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RĪGAS STRADIŅA UNIVERSITĀTE

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# CARIES AND ITS RISK FACTORS AMONG RIGA PRESCHOOL CHILDREN 2–3 YEARS

Summary of Doctoral Thesis
for obtaining the degree of Doctor of Medicine
Speciality – Dentistry

Riga, 2016

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The Doctoral Thesis will be available in the library of RSU and on the RSU website: www.rsu.lv

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# ABBREVIATIONS

ANOVA – statistical Analysis of Variance (dispersion analysis)

ANCOVA – statistical Analysis of Variance (covariance analysis)

CFU/ml – Colony forming units (colony forming units in 1 ml of the saliva)

FDI – Federation Dental International (World Dental Federation)

m t – missed teeth

IADR – International Association of Dental Research (International Dental Scienece Association)

dmft – caries intensity index

d t – carious teeth

SD – Standard deviation

SM – *Streptococcus mutans*

LB – *Lactobacillus*

p – Statistical significance (level of significance – probability that is applied in the statistical test, the zero hypothesis brought forward)

f t – filled teeth

WHO – World Health Organization

Etc. – (et cetera) and others

WHO – World Health Organization

# 1. INTRODUCTION

Oral health is of vital importance to humans' general health. Despite the marked improvement in oral health, caries occurs in both developed and developing countries worldwide (Pakpour, 2011; Amorim, 2012). It is still widespread among children, and it merely can be controlled, not eliminated. Dental caries was sixth on the World Health Organization's list of the most common diseases in the 20$^{th}$ century (Kunzel, 1997).

The patient's age is important for determining caries risk. Special attention must be paid to children's oral health when deciduous teeth start erupting and occlusion has formed in 2- to 3-year-old children. The assistance of dentistry personnel during early childhood is necessary to encourage parents to develop good oral health skills in their children; this is particularly important for families in a disadvantageous social environment (Koch, 2009).

Caries risk factors need to be viewed as a whole because each factor separately possesses a less potent ability to influence caries development (Fontana, 2006). Caries development is determined by the balance between pathological and protective factors or between demineralisation and remineralisation processes (Featherstone, 2000; Featherstone, 2006; Koch, 2009; Fontana, 2011). To determine caries risk, numerous aspects must be evaluated: general medical anamnesis, clinical examination, eating habits, the use of fluoride, the amount of cariogenic bacteria in the saliva, saliva function and sociodemographic factors (Fontana, 2006; Cameron, 2008; Koch, 2009).

For many years, attention has been focused on the fact that caries is a disease that is caused by numerous factors and cannot be evaluated by one individual method combining all caries aetiology factors (Reich, 1999). These factors include the usage of sugar and sugary products in the diet (Sheiham, 2001), plague (Busscher, 1997; Fontana, 2006), gingivitis (Pine, 2004), amount of *Streptococcus mutans* in the saliva of children (Tinanoff, 1995; Fontana,

2006) and mothers (Petersson Hansel, 2002) and parents' attitude towards health (Pine, 2004). There is a view that considers children's oral health in terms of the socially economic position of their family and their parents' education level, occupation and attitude towards health (Tinanoff, 1998; Ismail 2001; Ramos-Gomez, 2002; Wennhall, 2002). Parents are responsible for their children's' oral health (Arora, 2012; Isong, 2012).

Lately, the attention has been globally directed to the analysis of factors such as socially economic and behavioural ones because they possibly act as caries-contributory agents (Pine, 2004; Fisher-Owens, 2007). Social and behavioural factors in caries development have not been evaluated in Latvia.

In Latvia, caries is a population problem affecting all age groups (Urtāne, 1994). Studies conducted in the 1970s and 1980s suggested that 2% of children at the age of 1 year had caries (Care, 1988). From 1989- 2000 in Latvia, the prevalence of caries among 2-year-old children increased from 17.3% to 20.3% (Henkuzena, 2007), and in 2001, 48% of children at the age of 2-3 years had caries (Henkuzena, 2007). The number of children in Latvia whose teeth are treated while they are under general anaesthesia has increased dramatically; there were 926 such children in 2010 (Ciganoviča, 2013).

FDI, WHO and IADR have proposed that until 2020, the effect of oral and craniofacial illnesses on an individual's health and psychosocial development should decrease. They have emphasised 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 risk factors on the prevalence of the disease (Hobdell, 2003). Therefore, systematic epidemiologic investigations must be conducted to control the situation (Gowda, 2009).

Caries is one of the most widespread chronic illnesses among people worldwide, and individuals are susceptible to this disease throughout their lives (Selwitz, 2007). As an early display, caries affects children aged up to 71 months. In studies conducted in industrialised and unindustrialised countries, caries afflicts from 28% to 82% of children (Leong, 2013). According to sources, 25% of children have damaged teeth (Beltran-Aguilar, 2005), and 80% of the parents whose 2- to 5-year-old children's teeth were damaged had low income (Warren, 2008).

In all European countries, the prevalence of caries has decreased among children and teenagers (Martens, 2006). However, in several countries where caries prevalence in deciduous teeth is low, a decrease in the development of this disease is not observed (Marthaler, 2004). A high frequency of caries among children has been observed in some Central and Eastern European countries (Marthaler, 1996). In the USA, a caries increase among children aged 2 to 5 years can be observed (Beltran-Aguilar, 2005; Dye, 2007).

The prevalence of caries among children is high and tends to increase in populations that consume cariogenic foods (Blinkhorn, 1996; Njoroge, 2010).

An individual's health is influenced by biological, social, economic and environmental factors and factors related to lifestyle habits. These factors affect the health of a whole society and therefore sustainable society development. To create preconditions for lifelong good health, preventive actions must be popularised and developed. A public opinion must be formed that healthy lifestyle is a value, and the health care system in general must be improved (European Semester, 2015).

Our study identifies the problems and provides data to evaluate the situation and to solve questions regarding the biological and social reasons for caries development among small children, caries-affecting bacteria in children's and their mothers' saliva, and parents' attitude towards dental health

in Riga and in the cities included in the WHO study (Erfurt, Minsk, Volgograd, Ouro Preto).

**Objective of the Study**

To evaluate the oral health condition and caries risk factors among preschool children ages 2–3 years old in Riga.

**Tasks of the Study**

1. To assess the prevalence of caries among preschool children ages 2–3 years in Riga.
2. To assess caries intensity among preschool children ages 2–3 years in Riga.
3. To assess oral hygiene and gingivitis among preschool children ages 2–3 years in Riga.
4. To assess the *Streptococcus mutans* and *Lactobacillus* counts in saliva in children and their mothers.
5. To conduct a survey of the mothers and to analyse the study participants' eating habits, social status and their parents' attitude towards dental health based on the obtained data.

**Hypotheses of the Study**

1. The prevalence and intensity of caries among 2- to 3-year-old pre-schoolers in Riga is high.
2. High *Streptococcus mutans* and *Lactobacillus* concentrations in mothers' saliva has a connection with caries development in their children.
3. As *Streptococcus mutans* increases, the *Lactobacillus* count in the intensity of saliva caries simultaneously grows.

4. The most significant caries risk factors are social aspects, the frequent consumption of sugar and parents' insufficient knowledge of oral health.

**Scientific Novelty of the Study**

1. For the first time, the transmission of *Streptococcus mutans* and *Lactobacillus* in the saliva from a mother to her child is studied.
2. The influence of social factors on caries development among preschool children ages 2–3 years in Riga is extensively analysed.
3. By collaborating with other countries (Germany, Brazil, Belarus and Russia) following the same methodology, data for comparing oral health and social conditions have been obtained.

# 2. MATERIAL AND METHODS

## 2.1. Children selection criteria

The study was conducted from 2008 to 2012 in a group of 2- to 3-year-old children who were attending Riga kindergartens. According to the data of the Ministry of Education of Latvia, during the given time frame, there were 157 preschool educational institutions in the area of Riga City and its outskirts, 30 of which were inspected. For the study purposes, Riga was divided into regions: Vidzeme, Kurzeme, Latgale, Zemgale, North and Centre. To form the sampled population of children, the principle of randomisation was applied, and the children were stratified according to their age and the regions of Riga in which they went to kindergartens. In each of the regions, the number of children to be included in the examination was calculated. Based on the principle of randomisation, Riga preschool educational institutions in each region that contained enough children in the respective age groups studied were chosen. Employees of the establishments and the parents of the children were informed about the study goal beforehand. These people wished to participate in and collaborate with the study personnel. Therefore, bearing in mind that each of the outskirts was represented, children from the selected Riga preschool educational institutions whose parents agreed to participate in the study, acknowledged in written form their permission for examinations and gave saliva samples were included in the study. In total, 330 children and their mothers participated.

The design of the study was cross-sectional.

### 2.1.1. Ethics Principles

The study was conducted in accordance with the protocol confirmed by the RSU Ethics Committee.

## 2.2. Clinical Examination

The methodology of the clinical examinations was coordinated with the study methodology around the four countries. The author of this study acquired the methodology in the University of Jena, Germany.

The examinations of the children's oral cavities were conducted in conditions as similar as possible among the preschool premises in the rooms of the corresponding children's age group. The study author performed the examinations alone. In the examinations, an optical fibre lamp (ROR Int ApS), dentistry mirrors and blunt probes were used. The acquired data (carious, filled, missed teeth, plaque and gum health) were recorded on the clinical examination cards.

An X-ray examination was not used.

### 2.2.1. Evaluation of caries prevalence and frequency

The prevalence and frequency of caries in teeth were used to describe caries.

Caries prevalence was expressed as a percentage (%): the proportion of persons with decayed teeth among the total number of examined persons, multiplied by 100.

The caries frequency in children with deciduous occlusion (dmft) shows the caries experience of one person or a group of children. The caries decay (dmft) in children for one person is the sum of carious, missing and filled teeth. The mean value of dmft is the sum of the children group divided by the number of examined children.

### 2.2.2. Evaluation of Plaque and Gingivitis

To evaluate plaque on the deciduous incisor vestibular surfaces, a modified index described in the *Silness-Löe* (1964) was applied. To evaluate

oral hygiene, a blunt probe was utilised. The acquired results were recorded as follows:

2 – no plaque;

1 –plaque can be seen by scraping the surface of the tooth with the probe;

0 – no plaque can be seen on the tooth surface with the naked eye.

To assess the degree of gingivitis, the Gingival index (modified from Loe & Silness 1963) was used, where:

0 – no pathology;

1 – inflammation in the initial stage;

2 – bleeding when touched with the probe; and

3 – spontaneous bleeding.

## 2.3. *Streptococcus mutans* and *Lactobacillus* counts in Saliva of the Mother and Child

In children and their mothers, *Streptococcus mutans* and *Lactobacillus* counts in saliva were determined using chair side test CRT bacteria (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 $37\ ^{0}$C. Afterwards, the scores of the *Streptococcus mutans* and *Lactobacillus* were evaluated semi-quantitatively by comparing the density of the colonies on the culture medium with the CRT bacteria map.

Saliva stimulation was not used.

Saliva inoculation and analysis were performed by the author of the study, who had previously acquired the methodology on microbiologic culture mediums at the University of Jena, Germany (30.11.2008-06.12.2008).

## 2.4. Questionnaire

The parents' survey was conducted to obtain information on oral hygiene and eating habits, the social condition and the parents' education level, occupation and attitude towards oral health. The questionnaire used was adapted and validated for the joint study in 5 countries (Latvia, Germany, Brazil, Russia and Belarus); it was called " Oral health of young children."

The following groups of questions were included in the questionnaire:

1) general data (the child's gender, age and number of siblings and the parents' family status, education level and occupation);
2) the child's care and upbringing;
3) the child's nutrition habits;
4) the child's general medical anamnesis;
5) the child's dental hygiene and prophylaxis;
6) the parents' attitude towards dental health; and
7) the child's oral health condition.

The questionnaires were filled out by the mothers/parents at home and were returned within a week.

This study was conducted simultaneously in several countries (Germany, Belarus, Brazil, Russia and Latvia) following the same methodology. The study was directed and coordinated by the WHO prophylaxis and collaboration centre in the University of Jena.

The encryption and data input was performed by the author of this study.

## 2.5. Statistical Analysis

According to the type of variable, the central tendency indicator − the average value of the feature, median, mode and dispersion indicators – the standard deviation and minimal and maximal values of the feature were calculated.

To determine whether the data corresponded with the normal distribution, the Shapiro-Wilk test (Shapiro-Wilk) was used.

To compare two dependent and independent groups by one feature, a suitable Student t test was used; however, to compare several independent groups by one feature, dispersion analysis (ANOVA) was applied. To analyse the additional factors (covariants), covariant analysis (ANCOVA) was used.

In cases where the data to be analysed did not correspond with the normal distribution, a suitable non-parametric test (Mann-Whitney test) was used.

The result was assessed as significantly varied if the zero hypothesis probability was 0.05 or lower, i.e., if the criterion for rejecting the zero hypothesis was a level of significance of $p = 0.05$. Otherwise, the zero hypothesis was accepted.

To analyse the connection of two features, Pearson correlation analysis was used. The following correlation closeness classification depends on correlation coefficient value r:

The correlation is weak if $r \leq 0.3$.

The correlation is average if $0.3 < r < 0.7$.

The correlation is high if $r \geq 0.7$.

When analysing the nominal or rank data, to compare the proportional distribution of two or more features, Pearson chi-squared statistical analysis was used (if the contingency table frequency was < 5); however, Fischer's precise test was used if the contingency table frequency was > 5.

To be able to generalise the obtained data and to determine the dispersion boundaries, interval values of 95% credibility were also calculated.

Data statistical processing was carried out by applying IBM SPSS version 17.

# 3. RESULTS

## 3.1. Oral health in 2- to 3-year-old children

Three hundred thirty children aged 2 to 3 years and their mothers took part in the study. Of the examined children, 165 (50%) were girls, and 165 (50%) were boys. The average age of the group was 31.5 (SD 3.8) months.

Of the children, 231 (71%) were caries free, but the average dmft index in the deciduous occlusion dmft was 1.55 (standard deviation 3.12) divided into dt – 1.37 (standard deviation 2.94), ft – 0.15 (standard deviation 0.77) and mt – 0.05 (standard deviation 0.395). Sixteen (5%) of the children had filled teeth, and 7 (3%) of the children had missing teeth.

According to the non-parametric Mann-Whitney (Mann-Whitney) test analysis, it was concluded that there was a significant distinction between caries and the child's gender ($p < 0.001$). In this age group, caries was observed more frequently in boys than in girls.

To acquire more precise information, the study group was divided into two sub-groups: children with caries and children without caries.

According to the Spearman correlation coefficient analysis, it was ascertained that in the group with caries, there was no significant correlation between age and caries ($p = 0.71$) (Figure 3.1).

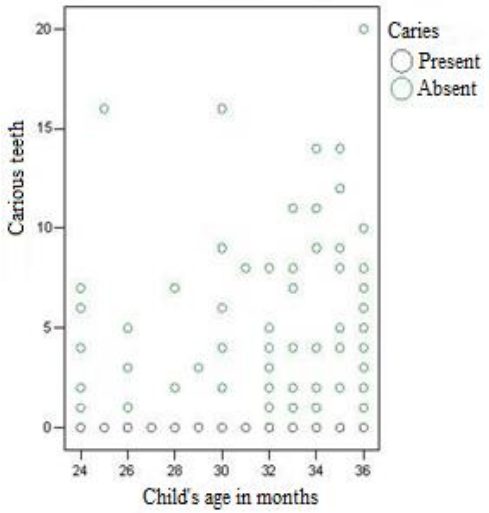


Figure 3.1**. Caries according to the child's age**

During the study, it was discovered that caries does not depend on the child's age.

There was a significant correlation between existent caries and the child's gender in the age group of 25-36 months ($p < 0.001$). At the age of 3 years, the caries difference between the genders increased; i.e., caries at this age was observed more frequently for boys than for girls (Figure 3.2).

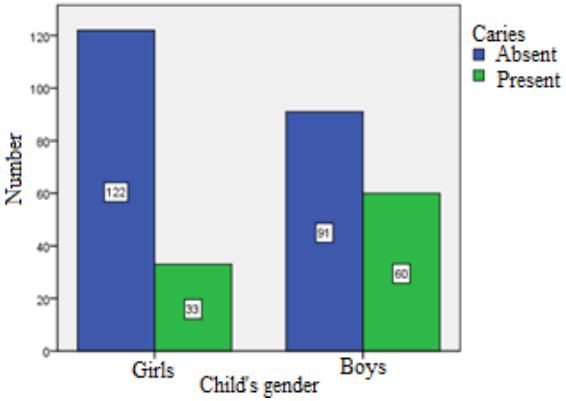


Figure 3.2. **Caries and the child's age**

## 3.2. Oral Hygiene

Out of all of the 2- to 3-year-olds, 26.7% had plaque on their examined teeth surfaces. For the rest of the children (73.3%), plaque was not observed on the evaluated teeth surfaces.

There was a significant correlation between existent caries and plaque ($p < 0.001$). Plaque influenced caries existence for 55 children (Figure 3.3).

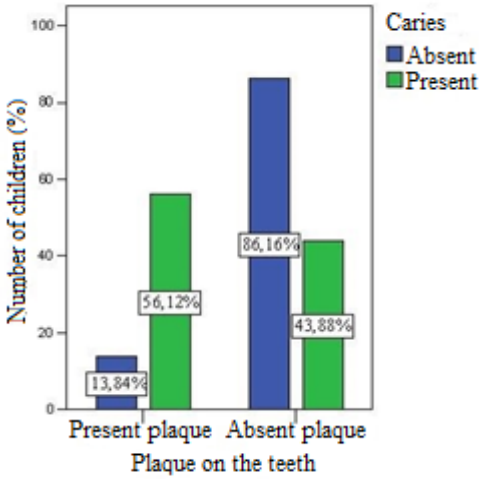


Figure 3.3**. Caries and the amount of plaque among 2 to 3 year-olds**

Gingivitis influenced caries existence for 21 children; there was a significant correlation between caries existence and gingivitis ($p < 0.001$) (Figure 3.4).

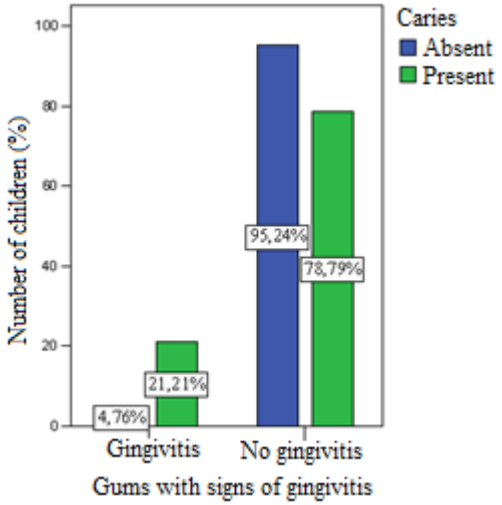


Figure 3.4. **Caries and gingivitis for 2 to 3 year-olds**

## 3.3. Saliva *Streptococcus mutans* and *Lactobacillus* in Children and Mothers

When inspecting the data obtained on the amount of *Streptococcus mutans* and Lactobacillus in the saliva, it was concluded that 225 (80.6%) of children and 168 (62.7%) of mothers had *Streptococcus mutans* < 100000 CFU/ml. Fifty-four (19.4%) children and 100 (37.3%) mothers had *Streptococcus mutans* >100000 CFU/ml; 197 (74.6%) children and 135 (50.6%) mothers had *Lactobacillus* < 100000 CFU/ml; and 67 (25.4%) children and 132 (49.4%) mothers had an elevated amount of *Lactobacillus* (>100000 CFU/ml) in their saliva.

There was a significant correlation ($p < 0.001$) between caries and SM. A higher amount of SM in the saliva was found for 28 of the examined children who had caries (Figure 3.5).

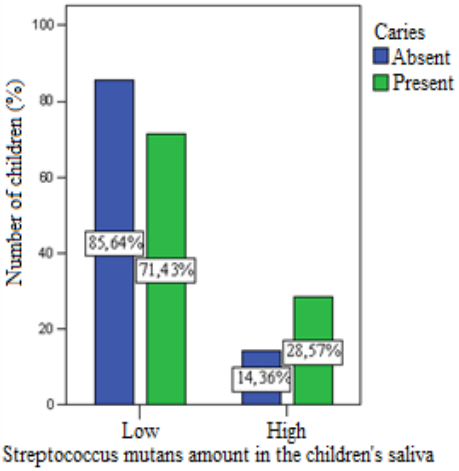


Figure 3.5. **Amount of caries and the *Streptococcus mutans* in the saliva of 2 to 3 year-olds**

This study shows that there is a significant correlation ($p < 0.001$) between caries and LB; for 38 children who had caries, a high amount of LB in the saliva was also found (Figure 3.6).

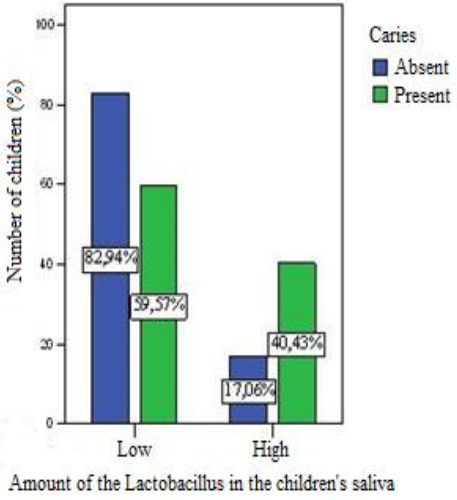


Figure 3.6. **Amount of caries and *Lactobacillus* in the saliva of 2 to 3 year-olds**

If the mother's saliva was found to contain higher amount of SM, then a higher amount of SM could also be observed in the child's saliva. It follows that there is a significant correlation ($p < 0.001$) between the SM of children and that of their mother.

During the study, it was established that there is a significant correlation ($p < 0.001$) between the LB of children and that of their mother. If there is a high amount of LB in a mother's saliva, there is a chance that her child will also have higher amount of LB in his/her saliva.

There is a significant correlation ($p < 0.001$) between a child's SM and plaque. A more explicit plaque on the teeth was observed for children with higher amount of SM in their saliva (Figure 3.7).

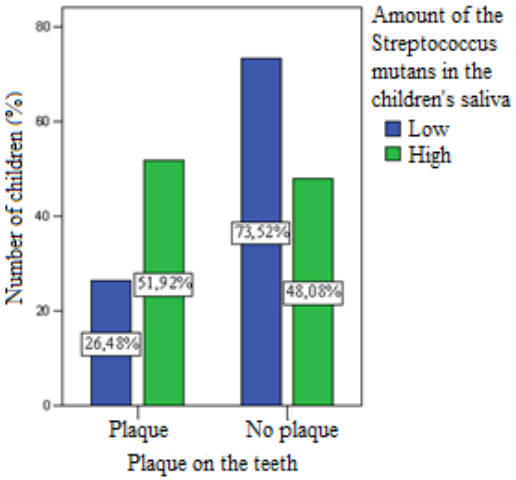


Figure 3.7. **Influence of the *Streptococcus mutans* and plaque among 2 to 3 year-olds**

In compliance with the Cochran-Mantel-Haenzel test (Cochran-Mantel-Haenzel), it was concluded that the prospect proportion between plaque and the SM in the caries/caries-free group was significantly different from 1 ($p = 0.01$); it follows that caries changes the amount of plaque and SM.

The Mann-Whitney statistical analysis showed a significant difference (p=0.02) between the SM in terms of the child's and the mother's age. The amount of SM was lower for older mothers than younger mothers (Figure 3.8).

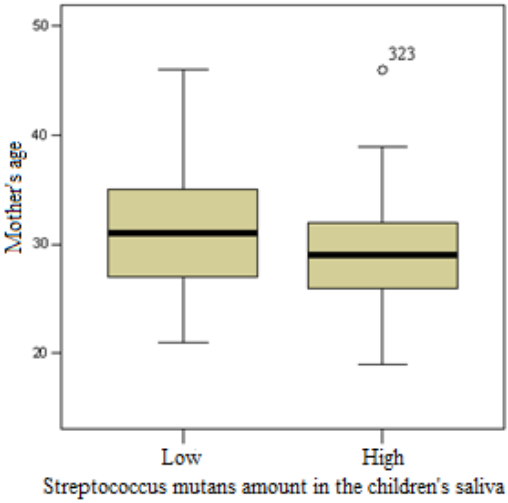


Figure 3.8. **Correlation between the amount of the *Streptococcus mutans* in the child's saliva and the mother's age**

A high amount of SM in saliva ($p < 0.001$) was found for 28 children who had caries. A high amount of LB in saliva ($p < 0.001$) was found for 38 children who had caries. If the amount of SM in the mother's saliva was high, it was observed that the amount of SM in the child's saliva was also high ($p < 0.001$). If the amount of LB was high in the mother's saliva, the amount of LB in the child's saliva would also be high ($p < 0.001$). Plaque on the children's teeth was observed to be more frequent for children with high amount of SM in their saliva ($p < 0.001$). The amount of SM in the children's saliva did not influence gingivitis ($p = 0.07$). Caries changed the amount of plaque and SM ($p = 0.01$). The amount of SM was higher for older than younger mothers ($p = 0.02$).

## 3.4. Eating habits and consumption of sugar

By analysing the obtained data and surveying the mothers, it was concluded that the majority of children (96%) had three or more main meals. The data analysis indicates that two or more main meals contain sugar for 41% of 2- to 3-year-old children, and 47% of children consumed a sugary drink daily.

Additional eating between the main meals was marked for all children; the majority of children (58%) had two additional meals. Ten percent of the respondents marked that they purchased cookery products for their children.

A high caries prevalence was not observed for children who used multivitamin juice. There is no significant correlation between drinking multivitamin juice and caries.

There is a weak but significant correlation ($p = 0.03$) between the cariogenic extra meals in between the main meals and the amount of SM in saliva (Figure 3.9).

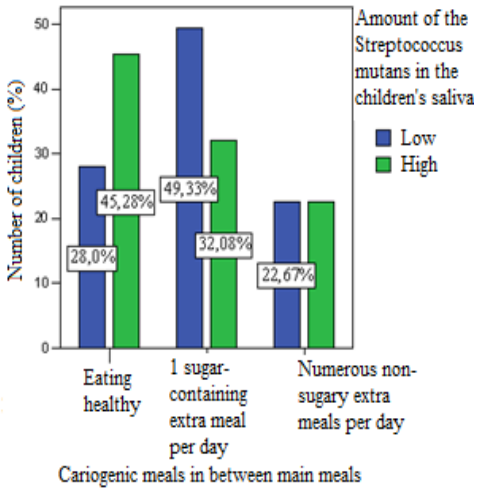


Figure 3.9. **Cariogenic meals between the main meals and the amount of the *Streptococcus mutans* in the 2 to 3 year-old children saliva**

There is a significant correlation (p = 0.001) between caries and cornflakes: The consumption of cornflakes influences caries development.

There is a significant correlation (p = 0.006) between SM existence and the frequency of eating candy (Figure 3.10).

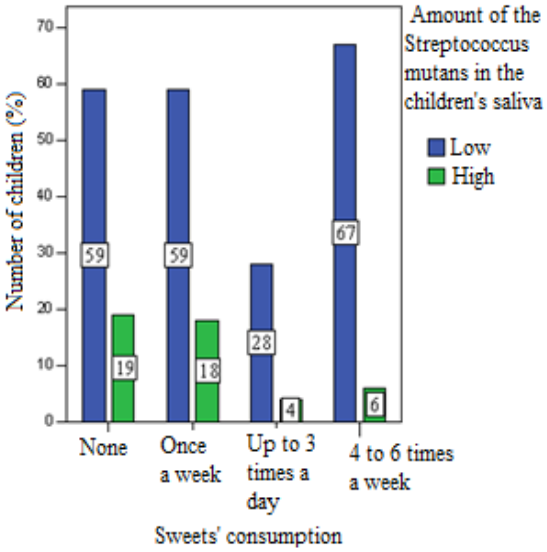


Figure 3.10. **Candy and the amount of the Streptococcus mutans in the 2 to 3 year-old children saliva**

There is a significant correlation (p = 0.01) between SM and sugary drinks. The frequent consumption of sugary drinks elevates the amount of SM in the saliva (Figure 3.11).

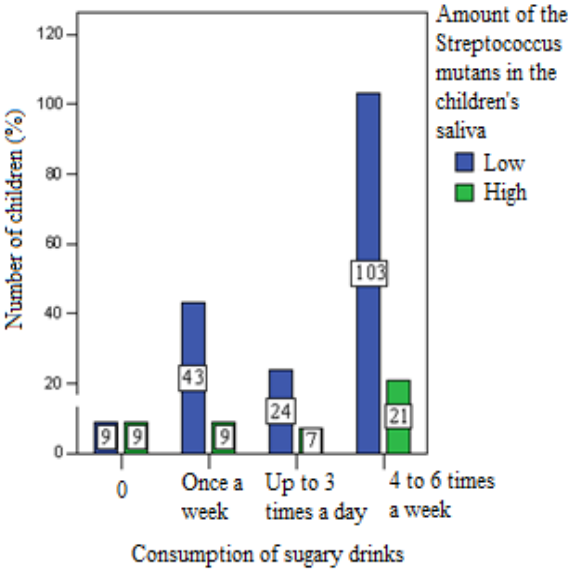


Figure 3.11. **Influence of sugary drinks on the SM development**

The 2- to 3-year-old children ate biscuits, chocolate and candy at least once a week. Most frequently, parents provided the sweets (46%); however, children who asked for sweets received them the most.

### 3.4.1. Breastfeeding

By analysing the data collected from 311 mothers (19 mothers did not answer this question), it was concluded that 26 (8.1%) children were not breastfed, but 285 (89.1%) children were breastfed. Of the children, 186 (63.9%) were breastfed for more than 6 months, and 58 (19.9%) children were breastfed up to 6 months.

A significant correlation ($p = 0.02$) was observed between the mother's education level and breastfeeding: As the mother's education level increased, so did the length of time she breastfed her child

The survey of the mothers showed no significant correlation ($p = 0.1$) between breastfeeding and plaque on the children's teeth. Breastfeeding does not influence the amount of plaque.

By analysing the obtained data according to covariance analysis (ANCOVA), it was concluded that the average dmft differed significantly ($p = 0.03$) with breastfeeding durations, which is connected to the mother's age. By applying the LSD *post-hoc* analysis, it was concluded that 3-month and 6-month breastfeeding periods did not significantly differ ($p = 0.37$); however, if the child was breastfed longer than 6 months, the dmft and the mother's age were significant factors influencing the child's dmft development ($p = 0.01$) (Figure 3.12).

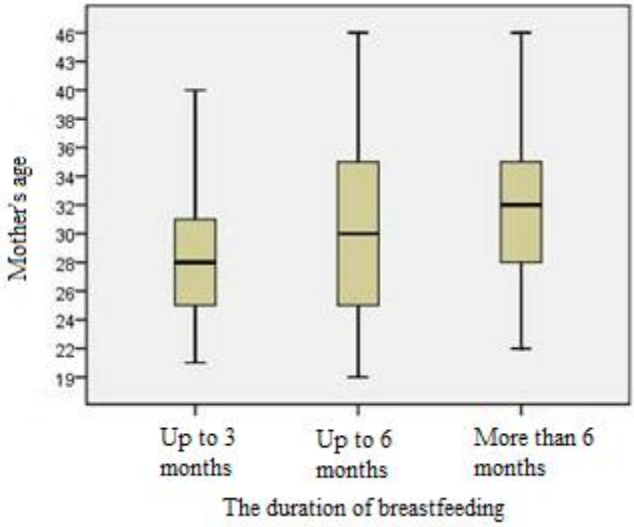


Figure 3.12. **The influence of the mother's age on breastfeeding**

## 3.5. Analysis of the social factor

### 3.5.1. Evaluation of the parental education level and speciality

For the mothers' questionnaire, a special inquiry form prepared for this study was used. Questions about the child's age, the child's gender, the family situation, the parents' education and occupation, the child's care and upbringing, the child's eating habits, the child's oral health habits and the parents' attitude towards dental health were included in the questionnaire.

In total, 330 mothers with the average age of 30.85 (SD 5.14) took part in the study. The youngest mother was 19 years old, and the oldest was 46 years old. The fathers' average age was 32.97 years (SD 6.41). The youngest father was 20 years old, and the oldest was 67 years old.

Three hundred twenty-five mothers answered the questions on the education; 59% of mothers had higher education, and 38% of fathers did.

The questionnaire results reflected that the majority of the children (84.56%) received care from both parents, and 15.44% of the children were in their mother's care.

In the study, a significant correlation ($H\bar{i}2 = 12.83$; $df = 2$; $p = 0.002$) was discovered between child care and mother's education level. The data analysis results showed that in the families where both parents had higher education, child care was more frequently provided by both parents than in the families where the parents had secondary or primary education.

Based on the Pearson's chi-squared statistical analysis, it was concluded that there was no significant correlation ($p = 0.07$) between the child's caretaker, the marital status of the parents and the mother's education level.

Based on the non-parametric Mann-Whitney (Mann-Whitney) test analysis, it was concluded that there was no significant difference ($p = 0.98$) between caries and child care.

By analysing the data, it was concluded that there was a significant correlation ($p < 0.002$) between the mothers' working hours and their education level.

A significant correlation ($p < 0.05$) was shown between mothers' working hours and the existence of caries in their children child. Children whose mothers spent considerable time at work more frequently had caries than children whose mothers devoted more time to looking after them.

A significant correlation ($p = 0.01$) was observed between mothers' education level and their teeth brushing. Mothers with a higher education brush their teeth more often than mothers with a lower education level.

By analysing the data, it was found that there was a significant correlation ($p = 0.05$) between mothers' education level their children's teeth brushing. Mothers with a higher education level brushed their children's teeth more often (Figure 3.13).

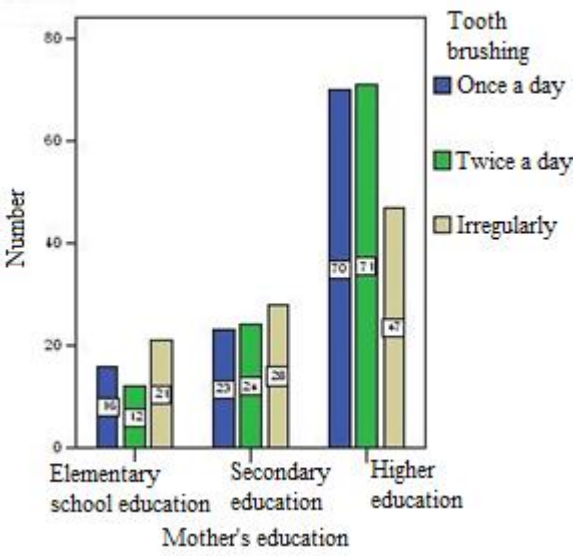


Figure 3.13. **Mother's education and tooth brushing of the child**

According to the obtained data, it was concluded that there was a significant correlation ($p = 0.002$) between mothers' education level and the frequency with which their children ate candy. As the mothers' education level increased, so did the frequency with which their children age candy.

By analysing the data, a significant correlation ($p = 0.01$) between mothers' education level and dentist visit frequency was found. Mothers with a higher education level visited the dentist more often.

The questionnaire results reflected that the majority of mothers (58%) had higher education, and 36.1% of fathers did. The majority of parents (72%) were married, but the number of the unmarried parents was also rather high (18%). Both parents provided care for the majority of the examined children (72.6%), and only 13.3% of the children were in their mother's care. The data analysis results showed that parents who both had higher education participated in child-care three times more often parents who both had secondary education and four times more often than parents who both had primary education ($Hī2 = 12.83$; $df = 2$; $p = 0.002$). It was concluded that there was a significant correlation ($p < 0.002$) between mothers' working hours and their education level. Caries was found more in children whose mothers spent considerable in work than in children whose mothers dedicated more time to looking after their children ($p < 0.05$).

### 3.5.2. Parents' attitude towards dental hygiene

Of the examined children, 34% brushed their teeth twice a day, 35% brushed their teeth once a day, and 31% brushed their teeth irregularly.

Of the surveyed mothers and fathers, 74% brushed their teeth twice a day. Between brushing teeth once and twice a day, a significant correlation ($p < 0.005$) was found. Children who brushed their teeth once a day had more carious defects than children who brushed their teeth twice a day (Figure 3.14).

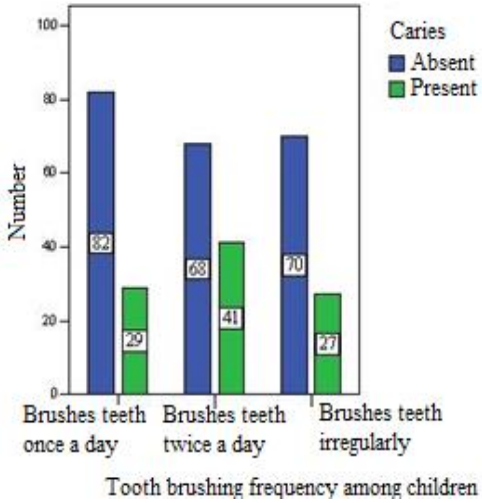


Figure 3.14. **Caries and tooth brushing in 2 to 3 years old children**

Most 2- to 3-year-old children cleaned their teeth in the morning after waking up and in the evening before sleeping.

The results of the Fischer's statistical analysis showed a significant correlation ($p < 0.001$) between mothers' and children's teeth-brushing habits. If a mother brushed her teeth twice a day, then her child's teeth were also cleaned twice.

Of the children, 47% received help from their parents when brushing their teeth, and 43% brushed by themselves. Eighty-eight percent of the children used toothpaste, and 12% cleaned their teeth without toothpaste.

The statistical analysis of the Fischer's showed a significant correlation ($p < 0.001$) between the usage of toothpaste and plaque. Less plaque was found on the teeth of the children who cleaned their teeth with toothpaste than on the teeth of those who did not use toothpaste.

According to the mothers' answers, 65% of the children brushed their teeth willingly, and 35% of children reacted inconsistently to teeth brushing.

Two- to 3-year-old children are not able to brush their teeth effectively; however, the mothers' survey results showed that 54% of parents rarely checked how well their child cleaned their teeth. After the check-up, 6% of the parents made the child re-brush their teeth, and 38% did not.

The study gives an idea of parents' knowledge of dental health. Although most parents had higher education and knew that it was necessary to see the dentist after the child's first tooth erupted, 38% of the 2- to 3-year-olds were not taken to the dentist. According to the results of the survey, 80% of the mothers had not received any information on the necessity to preserve deciduous teeth.

As reported in the study results, 79% of mothers believed that children can grow up with completely healthy teeth, and 63% thought it might be possible to inherit good or bad teeth.

Regarding mothers' knowledge regarding deciduous teeth, it was concluded that 70% thought that deciduous teeth should be treated.

Regarding the possible connection between dental health and nutrition, 86% of mothers indicated that nuitrition affects dental health.

When asked about how much time their families dedicated to the child's oral hygiene, 74% of mothers responded that up to 5 minutes was devoted to the child's oral health.

Of the 2- to 3-year-old children, 38% were never taken to the dentist. When questioned about the knowledge of the relationship between nutrition and dental health, 86% the mothers stated that nutrition affects dental health.

# 4. DISCUSSION

## 4.1. Caries in 2- to 3-year-old children

Dental caries is the most common disease in the world (Vanobbergen, 2001). As Marthaler's study shows, in all European countries, caries prevalence tends to decrease among children and adolescents. However, in numerous countries with an already low caries prevalence, its decline in deciduous teeth is not observed. The intensity of early childhood caries has actually increased in 2- to 5-year-old children in the United States of America (Beltran-Aguilar, 2005). In some Central and Eastern European countries, caries prevalence among children is high (Marthaler, 1996). The available data show that in Estonia (2006), caries prevalence among children aged 2 to 4 years was 41.6% (Olak, 2007); in Sweden (2007) 38% of the children ages 2–5 had caries (Stecksen-Blicks, 2008); in Erfurt, Germany (2001), 14.7% of children ages 2–3 years had caries (Borutta, 2002); in Poland (2002), 43.8% of 3-year-old children had caries (Szatko, 2004); in Lithuania (2003), 50.6% of 3-year-olds had caries (Slabsinkiene, 2010).

In Latvia, there is little information on children aged 2–3 years, and most commonly, the information is episodic. In a study conducted by Henkuzena on a group of children ages 2 to 6 years, it was observed that the intensity and prevalence of caries in the kindergartens of Riga was high and increased with the age of the children (Henkuzena, 2007). Our study found that 30% of children between 2 and 3 years old had caries. In comparison with the data found in the literature, this rate is high; however, it is lower than the rates for Estonia and Sweden. Our study established that the high caries prevalence could be connected to the frequency and quantity of sugar intake in the given age group and to irregular teeth brushing.

Studies in previous years have shown that the intensity of caries (dmft) is high. In 1993, the dmft index in children aged three years reached 2.2, but in 2000, the dmft index in this age group was 1.6 (Bērziņa, 2008). In 2001, the average caries frequency in deciduous teeth of two-year-olds was 0.7 and in three-year-olds was 1.6 (Henkuzena, 2007), but the caries intensity in children at the age of six years was 5.75 (Gudkina, 2009).

In Lithuania, the dmft index in children aged 3 years reached 2.11 (Slabsinskiene, 2010); in Canada, 5.2 (Peressini, 2004); in Sweden, 0.2 (Grindefjord, 1995). In Belgium, 18.5% of children aged 24 to 35 months were diagnosed with caries, and the dmft index was 0.83 (Martens, 2006).

In comparison with the previous studies, our study found a dmft index of 1.55, which is a better rate. Although in past years, the caries intensity has been decreasing, in the context of small children, it is still viewed as high. Our study also found that caries was observed more often in boys than in girls, and in other countries, the data showed similar findings (Peressini, 2004; Campus, 2004).

## 4.2. Significance of plaque and hygiene in caries development

Plaque is believed to be one of the contributing factors in caries development (Marsh, 1999). Our study found that 56% of the children had plaque on the vestibular surfaces of the upper jaw frontal teeth. Gingivitis was found in 6.4% of children, which is explained by the fact that parents do not pay enough attention to deciduous teeth cleaning. Of the children, 31% brushed their teeth irregularly, and 34% brushed their teeth twice a day; 47% of parents helped their children with teeth brushing. The age of the studied children was 2 to 3 years, and children this age are not capable of cleaning their teeth effectively; therefore, parents should pay more attention to the oral hygiene of their children. Based on the data collected by Vanobbergen, starting teeth

cleaning early and cleaning teeth frequently reduces caries risk (Vanobbergen, 2001). Saporito noted that for children younger than 2 years, teeth brushing twice a day considerably decreases caries (Saporito, 2000). Clinical trials have shown that in children ages 3–6 cleaning teeth twice a day with fluoridated toothpaste decreases the prevalence of caries (Tinanoff, 2009). A study on 3-year-olds in Lithuania found a positive correlation between teeth brushing and early childhood caries (Slabsinskiene, 2010).

A study on a group of children aged two to six years in Riga from 2000–2001 showed that caries is more frequent in children with poor oral hygiene (73.7%) and gingivitis (69.1%; Henkuzena, 2007).

A study conducted on a group of children aged 12 to 36 months in Brazil from 2009-2010 found plaque in 76% of cases and gingivitis in 34.1%; 50.7% of the children had their teeth brushed twice a day by their parents (de Souza, 2015).

## 4.3. Significance of Saliva in Caries Development

It was shown that the amount of *Streptococcus mutans* and *Lactobacillus* in saliva and plaque had a direct connection with the appearance of caries and its further development (Caufield, 2001). *Streptococcus mutans* is associated with caries formation in its early stages (Edwardsson, 1974). In our study, a higher amount of *Streptococcus mutans* was found in the children's (19.4%) and their mothers' (37.3%) saliva. A positive correlation between the amount of *Streptococcus mutans* in children's and their mothers' saliva was found. A higher amount of *Lactobacillus* in saliva was found among 25.4% of children and 49.4% of mothers. A significant correlation was found between *Lactobacillus* in mothers and children ($p < 0.001$). The data collected in the study showed that mothers do not know that at the child's birth, microorganisms colonise their oral cavity, and bacteria can enter children's

mouth from their surroundings, from their nutrition intake and during contact with other people. There is a hypothesis that a mother with high concentration of *Streptococcus mutans* in her saliva can transmit certain microorganisms to her young child, thereby contributing to the development of caries (Berkowitz, 2003). According to this study, the transmission of bacteria from a mother to a child occurs through saliva, such as by using a spoon to taste the child's food or by licking a fallen pacifier. In Latvia, there are relatively few studies on the caries risk factors in young children, and there are no studies on mothers who can transmit these factors to their young children, thereby promoting the development of caries. Mothers do not know that they can infect their children with caries-causing bacteria starting at an early age.

It is important for prophylaxis for caries prevention start in the prenatal period (Kawashita, 2011). The use of xylitol in pregnant women and new mothers has been studied for 30 years, and it has been shown to decrease the amount of bacteria in saliva. It has been shown that among young children whose mothers used xylitol chewing gum, the prevalence of caries was lower than it was in the control group (Marrs, 2011). Data on the use of xylitol are not included in our study.

In a study that gave children ages 15 to 25 months 8 grams of xylitol daily, it was shown that caries prevalence decreased even by 70% (Milgrom, 2009).

## 4.4. Significance of eating habits and sugar consumption in caries development

Nutrition plays an important role in human life. Food quality affects human health in general and an individual's dental health. Food and eating habits play a significant role in caries development.

It is essential to establish good eating habits at a young age because these habits will last throughout childhood and adulthood (Lanigan, 2007). The

mutual influence between nutrition and caries has been confirmed in several studies. However, nutrition itself does not cause caries. For food to be considered a potential risk factor for caries, it would have to contain fermentable carbohydrates, which plaque bacteria use in their metabolism and acid production (Featherstone, 2000; Fejerskov, 2008; Koch, 2009). In caries development, the most commonly involved fermentable carbohydrate is sugar (Koch, 2009). According to Gao's study, sugar, not parental knowledge and attitudes, is considered the main cause of caries development in children (Gao, 2010).

In our study, 41% of children had two or more main meals containing sugar per day, and 47% of children drank sugar-based drinks at least once a day. The sugar-containing food was mostly chocolate, candy, biscuits and curd cheese desert, and the drinks were sweetened lemonades, juice and sweet tea. Most frequently, sweets were given by the parents (46%), followed by acquaintances, friends, brothers and sisters (36%) and then grandparents (17%). Obviously, family members do not consider deciduous teeth to be important because they will eventually fall out anyway, and because of the everyday occupancy, oral hygiene becomes secondary.

Our study showed that caries can develop from incorrect breastfeeding, i.e., if feeding takes place on demand and the child is often and long breast fed at night. The 2001 study by Reisine produced similar findings.

There are controversial opinions on breast-milk carcinogenicity. Descriptions of higher caries risk caused by breastfeeding for a longer period than a year and feeding at night can be found in the literature. An observation made in Japan suggests that breast milk causes smooth-surface caries and is more cariogenic than cows' milk. Experimental studies have shown that cows' milk has little carcinogenicity (Kawashita, 2011).

Palmer observed that children who drank juice between meals had more caries. Children with caries consumed snacks and drinks more frequently than

caries-free children. Sugary drinks during sleep were consumed more often by children with caries. Moreover, these children were given food that was more cariogenic (Palmer, 2010).

Saliva secretion diminishes during sleep, which promotes cariogenic potential if sweetened drinks are consumed. Therefore, water is the only liquid that should be given to a child at night (Kawashita, 2011).

## 4.5. Social factors' significance in caries development in young children

Currently, social and economic values considerably affect oral health. Retrospective studies have shown that there is a difference between parents' attitude towards oral hygiene control and the correlation between social factors and the family (Twetman, 2010). Caries is a serious social and dental problem that affects infants and young children worldwide (Prakash, 2012).

Early caries development is predetermined by a low socio-economic level, insufficient knowledge about health and parents' low level of education (Harris, 2004; Congiu, 2014). To reduce the risk factors of caries development, it is necessary to create cooperation within the family (Congiu, 2014), thus developing individual and social prophylactic measures.

It is mentioned in literature that mothers' low level of education is related to a high prevalence of caries (Warren, 2008; Nunn, 2009; Thitasomakul, 2009; Feldens, 2010). Studies in Riga preschool educational establishments did not confirm such regularities. Parents with higher education may have knowledge about oral health. In addition, many mothers may be too busy at work; 54% of surveyed mothers spent little time at home. It should be taken into account that the studies were conducted in socially, culturally and economically different countries; therefore, the results should be evaluated in a relatively cautious manner.

## 4.6. Comparison of the results obtained with the survey data of other countries

In the study, the WHO's "Oral health of young children" was performed in five countries (Germany, Latvia, Russia, Belarus, Brazil) starting from 2008. The study was led by the WHO Collaborating Centre for Prevention of Oral Diseases. The Latvian representative – the author of this research – conducted a study with 2- to 3-year-olds.

In Riga, caries intensity among children aged 26 to 34 months was 1.16, which was one of the worst results. The lowest dmft was in Erfurt: 0.62. The dmft was 1.02 in Volgograd, 1.28 in Minsk and 1.57 in Ouropretu – the highest.

The interaction of several circumstances can be considered caries risk-modifying factors. These include plaque, gum inflammation, Streptococcus mutans and parents' caretaking attitude (Petti, 2010). Dental plaque has a significant role in the development of caries (Marsh, 1999). The most plaque was found on the vestibular surfaces of the upper jaw frontal teeth. In this study, plaque and dmft were the main direct-correlation indicators in Riga ($r = –0.24$), Brazil ($r = –0.24$) and Minsk ($r = –0.26$). This finding indicates that parents do not pay enough attention to deciduous teeth brushing. The age of the studied children was 2 to 3 years. Children this age are not capable of effective teeth brushing. Therefore, parents should pay more attention to the oral hygiene of their children; that is, they should clean their children's teeth. When analysing the data on oral hygiene as a caries risk factor, many authors have shown a negative influence of its impairment on further caries development (Anusavice, 2005). Gum inflammation was observed most frequently in children from Erfurt (33.6%), and in the rest of the cities, the frequency of gingivitis did not differ (9.5%). The dmft in Erfurt was the lowest, suggesting that in Germany, the aim control is chosen as the optimal preventive strategy for reducing the prevalence of caries.

A study conducted in Latvia in 2001 on 3-year-olds showed that 3.8% had gingivitis (Henkuzena, 2001). The study found that gum inflammation in children indicates insufficient oral hygiene. In the 1980s, it was recognised that the amount of *Streptococcus mutans* in the saliva as a caries risk factor had a stronger influence on the further caries development if combined with other caries-causing factors (Motohashi, 2006; Denny, 2007; Zukanovic, 2007).

This study determined the amount of *Streptococcus mutans* in saliva because it is widely known as the main etiological factor in caries development. Its early colonisation can increase caries risk. *Streptococcus mutans* transmission to infants primarily occurs through maternal saliva (Li, 2002; Robert, 2006). By determining the amount of *Streptococcus mutans* in saliva, it is possible to predict caries development (Petti, 1999). Caufield's study found *Streptococcus mutans* in 25% of children aged 19 months and demonstrated that the quantity of *Streptococcus mutans* in the saliva increased with the child's age (Caufield, 1993). During a study on Erfurt children, a direct correlation between the dmft and *Streptococcus mutans* was found ($r = 0.36$).

Inattention towards health can cause poor oral hygiene. According to the study data, a relatively large number of mothers did not know about the importance of preserving deciduous teeth, but most of them believed that deciduous teeth should be treated. According to the study data, approximately 70% of mothers in Volgograd and Minsk believed that good or bad teeth are heritable, indicating that mothers are not sufficiently informed about dental health; however, most mothers from the surveyed countries believed that a child can grow up with completely healthy teeth. Most mothers believed that there is a positive correlation between the diet and dental health. In turn, a positive fact is that mothers in Ouro Preto, Riga and Volgograd wanted to limit their children's sugar consumption to maintain their teeth health. Following the parents' behaviour, the development of this disease could be predicted (Pine, 2004). A very small percentage of the surveyed mothers prepared the children

for a visit to the dentist, which could be explained by the lack of time and knowledge.

Upon questioning mothers about meal frequency, it was found that 99% of children from Erfurt, 58% from Riga, 54% from Volgograd and 11% from Minsk had 3 main meals a day. Fifty-eight percent of children from Ouro Preto consumed 2 main meals a day. It was found that 89% children Minsk, 35% from Volgograd, 32% from Riga, 1% from Erfurt and 8% from Ouro Preto consumed more than 3 main meals per day. Forty-nine percent of children from Erfurt, 40% from Ouro Preto, 36% from Riga, and 28% from Minsk consumed at least one caries-causing meal.

Upon interviewing mothers about sugar consumption, it was found that 59% of the children from Erfurt, 58% from Volgograd, 34% from Ouro Preto and 24% from Riga consumed fruit yoghurt several times a week. Furthermore, 50% of the children from Minsk, 46% from Volgograd, 44% from Riga, 30% from Erfurt and 23% from Ouro Preto consumed chocolate once a week.

Forty percent of children in Volgograd were given sweets by their mother and father; 28% of children in Erfurt, by their mothers, fathers and grandparents; 26% of children in Minsk, by their grandparents; 19% of children in Riga, by their mother; and 19% of children in Ouro Preto, by their father.

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

Of the children, 50% in Ouro Preto, 35% in Volgograd, 38% in Erfurt, 26% in Riga and 19% in Minsk brushed their teeth regularly (twice a day).

Of the children, 72% from Erfurt and 41% from Riga brushed their teeth themselves; 79% of the children from Ouro Preto and 52% of those from Volgograd had their teeth cleaned by their parents. Of the children, 62% from Ouro Preto, 60% from Erfurt, 59% from Riga and 56% from Volgograd willingly cleaned their teeth. Of the parents, 65% from Minsk, 62% from

Erfurt, 50% from Ouro Preto, 42% from Volgograd and 22% from Riga regularly checked the cleanness of their child's teeth after brushing.

Of the children, 86% in Volgograd, 63% in Riga, 52% in Ouro Preto and 45% in Erfurt had visited the dentist.

In the study among five countries, 472 children were examined: 179 from Riga, 152 from Erfurt, 62 from Ouro Preto, 116 from Minsk and 84 from Volgograd.

In Riga, plaque on the upper jaw's frontal teeth was found in 19% of children, which was the best result of all countries studied (Erfurt 42.1%, Ouro Preto 22.6%, Volgograd 32.1% and Minsk 56.9%). The amount of *Streptococcus mutans* in the saliva was determined in 3 countries: Latvia, Germany and Brazil. The findings concerning the amount of *Streptococcus mutans* in the saliva revealed that in Riga, 84.3% of children and 71.7% of mothers had *Streptococcus mutans* <100,000 CFU; in Ouro Preto, 80.7% of children and 77.4% of mothers did; in Erfurt, 77.5% of children and 35.8% of mothers did. *Streptococcus mutans* > 100,000 CFU was found in 22.5% of children in Erfurt, 19.3% of children in Ouro Preto, 15.7% of children in Riga, 64.2% of mothers in Erfurt, 28.3% of mothers in Riga and 22.6% of mothers in Ouro Preto. In Riga, 26% of children brushed their teeth on a regular basis (twice a day), but less often, only children in Minsk (19%) brushed their teeth. The data obtained in Riga do not significantly differ from that of the other countries included in the study.

# CONCLUSIONS

1. The prevalence and intensity of caries among children aged 2 to 3 years in Riga preschools children is high. (The prevalence of caries was 30%, but the average dmft index was 1.55.)
2. Plaque and gingivitis among children ages 2 to 3 years in Riga preschools affected the development of caries ($p < 0.001$).
3. The amount of *Streptococcus mutans* in the saliva of 2- to 3-year-olds is high (> 100 000 CFU/ml). Higher levels of *Streptococcus mutans* were found in 15.5% of children and 28.6% of mothers. A positive correlation between the amount of *Streptococcus mutans* in children's and their mother's saliva was found ($p < 0.001$).
4. The amount of *Lactobacillus* in the saliva of 2- to 3-year-olds is high (>100 000 CFU/ml). A higher amount of *Lactobacillus* was found in 25.4% of children and 49.4% of mothers. There is a significant correlation between caries and *Lactobacillus* ($p < 0.001$).
5. Cariogenic products, cariogenic drinks, irregular teeth brushing and improper breast feeding are the most important caries risk factors among children aged 2 to 3 years.
6. Mothers lack information and knowledge on child dental care, nutrition and caries risk factors; our study found that this knowledge is not affected by mothers' or fathers' level of education.
7. Parents need additional information on children's oral health. This information should also be covered in the guidelines for family doctors, "Child health monitoring until the age of 3".

# PRACTICAL RECOMMENDATIONS

It is necessary to educate the population (through the press, TV, radio and leaflets for gynaecologists) and pre-school staff on children's oral health.

As a standard requirement, pre-school education institutions should have to establish methods for caries prevention, for example, brushing teeth with fluoride toothpaste and limiting sugar-containing takeaway food and beverage consumption, to provide adequate nutrition for children.

“Child health monitoring of children up to 3 years of age” details information about children's oral care to include in the family doctors’ guides:

1. Explain the importance of bottle use.
2. Educate mothers on bacterial transmission.
3. Visit the dentist after the first tooth has erupted.
4. Brush teeth with fluoride-containing toothpaste.
5. Limit the excessive use of sugar-containing foods and beverages.
6. Explain to mothers incorrect breastfeeding.
7. Present family doctor and paediatrician associations the results of this study.

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# SUMMARY

Caries is one of the most widespread chronic diseases worldwide, and individuals are susceptible to it throughout their lives. Patients' age is important for caries-risk assessment. When deciduous teeth start to erupt, and when the child is 2 to 3 years old and deciduous occlusion has formed, oral health should receive special attention. Caries risk factors should be seen as a whole because separately, they have less ability to influence caries. To determine caries risk, several aspects should be evaluated: general medical anamnesis, clinical examination, nutrition habits, the use of fluoride, the amount of cariogenic bacteria in the saliva, the function of the saliva and socio-demographic aspects. Lately, attention has been focused on the analysis of social, economic and behavioural factors because they possibly act as caries-contributing factors.

The results of our study show that the intensity and prevalence of caries among children aged 2 to 3 years in Riga preschool establishments is high, and plaque and gingivitis influenced the presence of caries. In turn, the levels of Streptococcus mutans and Lactobacillus in the saliva of children aged 2 to 3 years is high, which can contribute to the development of caries. Social factors, such as parents' education and occupation and their attitude towards oral health, has an essential role in the development of caries in children aged 2 to 3 years. The most important risk factors for caries development in children this age are the use of caries-promoting foods and drinks and irregular teeth brushing.

The study suggests that mothers do not have enough information and knowledge regarding children's dental care, nutrition and caries risk factors.

In collaboration with other countries (Germany, Brazil, Belarus and Russia), by following a common methodology, data on oral hygiene and social

conditions were obtained. It was shown the data obtained in Riga were not significantly different from those obtained in the other countries included in the study.

# PUBLICATIONS AND APPROBATION

## Publications

1. Kneist, S., Maslak, E., Care, R., Berzina, S., Skrivele, S., Tserekhava, T., Shakovets, N., Wagner, M., de Moura-Sieber, V., de Moura, R. and Borutta, A. (2011) Biological and social risk factors of early childhood caries. *Modern dentistry*, 1: 62–65.
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2. Skrīvele, S., Bērziņa, S. and Care, R. (2011) ‘Bioloģisko un sociālo faktoru ietekme uz kariesa attīstību bērniem piecās valstīs vecumā no 26–34 mēnešiem’, theses from the *APLZK Medicīnas zinātne un Latvijas sabiedrības veselība XXI gadsimtā, medicīnas sekcija*, conference of Latvia University, Riga, Latvia, pp 86.
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8. Skrīvele, S., Care, R. and Bērziņa, S. (2008) ‘Kariess un tā riska faktori bērniem agrīnā vecumā Rīgā’, theses from the *RSU Scientific conference*, Riga, Latvia, pp 75.
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