dmft index is in Erfurt and the highest- in Brazil.
3. Plaque and dmft are one of the indices with

a direct relationship in Riga, Brazil and Minsk.

4. Poor oral hygiene, irregular tooth brushing and the consumption of caries- producing foods and drinks are the most important caries risk factors among children at the age of 2-3 years.

5. The mother's knowledge and attitude affect the child's oral health.

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