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RĪGAS STRADIŅA
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Inga Rendeniece

**PREVENTION PROGRAM
DEVELOPMENT AND EVALUATION
OF ADVANCEMENT OF CARIES
IN PREGNANT WOMEN AND
THEIR CHILDREN**

Summary of Doctoral Thesis
for obtaining a degree of a Doctor of Medicine
Specialty – Dentistry

Riga, 2016

INGA RENDENIECE

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ANNOTATION

Young children caries is a topical problem in Latvia as well as worldwide. Several studies have been carried out fully describing causes of caries, as well as a number of preventive programs have been developed, however there are no countries in the world where young children caries would not be a topical issue. Several studies have shown that education of pregnant women and young mothers has significantly reduced development of caries in children. A number of the world's leading associations have developed guidelines on how to protect children from caries by educating pregnant women and new mothers. Through assessment of oral health of pregnant women or new mothers and evaluation of their knowledge on the child's oral care, a dentist or a hygienist is able to assess the child's risk of caries, and to take all necessary preventive measures to protect the child from tooth decay.

The paper was targeted at development and assessment of dental disease prevention program for children starting from the pregnancy of a mother. The main objective of the paper was to develop a child's oral health passport and guidelines on oral health for pregnant women and their young children.

The study involved a survey of pregnant women and an assessment of their knowledge on their own and the future child's oral health. Pregnant women were advised on their daily oral care. Pregnant women were explained what regimen should be followed when feeding an infant with breast milk or infant formula, especially at night. Recommendations were given on times when the child should be taught drinking from a bottle and a cup, advising to avoid sweetened beverages, especially at night. The expectant mothers were explained that the child can be infected with caries-causing bacteria via saliva which can be passed from the mother or any other carer by kissing the child, licking the child's spoon or soother. The pregnant women were explained how to properly take care of the child's mouth. The young mothers with children

were surveyed when the child reached the age of one and two years. At the end of the study, the mothers were asked to fill out a questionnaire about the child's eating and dental care habits. As the result, the children involved in the study whose parent had followed the above instructions, showed lower caries prevalence compared to children of the control group.

Having analysed the results of the study and scientific literature, as well as having considered experiences of other countries, an oral health passport and guidelines for children residing in Latvia were developed, taking into account various caries risk factors.

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1. TOPICALITY OF THE STUDY

Dental caries, especially young children caries, should be treated at different levels – at individual level, at family level, at clinical and society level. Young children caries is particularly dangerous when it affects infants, young children and children of pre-school age. If caries is left untreated on time, it can develop rapidly, causing pain and inflammation (*Medeiros et al., 2015*). A study conducted in Riga kindergartens showed that caries is present in 30% of 2 – 3 year old children (*Skrīvele et al., 2010*). Treatment of young children caries is costly, as it is usually carried out under general anaesthesia (*Nunn et al., 2009*). Several studies have been conducted showing decrease of life quality of young children and their families because of dental issues. Young children caries has negative impact on a child's behaviour and mood, as well as it reduces a child's ability to eat and to fully absorb all of the necessary nutrients (*Easton et al., 2008*).

Several studies have shown that education of pregnant women and young mothers can significantly reduce development of dental caries. Through assessment of oral health of pregnant women or new mothers and evaluation of their knowledge on the child's oral care, a dentist or a hygienist is able to assess the child's risk of dental caries, and to take necessary steps to prevent decay of the child's teeth (*Plutzer et al., 2008; Plutzer et al., 2012*).

A healthy diet is an essential part of the process of oral care needed for development of teeth and long-term oral health. Proper oral care, right food choices and healthy eating habits must begin before pregnancy. Good dietary and oral hygiene habits should continue during the entire pregnancy and then they must be implanted in the growing children (*Leong et al., 2013*).

Pregnancy and early period of a child's life is a great opportunity for children to learn prevention-oriented dental care and eating habits, which later

will contribute to their oral health (*Medeiros et al., 2015*). Child's first visit to a dentist's office should be no later than at the age of 1 year, however most parents wait until the child has most of his or her milk teeth erupted, usually it is at the age of 2 to 3 years (*Menghini, 2008*). At this time, dental caries and most of harmful habits such as thumb sucking may have already been developed. Insufficient oral care at early stages of life increases the risk of caries in the later period of life, especially if a person has developed caries-promoting habits, such as frequent snacking on sweets and juices (*Ng et al., 2012; Ng et al., 2013*).

Link between nutriment and dental health is often not given due attention during pregnancy, infancy and early childhood period for two reasons: the majority of dietary specialists, family doctors and paediatricians lack proper expertise to provide preventive or therapeutic recommendations in relation to oral health, while dentists may lack expertise to advise on proper eating habits (*Ramos - Gomez et al., 2012*).

1.1. The aim and the tasks of the study

Aim of the study

To develop and to evaluate dental disease prevention program for pregnant women and their children.

Tasks of the study

1. To develop prevention program for pregnant mothers targeted at child's oral health.
2. To assess oral health of pregnant women determining DMF, plaque volumes and periodontal status, count of *Streptococcus mutans* and *Lactobacillus* in saliva, as well as to assess impact of these showings on a child's oral health.

3. To assess tooth brushing habits of pregnant women, as well as their knowledge about the future child's oral health.

4. To assess oral health of one-year old children of the study group, determining their dmf and volume of plaque.

5. To assess oral health of two year old children of the study group and the control group determining their dmf and volume of plaque, as well as to identify count of *Streptococcus mutans* and *Lactobacillus* in saliva of children and their mothers.

6. To evaluate and compare tooth brushing and eating habits of children in the study group and the control group.

7. To assess prevention program, evaluating and comparing intensity of caries among two-year old children.

8. Based on the results of the study and the scientific literature, to develop child's oral health passport and oral health guidance for pregnant women and young children.

1.2. Hypothesis of the study

Oral health status of pregnant women as well as their tooth brushing habits and knowledge on oral health maintenance of their future children affects development of caries and its intensity during the first two years of life.

Oral health status of two-year old children tends to improve, if the mother during her pregnancy participates in a prevention program.

1.3. Scientific novelty

The study involved the first in Latvia assessment of oral status of two-year children whose mothers participated in a specialized training on their own oral care and oral care of their future children.

There was compared oral health status of the study group and the control group and, based on the results obtained, there was developed a prevention program for pregnant women on mother's and her future child's proper oral care, as well as there was developed child's oral health passport and oral health guidance for pregnant women and young children.

2. MATERIALS AND METHODS

2.1. Study Design

The study “Prevention Program Development and Evaluation of the Advancement of Caries in Pregnant Women and their Children” was commenced in March 2010 and completed in May 2013. The study was conducted as case control study.

Selection of the study group: 85 pregnant women residing in Riga who voluntarily agreed to participate in the study “Prevention Program Development and Evaluation of the Advancement of Caries in Pregnant Women and their Children.” The study group was comprised of pregnant women free of any serious health issues. The study lasted until the children reached two years of age and resulted with 72 mother-children pairs remaining in the study.

Selection of the control group: the control group was comprised of 95 pairs of mothers and their two-year old children involved in no other prevention programs and residing in Riga. Out of 113 pairs of mothers and their two-year old children, 95 mother-child pairs were included in the control group. Exclusion criteria were related to general health problems of the mother or the child (such as prolonged use of medicines, chronic diseases such as asthma, etc.) or incompletely filled in questionnaire about the child’s oral care and dietary habits.

2.2. Oral Health Assessment

For the purpose of the oral health assessment, pregnant women underwent oral exams determining their DMF, CPITN and Silness – Løe index; the data obtained were registered in examination reports (*WHO Oral Health*

Assessment Form (1987). Saliva was investigated for the purpose of estimation of the count of *Streptococcus mutans* and *Lactobacilli*.

2.2.1. Assessment of Dental Status

Dental caries intensity of pregnant women was assessed using DMF index (number of decayed, missing and filled teeth), calculating DMFs (for surfaces) and DMFt (for teeth). Dental status of women of the study was assessed during their pregnancy and when the child reached two years of age. In the control group, DMF index of the mothers of two-year old children was assessed once.

Caries intensity of the children was estimated using dmf index (number of decayed, missed and filled teeth). For the children in the study group, the index was determined at ages one and two years. For the children in the control group, dmf index was determined at the age of two years.

2.2.2. Dental Plaque Assessment

Dental plaque was assessed by the Silness – Løe plaque index (*Silness et al.*, 1964). In pregnant women, soft and mineralized plaque built up on four surfaces (buccal, lingual, mesial and distal) of six teeth (dd 16, 12, 24, 36, 32, 44) was measured.

In order to calculate a woman's overall index, all indices were summed up and divided by a number of teeth examined.

For women of the study group, the plaque index was measured during their pregnancy and when their children reached two years of age. In the control group, the plaque index of the mothers of two year old children was measured once.

For children of the study group, plaque was measured at the age of one year and two years, during exam of all fully erupted teeth. For children of the

control group, plaque was assessed at the age of two years, during exam of all fully erupted teeth.

2.2.3. Periodontal Assessment

In order to assess periodontal status, the CPITN index (*Community Periodontal Index of Treatment Needs; WHO 1987*) was used. Periodontal status of women participating in the study was assessed during pregnancy and when their children reached two years of age. In the control group of mothers of two-year old children, periodontal index was determined once. For assessment of the CPITN index, the largest one of the six sextant readings was taken into account for each pregnant woman.

2.2.4. Examination and Assessment of Saliva

Saliva tests were performed for women in the study group during their pregnancy and when their children reached two years of age. In the control group, saliva of the mothers of two-year old children was examined once.

Saliva examination in children of the study group was performed at the age of one year and two years. For children in the control group, saliva examination was performed at the age two years.

2.3. Clinical Examination

The clinical examination was carried out on a dental chair with standard lighting and dental tools: a mirror, a probe and a calibrated button probe.

Later, when children reached one and two years of age, the mothers with their children were invited to arrive for re-examinations. For children at one year of age, there was measured dmf and plaque volume. For children of two

years of age, there was measured dental status and plaque volume. Saliva samples were taken from mothers and children for the count of *Streptococcus mutans* and *Lactobacilli*.

In mothers of the control group, dental status, volume of plaque and periodontal status was assessed. In two-year old children of the control group, dental status and volume of plaque was assessed. Saliva samples were taken from the mothers and the children for the count of *Streptococcus mutans* and *Lactobacilli*.

Exams of the patients both in the study group and the control group were executed by the author of the study.

2.4. Questionnaire Survey

Questionnaires were used in surveys of pregnant women as well as mothers of two-year children in order to assess their knowledge on oral health of the expected/two-year children, to learn their tooth-brushing habits and to gather information about their children's eating and drinking habits.

2.5. Description of the Prevention Program

Prevention program targeted at promotion and maintenance of a child's dental health was launched during the mother's pregnancy and consisted of three stages. Schematic representation of the prevention program shown in Figure 2.1.

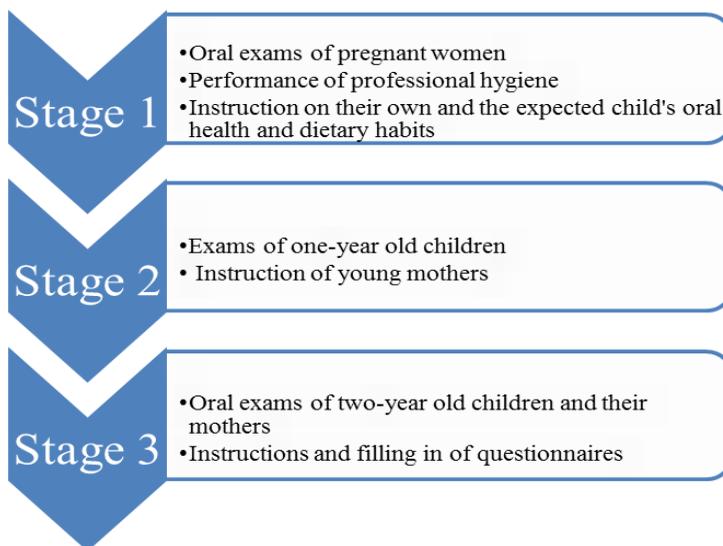


Figure 2.1. **Schematic representation of the prevention program**

2.6. Ethical Considerations of the Study

The study was confirmed by Riga Stradins University Ethics Committee. All interviews, questionnaires and clinical exams were performed in compliance with the Declaration of Helsinki (*The World Medical Association Declaration of Helsinki*). The study was conducted in compliance with provisions of laws of the Republic of Latvia concerning protection of personal data. All data were collected jointly with written informed consent of the participants of the study.

2.7. Data Statistical Analysis Methods

The database was created in Microsoft Office Excel. The analysis of data on pregnant women was carried out using descriptive statistical methods. Mean and standard deviation values were calculated for DMF and plaque index, as well as age. Frequency tables were used for description of periodontal

status. Distribution of severity of periodontal pathology was calculated for each quadrant separately and for an oral cavity as a whole. Frequency tables were used for description of results of questionnaires. Data compliance with the normal distribution was tested with histograms and the Kolmogorov-Smirnov test. In order to assess and to compare plaque volume and caries intensity depending on hygiene habits of pregnant women, as well as their knowledge about their own and the child's oral care, ANOVA single factor analysis of variance with Bonferroni post hoc test or t test for independent features, where data were in ratio scale, was used, while *Kruskal–Wallise* or *Mann-Whitney* tests were used for comparison of ranking scale data.

For analysis of data obtained from children of the study and the control group, descriptive and analytical statistical methods were used. Mean values and standard deviations were determined, as well as potential division into various groups of factors of interest. Indices were compared both between groups and within a group at different times. Depending on the data distribution correlation to normal distribution, parametric (t test, *Pearson* χ^2 or *Fisher's exact* test) and nonparametric (*Wilcoxon* or *Mann-Whitney* test) statistical analysis methods were used for the analysis. Threshold of statistical significance was chosen as $p < 0.05$.

Correlation between oral microflora (*Streptococcus mutans* and *Lactobacillus*) of the mother and the child was determined through calculation of *Spearman's* correlation coefficient.

3. RESULTS

3.1. Profile of pregnant women as a group and oral health indicators

The age of the pregnant women was 21 to 38 years (the average age was 29.6 years).

Caries intensity indicators – average DMFt 10.98 (SD = 4.32), DMFs = 23.44 (SD = 15.02). Silness-Löe index = 1.02 (SD = 0.48). The assessment of plaque showed that for 57% of the pregnant women the plaque index was less than one, which suggests good oral hygiene. The condition of periodont was assessed by CPITN index shown in figure 3.1. In assessing the CPITN index, the biggest of the six sextant indicators was taken into account for each pregnant woman. As a result, eighteen of the women were found bleeding gums, forty-four had scale and eight had gingival pockets of 4 - 5 mm. None of the pregnant women had a completely healthy periodont.

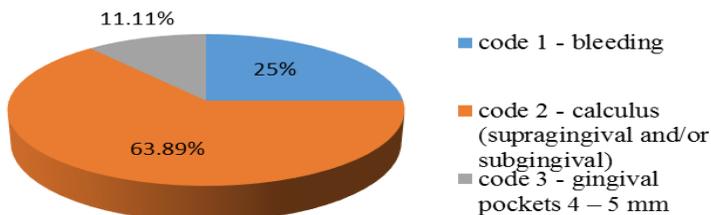


Figure 3.1. CPITN assessment of pregnant women

62.5% (n = 45) of the pregnant women pointed out that during the pregnancy their gums were bleeding more.

When analysing the amount of microorganisms in pregnant women's saliva, an increased SM level was found in 51% and increased LB level in 54% of the cases

3.2. Assessment of the pregnant women's tooth brushing habits

When analysing the pregnant women's tooth brushing habits, it was found that 75% (n = 54) of them brushed their teeth twice a day and 48.6% (n = 35) flossed their teeth daily. When brushing the teeth twice a day, the average Silness-Löe index (0.89; SD = 0.42) was considerably lower than when brushing the teeth less than twice a day ($p < 0.0005$).

When brushing the teeth twice a day, the average DMFt (10.21; SD = 4.42) is lower than when brushing the teeth more seldom (13.16; SD = 3.27) ($p < 0.01$).

When flossing the teeth daily, the average Silness-Löe index (0.65; SD = 0.27) is lower than when flossing the teeth irregularly (1.13; SD = 0.48) ($p < 0.0005$) or not flossing the teeth at all (1.38; SD = 0.36) ($p < 0.0005$), however there is no difference between irregular flossing and absence of flossing.

The level of SM and LB was higher for the pregnant women who brushed their teeth less than twice a day ($p < 0.01$) and who flossed their teeth irregularly ($p < 0.005$). The microbiological study conducted on these women when their child had reached the age of two showed that just 25% (n = 18) of the mothers had an increased level of SM and LB.

3.3. Comparison of the oral hygiene of the two-year olds in the study and control group.

The oral health indicators of the two-year olds in the study and control group are shown in table 3.1.

Table 3.1

Survey data of the two-year olds in the study group (SG) and control group (CG)

	SG	CG
Avg. dmf (SD)	0.33 (0.78)	1.42 (1.82)
Plaque index avg. (SD)	0.06 (0.10)	1.56 (0.68)
<i>Streptococcus mutans</i> % (n)	9.72 (7)	33.68 (32)
<i>Lactobacillus</i> % (n)	11.1 (8)	36.8 (35)

Dental caries indicators were higher in the control group. Just 47.36% (n = 45) of the children in the control group, compared to 81.9% (n = 59) in the study group, had no caries.

Similarly, also the dental caries distribution indicators for the two-year olds in the control group were higher than in the study group (52.63% compared to 18.06%). Together in the study and control group, the distribution of dental caries was 37.72%.

The assessment of the amount of microorganisms showed that an increased SM was more often observed with the children in the control group than in the study group (9.72% compared to 33.68%; $p < 0.001$). The SM in the mother moderately strongly correlated with the SM in the child both in the study group ($r^o - 0.57$; determinant ratio – 32.5%; $p < 0.001$) and in the control group ($r^o - 0.66$; determinant ratio – 43.6%; $p < 0.001$). Similarly, also an LB in the mother relatively strongly correlated with an LB in a child both in the study group ($r^o - 0.61$; determinant ratio – 37.2%; $p < 0.001$) and in the control group ($r^o - 0.71$; determinant ratio – 50.4%; $p < 0.001$).

3.4. Oral health indicators of the study group children in one and two years of age

The oral health indicators of the study group children in one and two years of age are shown in table 3.2.

Table 3.2

Oral health indicators of the study group children in one and two years of age

	1 year old	2 years old
dmf avg. (SD)	0.05 (0.23)	0.33 (0.78)
Plaque index avg. (SD)	0.05 (0.10)	0.06 (0.10)
<i>Streptococcus mutans</i> % (n)	6.94 (5)	9.72 (7)
<i>Lactobacillus</i> % (n)	6.94 (5)	11.1 (8)

Compared to one-year olds, in the age of two the dmf index had increased. Similarly, the distribution of SM and LB had grown.

3.5. Interrelation between dmf index and oral hygiene habits

The differences in the starting time and regularity of brushing teeth in the study and control group are shown in figure 3.1.

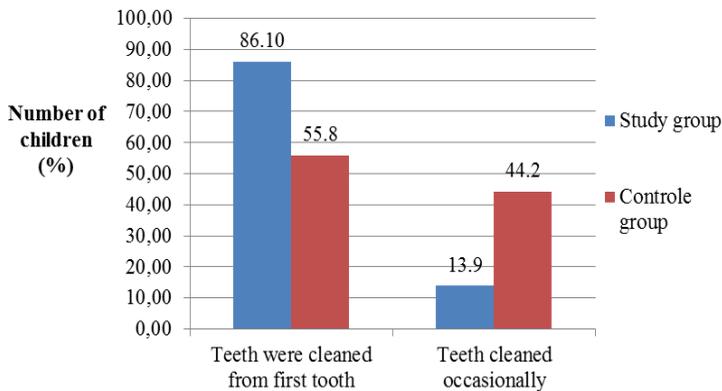


Figure 3.1. Differences in the starting time and regularity of brushing the teeth in the study and control group

In the study group more than in the control group teeth were more often brushed since the appearance of the first tooth and the proportion of the children whose teeth were brushed irregularly was smaller. A statistically

reliable correlation was observed ($p < 0.001$) between the beginning of teeth brushing and dmf index. That is, for the children where the brushing of the teeth was started since the appearance of the first tooth, dmf both in the study group (0.32) and in the control group (0.39) was lower than to the children whose teeth were brushed irregularly (the dmf in the study group was 0.4, in the control group = 2.71).

In both groups the dmf index was high for the children whose teeth were brushed irregularly by their parents, however, the increasing of the dmf index, compared to brushing teeth since the appearance of the first tooth, was smaller in the study group (regression ratio 1.7; $p < 0.0001$; 95% CI 1.27 – 2.15).

The earlier the toothpaste was applied the lower was the dmf index, see figure 3.2.

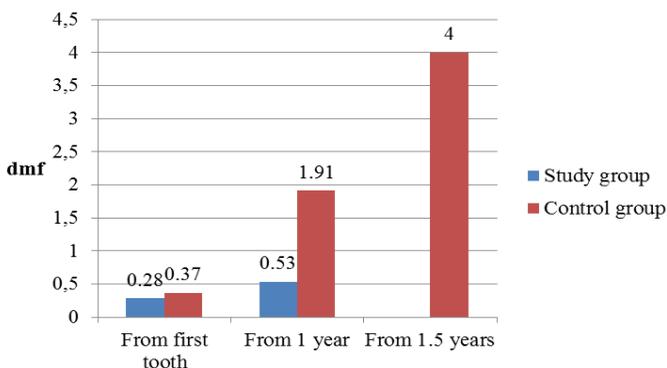


Figure 3.2. Value of dmf in relation to the age when the children started using toothpaste

In the age of two 63 (87.5%) children in the study group were using fluoride toothpaste and their dmf was 0.23. Nine children did not use fluoride toothpaste and their dmf was 1 ($p < 0.0018$). In the control group there were 65 (68.4%) children who used fluoride toothpaste and their dmf was 0.8, but the dmf of those who did not use fluoride toothpaste was 2.76 ($p < 0.0001$). The results of

the dispersion analysis suggested that there was a correlation between the dmf index and use of fluoride toothpaste (regression ratio 1.6; $p < 0.001$; 95% CI 1.15 – 2.11). Figure 3.3. shown regularity of teeth brushing and use of fluoride toothpaste.

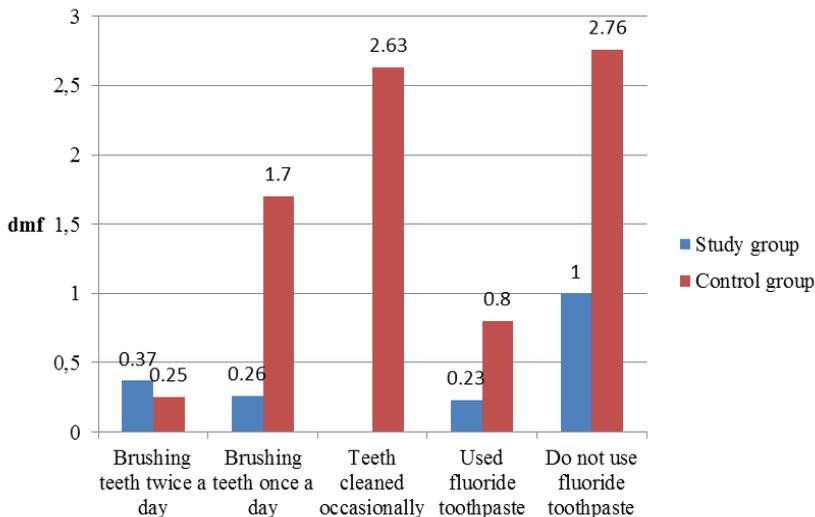


Figure 3.3. dmf depending on the regularity of teeth brushing and use of fluoride toothpaste

The answers to the question “Has your child attended a dentist?” showed that 18 children from the control group had attended a dentist at the age of one; 40 – at the age of 1.5 years and 37 two-year olds had not attended a dentist yet. The earlier the child had attended a dentist, the lower was his dmf index and the differences between the groups were statistically reliable ($p < 0.0004$), see figure 3.4.

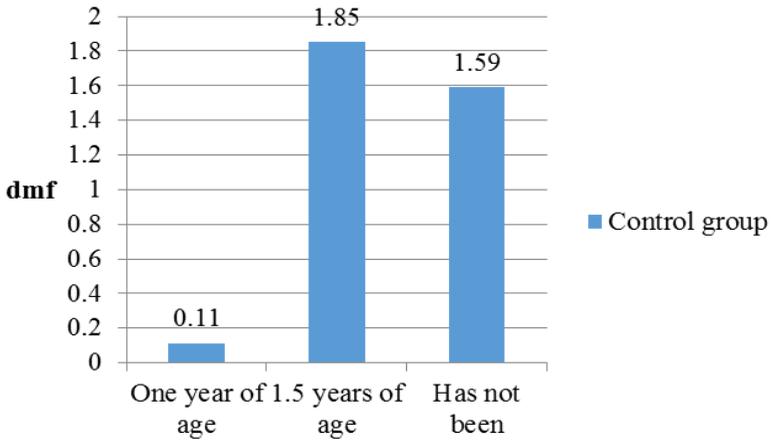


Figure 3.4. **dmf of two-year olds depending on their first visit to a dentist**

3.6. Relation between plaque indicators and oral hygiene habits

The evaluation of the tooth brushing habits of two-year olds and the volume of plaque suggested several regularities. In the study group there were 62 children whose teeth had been brushed by their parents since the first tooth appeared and their plaque was 0.05 (SD = 0.10), in the control group there were 53 such children with the average plaque 0.41 (SD = 0.36). The plaque indicators of the control group were higher than those of the study group ($p < 0.001$), see figure 3.5. The results of the dispersion analysis suggested that there was a correlation between the plaque index and the age (from the age of one) when tooth brushing was started (regression ratio = 0.34; $p < 0.001$; 95% CI 0.18 – 0.5).

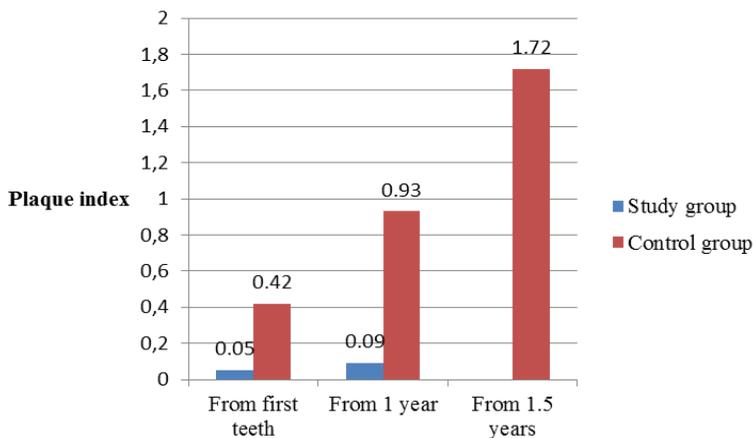


Figure 3.5. **Plaque index and the age when tooth brushing was started**

Forty-nine children from the study group who used fluoride toothpaste as the first one, had plaque index of 0.04 (SD = 0.07), in the control group there were 59 such children with plaque of 0.48 (SD = 0.6). 23 children of the study group who use non-fluoride toothpaste, showed plaque index 0.1 (SD = 0.14) and 36 children from the control group = 1.26 (SD = 0.57) ($p < 0.001$). The results of the dispersion analysis showed that there was a correlation between the plaque index and use of fluoride toothpaste (*regression ratio*- 0.49; $p < 0.001$; 95% CI 0.33 – 0.64).

The amount of plaque among the children of the control group differed depending of the first time attending a dentist ($p < 0.001$), see figure 3.6.

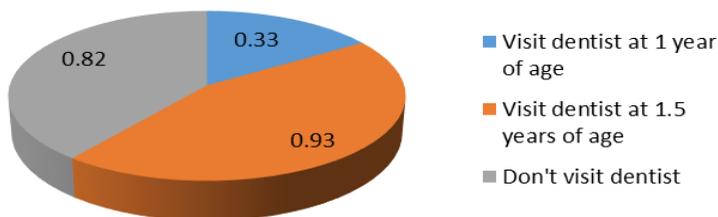


Figure 3.6. **Plaque indicators in relation to the time of attending a dentist**

3.7. Relation between the amount of microorganisms and oral hygiene habits

Table 3.4 shows the relation between oral hygiene habits and the amount of *Streptococcus mutans* and *Lactobacilli* in saliva of two-year olds. We must point out that neither in the study group, nor the control group there were children who brushed the teeth themselves or did not use toothpaste at all.

Table 3.3

Number of *Streptococcus mutans* and *Lactobacilli* in saliva in relation to teeth brushing habits

	Study group			Control group		
	n	Avg. SM (SD)	Avg. LB (SD)	n	Avg. SM (SD)	Avg. LB (SD)
1. At what age did you start to brush the child's teeth?						
1.1 Since the first tooth (in avg 6 months)	62	0.81 (0.27)	0.97 (0.3)	53	0.56 (0.23)	0.11 (0.32)
1.2 Sometimes when the child allowed to do that	10	0.2 (0.42)	0.2 (0.42)	42	0.69 (0.47)	0.69 (0.47)
2. At what age did the child start using toothpaste?						
2.1 Since the first tooth (in avg 6 months)	57	0.7 (0.25)	0.7 (0.25)	40	0.12 (0.33)	0.12 (0.33)
2.2 Since 1 year	15	0.2 (0.41)	0.26 (0.46)	48	0.45 (0.5)	0.52 (0.5)
2.3 Since 1.5 years	0	0	0	7	0.71 (0.49)	0.71 (0.49)
3. Did the child's first toothpaste contain fluoride?						
3.1 Yes	49	0.4 (0.19)	0.61 (0.24)	59	0.12 (0.32)	0.17 (0.38)
3.2 No	32	0.21 (0.42)	0.21 (0.42)	36	0.69 (0.47)	0.69 (0.47)
4. How many times a day are the child's teeth brushed and who does it?						
4.1 We brush the teeth twice a day under parents' supervision (parents rebrush)	45	0.8 (0.28)	0.11 (0.31)	33	0	0
4.2 We brush the teeth once a day under parents' supervision	27	0.11 (0.32)	0.11 (0.32)	30	0.33 (0.48)	0.43 (0.5)

4.3 Irregularly	0	0	0	32	0.69 (0.47)	0.69 (0.47)
5. Does the child use fluoride toothpaste?						
5.1 Yes	63	0.63 (0.25)	0.79 (0.27)	65	0.11 (0.32)	0.15 (0.36)
5.2 No	9	3.33 (0.5)	3.33 (0.5)	30	0.83 (0.38)	0.83 (0.38)

3.8. Results of surveying the eating habits of two-year olds and their relevance with the dmf value

The analysis of breastfeeding suggested several regularities, i.e., the children who were extensively breastfed had a higher dmf index, see table 3.5.

Table 3.4

Number of children and dmf value for two-year olds depending on the duration of breastfeeding

Time of breast-feeding	Study group		Control group	
	n	dmf	n	dmf
Until 6 months	12	0.66	14	0.85
Until 12 months	31	0.19	44	1.84
Until 1.5 years	20	0.25	23	1.73
Until 2 years	0	0.0	4	2.5

The dmf of the children in the control group who received formula at night until 1.5 years was 1.6 (n = 60). However, the children who used formula until 1 year of age had dmf of 0.5 (n = 16) ($p < 0.0001$). In the study group there were 35 children who received formula until 1.5 years old, their dmf was 0.34.

The analysis of the use of drinks at night until two years of age and dmf value showed a range of regularities. They are summarized in figure 3.7. 51 children drank just water at night, their dmf was 0.27. In the control group there were 50 such children with dmf 0.56. One child of the study group had

juice at night and his dmf was 1. In the control group there were 8 such children and their dmf was 3.25. 15 children in the study group drank tea without sugar in the study group and their dmf was 0.46; 18 children in the control group did the same and had dmf of 1.6. In the study group no children drank tea with sugar at night, however, in the control group 14 children did so and had dmf of 3. In the control group there were five children who had milk at night, their dmf was 2 ($p < 0.0001$).

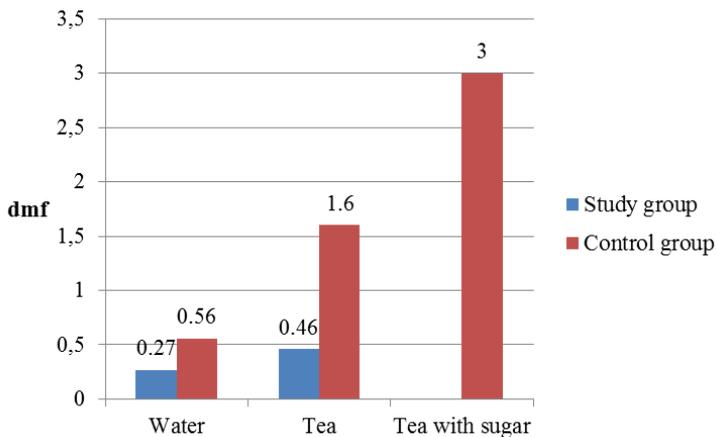


Figure 3.7. **Consumption of drinks at night and dmf value**

The analysis of the two-year olds drinking habits at night showed that water is consumed by 44.4% children of the study group and 35.8% of the control group. At night sweetened drinks were not used by any child in the study group, however, in the control group 35.7% ($p < 0.0001$) used them at night.

For the correlation of using sweets and dmf value see figure 3.8. In the study group 18 children used sweets every day, their dmf was 0.38. However, in the control group there were 35 such children with dmf of 2.74. 41 children of the study group used sweets once or twice a week, having dmf of 0.31 and

43 children in the control group did so having the dmf of 0.8. Very seldom (once in two weeks) sweets were used by 13 children in the study group, their dmf was 0.3. In the control group there were 17 such children whose dmf was 0.23 ($p < 0.0001$).

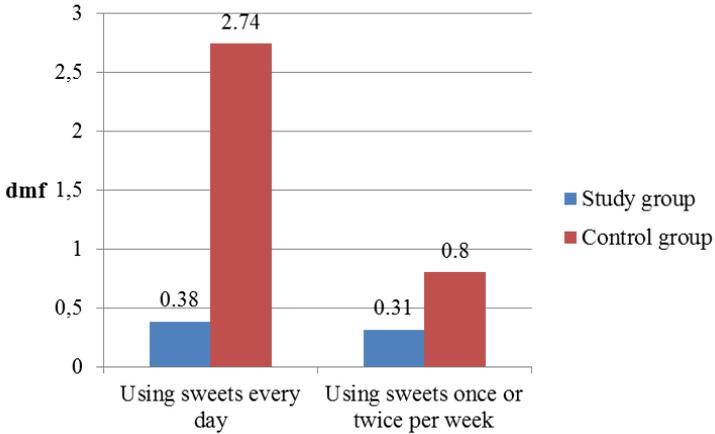


Figure 3.8. Habits of using sweets compared to the dmf value

From the analysis of the children’s eating habits concerning their preferences for fruit, vegetables or flour products, it was concluded that in the study group 33 (45.8%; dmf = 0.48) children preferred milk; in the control group 38 children (40%; dmf = 2) did so ($p < 0.0001$). Vegetables were preferred by 25 children in the study group (34.7%; dmf = 0.16) and 24 children in the control group (25.2%; dmf = 0.04). Bakery products were preferred by 8 children in the study group (11.2%; dmf = 0.5) and 16 children in the control group (16%; dmf = 2.31) ($p < 0.011$).

The analysis of whether the children were offered a store-bought food showed that in the study group 6 children (8.3%; dmf = 1.3) and in the control group 41 children (43.1%; dmf = 1.75) received store-bought food. In the study group 29 children did not use pre-made food (40.2%; dmf = 0.21) and in the

control group there were 24 such children (25.2%; dmf = 0.92) ($p < 0.039$). The number of children using various kinds of food in the study group was 37 (51.5%; dmf = 0.27) and in the control group 30 (31.7%; dmf = 1.36) ($p < 0.00013$).

3.9. Recommendations for the caries prevention programme

Based on the results of the research, it was concluded that pregnant women have insufficient knowledge about the oral hygiene of their forthcoming baby. The research showed that among the two-year olds whose mothers had received oral hygiene recommendations before they gave birth to their children, dental caries was less common than among the children from the control group. As a result, guidelines were created about the oral health of pregnant women and small children and “Child’s oral health passport”.

4. DISCUSSION

Early childhood caries is the most common disease among children, however, it can be avoided with the help of preventive measures. Caries is a multifactor disease that comprises several risk factors, such as plaque, pathogenic microorganisms, diet features, teeth brushing skills and, to the author's mind the most important, parents' knowledge about their own and their child's oral hygiene.

Despite the fact that caries can be easily treated with preventive measures, its distribution is very high (*Petti*, 2010). The research conducted in the kindergartens of Riga showed that among 2 – 3 olds dental caries was present in 30% of cases (*Skrīvele et al.*, 2010). Other researches regarding the teeth condition of children found high distribution of dental caries among two-year olds – 17.3 – 20.3% (*Bērziņa et al.*, 2008) and 48% dental caries prevalence among four to six year olds (*Henkuzena et al.*, 2004). In 2000 Henkuzena together with a group of authors studied 638 children in the kindergartens of Riga. The authors concluded that the distribution of dental caries among two-year olds was 20%, three-year olds – 36% and five-year olds – 50%. The two-year olds' DMF was 0.7 (*Henkuzena et al.*, 2004). In 2010 Skrīvele and co-authors published data where the average dmf of the examined 290 children at the age of two and three years was 1.53 (*Skrīvele, et al.*, 2010). It is difficult to compare the research conducted by various authors regarding the intensity and distribution of dental caries because the studies have been conducted in different years and the researchers have not been calibrated among themselves; neither have x-rays been made that might have changed the research results.

In the recent years increasingly more scholars and practitioner dentists address non-invasive treatment of dental caries where the disease is treated with preventive measures already at the initial stages of demineralization to prevent

its development. (Featherstone, 2004; Fontana et al., 2006; Plutzer et al., 2012).

4.1. Effect of the oral condition of pregnant women on the forthcoming child

Research suggests that early childhood caries is common both in the developed and developing world (Gussy et al., 2006) and it is connected with the pregnant women's oral health and their knowledge about the child's oral hygiene. (Günay et al., 1998; Medeiros et al., 2015). Research shows that the starting of the childhood prevention programme during pregnancy lowers the risk for the child to get infected with *Streptococcus mutans* and the intensity of dental caries (Günay et al., 1998; Plutzer et al., 2012). The research conducted in Latvia about early childhood dental caries shows that there is high distribution of dental caries in Latvia and it is connected with the poor social and economic conditions as well as lack of parents' awareness about a child's oral hygiene and diet (Henkuzena et al., 2004).

The study conducted in Kaunas indicated that 93.03% of pregnant women have periodontal diseases (Vasiliauskiene, 2003). The data from this study suggest that no pregnant woman had a healthy periodont.

Dental caries is caused by *Streptococcus mutans* which most often is transmitted from the mother's mouth. The mothers with a high *Streptococcus mutans* level are more likely to infect their child by tasting the child's food or sharing food with the child (Bertkowitz, 1985; Bertkowitz, 2003). In our research 51% of the pregnant women had an increased level of *Streptococcus mutans* which indicates insufficient oral hygiene of these women and raises the risk of transmitting the microorganisms to a child. An increased level of *Lactobacilli* was found to 54% of the pregnant women which suggests the insufficiency of their diet.

Statistically significant differences indicate that the pregnant women, who brushed their teeth twice a day and flossed them regularly, had a lower DMF, plaque index and the levels of *Streptococcus mutans* and *Lactobacilli*.

The only study in Latvia about the oral health condition of pregnant women was conducted in 1989. It showed that the distribution of dental caries among the pregnant women of various age groups was 100%, there were high plaque indices (13.74) and they had a tendency to increase still more in late stages of pregnancy (13.98). The author conducted the pregnant women awareness-raising activities about brushing teeth, treated their teeth with a fluoride varnish and remineralizing substances. As a result, the PMA index (papillary-marginal-alveolar index) decreased from 2.9 to 2.5 (Butāne, 1989).

Only 33% of the pregnant women knew that the child should not be given sweetened drinks in the evening and at night. The results of the survey indicated that pregnant women had insufficient knowledge about the dental hygiene of their forthcoming children. Such conclusions have also been made by other researchers (Günay *et al.*, 1998; Dimitrova *et al.*, 2009).

4.2. Assessment of the oral health of two-year olds

When studying the dental caries microflora, most attention was paid to *Streptococcus mutans* which already in 1924 was described by Clark, who isolated the above-mentioned microorganism from a decayed cavity (Clark, 1924). The study “Oral health and *Streptococcus mutans* in small children in kindergartens of Riga” conducted in Latvia by Simona Skrīvele showed that 15.5% of the children had an increased level of *Streptococcus mutans* (Skrīvele *et al.*, 2010).

The assessment of the saliva of the two-year olds of both groups during our research showed that 23.35% of the children had an increased level of microorganisms in their saliva. A baby receives *Streptococcus mutans* from her

parents (Caufield *et al.*, 1993, Warren *et al.*, 2009). It has been proved that 30% of children until six months old are infected with *Streptococcus mutans* (Wan *et al.*, 2003). Most often the child gets *Streptococcus mutans* from her mother (Bertkowitz, 2006). In 95% of cases the child has the same *Streptococcus mutans* serotype as her mother (Bertkowitz *et al.*, 1985). Consequently, during the research it was important to determine the amount of microorganisms in the study group – initially for the pregnant women and afterwards both the women and children. It must be pointed out that during the research *Streptococcus mutans* decreased in the saliva from being present in 51% of the pregnant women to 25% of mothers with two-year old children. Thus, it can be concluded that the information provided to pregnant women had improved their oral health. Several scholars have found that the amount of pathogenic microorganisms in saliva can be reduced by professional oral hygiene, improving daily dental hygiene, diet adjustments and local use of fluorides (Sanchit *et al.*, 2014).

4.3. Assessment of the eating habits of two-year olds

Diet has an important role in the development of dental caries, particularly in relation to young children. The parents must be aware what and how often they feed to their child. As early as 1902 Miller published his report on how the fermentable carbohydrates facilitate the development of dental caries (Miller, 1902). Weiss and Trihart proved the connection between the development of dental caries and regular use of sugar-containing products between meals (Weiss, 1960). Extended breastfeeding is also connected with the development of the early childhood caries (Kramer *et al.*, 2007). The reports published in 2012 and 2014 showed that breastfeeding if it lasts longer than 18 months may be related to teeth decay (Tanaka *et al.*, 2012). In the research hereby 63 children in the study group and 85 children in the control

group were breastfed. The big spread in the dmf index in groups can be explained by the fact that mothers in the study group followed a feeding and teeth brushing regime. Mother's milk is not considered cariogenic; however it contains lactases that serves as a nutrient to the cariogenic bacteria. (*Curzon et al.*, 2004). The American Academy of Pediatric Dentistry recommends breastfeeding until age one and breastfeeding at night must be stopped when the first milk tooth has sprouted. (*Johansson et al.*, 2010). The results of the research showed the correlation of the length of breastfeeding with the development of dental caries: in the control group there were four children who were breastfed until the age of two and they have higher dmf index.

However, the report published in 2012 concluded that extended breastfeeding did not provide for the teeth decay. The authors of the report attributed the development of caries to the role of the rest of the diet and insufficient brushing of teeth. (*Nunes et al.*, 2012). In order to unanimously conclude if extensive breastfeeding has promoted the development of caries, every children's situation must be assessed individually by analysing her eating, drinking and tooth brushing habits as well as the oral health of their parents or caregivers.

The development of caries is facilitated by the use of such cariogenic diet as sweetened milk, fruit juices, ready-bought teas or self-made teas with sugar. When drinking from a bottle or sucking the nipple, the sweetened liquid gets on the front teeth of the upper jaw from the side of the palate (the demineralization process starts), where first develops demineralization and later caries takes over all the tooth neck. (*Stevens et al.*, 2004).

The research published by Azevedo in 2005 confirmed that the use of bottles with sweetened drinks at night increases the child's risk of developing caries. Similar conclusions have been derived by other researchers. (*Azevedo et al.*, 2005; *Nunes et al.*, 2012). Our research proved that children who drunk pure water from a bottle at night had low dmf index. In the study group no child

drank tea with sugar at night. It is important in due time to provide parents with the information on giving drinks to children at night because later many parents are unable to change the habit. It was also indicated by the study published in 2004. Even if mothers have been explained that the cause of caries development in children is the use of sweetened drink bottles at night, 40% of mothers continue giving their child a bottle at night. The mothers explain this kind of behaviour with unwillingness to disturb children's sleep (*Stevens et al.*, 2004).

Our research showed that the frequency and time of using sweets had an important role in the development of dental caries.

The book "Primary prevention in dentistry" published in 1982 described the research by Gravite and Grjunbergs which had covered 13 kindergartens of Riga and examined 617 children in the age between two and six years. The authors concluded that the distribution of dental caries among the two-year olds was 47.8% (*Pohomovs*, 1982).

4.4. Assessment of the teeth hygiene habits of two-year olds

Regular brushing of teeth and use of fluoride toothpaste has a big importance in the prevention of caries (*Ten Cate*, 2013). The research data suggest that in both groups it was observed that for the children whose parents brushed their teeth with toothpaste since the sprouting of the first tooth dmf index was lower.

The effectiveness of tooth brushing with fluoride toothpaste since long has been unquestionable (*Tinanoff et al.*, 2009). In the article published in 2014 Wright and co-authors concluded that children must be brushed their teeth with fluoride toothpaste because it reduces the dental caries risk. To escape fluorosis the amount of toothpaste used for each tooth brushing time must not exceed the

size of a pea (*Wright et al.*, 2014). The research results indicated that it was important for the child's first toothpaste to contain fluoride. We must point out that the parents of the study group children were instructed how to brush their children's teeth correctly and how often it must be done therefore the children's dmf index was not so high. The clinical research conducted in the world shows that brushing teeth with fluoride toothpaste reduces the development of caries. To avoid fluorosis, a child until two years of age may safely use a fluoride toothpaste in the thickness of a thin layer. (*Tinanoff et al.*, 2009).

4.5. Assessment of the prevention programme for two-year olds

Knowing that caries is a multifactor disease several factors must be taken into account to prevent it. What concerns early childhood caries it is important to start the prevention still during the pregnancy. The conducted research showed that the average dmf of the children, whose mothers were provided with recommendations during their pregnancies, was lower. Possibly, the dmf index of the study group children would have been still lower if their mothers had right after the child's birth received the child's oral health passport.

It must be mentioned here that the prevention programme would have failed if the involved pregnant women had not been motivated. The pregnant woman is interested in the oral health of her forthcoming child. In the conducted research the consultation with every participating woman took place individually, thus the women could ask various questions they were interested in and receive thorough answers. Such motivating consultations could provide for the best results. The research by Heinz published in 2010 showed that motivating individually is a preventive measure that could decrease the development of early childhood dental caries. The results of the research

showed that among the children whose mothers had received individual consultations and who had had regular teeth examinations (once in six months) there was lower distribution of caries than among the children whose mothers had received written information and watched a video recording (*Heinz, 2010*).

5. CONCLUSIONS

1. The developed prevention program reduces caries development and improves oral health of pregnant women and their children.
2. Caries intensity in pregnant women is high, oral hygiene and knowledge of the future child's oral hygiene measures are inadequate. Poor oral health status of a pregnant woman increases the risk of the child's caries.
3. Pregnant women have inadequate tooth brushing habits and they require additional information about care of their own and the future child's mouth.
4. DMF, plaque index and SM and LB levels increased in children of the study group when compared these showings at the age of one year and two years.
5. Caries prevalence, plaque volume and levels of microorganisms in saliva of two-year old children were higher in the control group than in children whose mothers participated in the prevention program.
6. Children whose mothers participated in the prevention program showed better tooth brushing and eating habits.
7. Based on the results of the study and the scientific literature, there was developed an oral health passport for children and dental guidance for pregnant women and their young children.
8. Parents in Latvia must be equipped with their child's oral health passport to provide them with a follow-up on their child's dental health.

6. PUBLICATIONS AND PRESENTATIONS

6.1. International publications

1. Rendeniece I., Brinkmane A., Care R. The effect of dental prevention program for pregnant women on oral health of two-year children // accepted for examination Stomatologija, Baltic Dental and Maxillofacial Journal.
2. Rendeniece I, Brinkmane A, Care R, Kalniņa J, Kadiķe K. The eating habits of two-year-old children and caries development // accepted for examination Caries Research.
3. Maldupa I, Brinkmane A, Rendeniece I, Mihailova A. Evidence based toothpaste classification, according to certain characteristics of their chemical composition // Stomatologija, Baltic Dental and Maxillofacial Journal, 2012; 1: 12–22.
4. Maldupa I, Brinkmane A, Mihailova A, Rendeniece I. The impact of dental restorations quality on caries risk. 3rd International Interdisciplinary Scientific Conference SOCIETY. HEALTH. WELFARE. SHS Web of Conferences. Proceeding. 2012; 2:00019.

6.2. Publication in RSU Research Articles

1. Rendeniece I, Brinkmane A, Care R, Kalniņa J. Grūtnieču mutes dobuma veselības novērtējums, zināšanas par bērna zobu profilaksi un jaunākajām ārstēšanas iespējām // RSU Research Articles, 2012; 2: 145–150.
2. Kalniņa J, Care R, Rendeniece I. Ozona terapija kariesa ārstēšanā bērniem // RSU Research Articles, 2012; 2: 151–156.

6.3. Thesis and presentations

1. Rendeniece I, Brinkmane A, Care R, Jeļisejeva I. Zobu tīrīšanas ieradumu ietekme uz divgadīgo bērnu mutes dobuma veselību. Annual RSU Scientific Conference, Riga, Latvia, 2015, March 26 - 27, thesis, 92.p. and presentation.
2. Rendeniece I, Care R, Brinkmane A, Krasone K. Effect of oral health program during pregnancy on oral health of two years old children. 12th European Academy of Pediatric dentists congress Sopot, Poland, 2014., June 5 – 8, thesis 38.p. and presentation.
3. Rendeniece I, Brinkmane A, Care R. Assesment of oral health status of pregnant women, knowlwdge of dhilds dental care and new treatment options // Stomatologija, Baltic Dental and Maxiilofacial Journal, 2012; thesis 14(8): 37. p. and presentation.

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