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Risk factors associated with early childhood caries in autonomous province of Vojvodina, Republic of Serbia

Faktori rizika od nastanka karijesa u ranom detinjstvu u autonomnoj pokrajini Vojvodini, Republika Srbija

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Abstract

Background/Aim. Early childhood caries (ECC) is still unexplored in Vojvodina an autonomous province of the Republic of Serbia. The aim of this study was to determine its prevalence in preschoolers and to define the risk factors that affect the prevalence of this disease. **Methods.** The survey was designed as a cross-sectional analytical study of preschool children in the region of Vojvodina, the Republic of Serbia. Sample type has been projected as a systematic sample and contained both parents and their children from 13 to 71 months of age. The study was designed with a dental examination of children and self-administered questionnaire which included: gender of children, self-referred socioeconomic status, parental education, oral status and health information level about parents and their child, child oral hygiene habits, type of feeding during infancy, consumption of sweets, and use of medical syrups. The data was further analyzed using the SPSS for Windows Microsoft Excel, version 21. The percentage of caries-free children was compared using χ^2 test; one way ANOVA was used to compare the mean disease indices at the 5% level of significance. Categorical variables were compared for statistical difference across groups using contingency χ^2 tests together with multinomial logistic regression modeling regarding the predictive model for ECC prevention. **Results.** The case group involved 452 (52.44%) males and 410 (47.56%) females. The prevalence of ECC in children 13-71 months old was 46.64%. Logistic regression model showed that those children who used sweets between meals, were more likely to have ECC (OR = 181.16; 95%, CI = 84.29–389.34), as well as those who used medical syrups more than five times a year in comparison to those who never used medicines (OR = 8.08; 95% CI = 3.78–17.27), among parents with poor oral status (OR = 3.09; 95% CI = 1.65–5.79) and low health informed parents (OR = 217.57; 95% CI = 84.46–560.50). **Conclusion.** This study suggests an association between the examined risk factors and high ECC prevalence in preschool children in Vojvodina.

Keywords:
dental caries; prevalence; risk factors; child, preschool; parents; surveys and questionnaires; food habits; oral hygiene.

Apstrakt

Uvod/Cilj: Karijes u ranom detinjstvu (KRD) još uvek nije istražen u Vojvodini autonomnoj pokrajini Republike Srbije. Cilj našeg istraživanja bio je da se odredi prevalencija KRD kod predškolske dece i definišu faktori rizika koji utiču na rasprostranjenost ovog oboljenja. **Metode.** Istraživanje je sprovedeno kao analitička studija preseka kod predškolske dece u Vojvodini. Projektovan je sistematski uzorak, koji je obuhvatio roditelje i njihovu decu uzrasta od 13 do 71 mesec. Istraživanje je dizajnirano kao stomatološki pregled deteta, tokom kojeg je sproveden intervju sa roditeljima. Anketni upitnik sadržao je varijable: pol deteta, socioekonomski status porodice, nivo obrazovanja i zdravstvene obaveštenosti roditelja, oralni status roditelja i deteta, oralno-higijenske navike kod dece, način ishrane, učestalost konzumacije slatke hrane i upotreba medicinskih sirupa u toku ranog detinjstva. Statistička obrada podataka je sprovedena primenom statističkog paketa SPSS *for Windows Microsoft Excel,* verzija 21. Proveravana je značajnost utvrđenih razlika između frekvencija nezavisnih varijabli kod dece bez karijesa putem χ^2 testa, a jednosmerna analiza varijanse (ANOVA) korišćena je radi utvrđivanja značajnosti razlika parametrijskih obeležja (za oba testa nivo značajnosti $p < 0,05$ smatran je statistički značajnim). Proveravana je statistička značajnost razlika između proporcija različitih kategorija opisnih obeležja primenom neparametrijskog, univarijantnog testa (χ^2 test), a potom su putem multivarijantne logističke regresije generisani statistički modeli predikcije faktora koji mogu doprineti prevenciji KRD. **Rezultati.** Uzorak je

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obuhvatio 452 (52,44%) dečaka i 410 (47,56%) devojčica. Prevalencija KRD iznosila je 46,64%. Logističkim regresionim modelom neđeno je da su češće obolevala deca koja su uzimala slatkiše između obroka (OR = 181,16; 95%, CI = 84,29–389,34), koristila medicinske sirupe više od pet puta godišnje (OR = 8,08; 95% CI = 3,78–17,27), kao i deca roditelja lošeg oralnog statusa (OR = 3,09; 95% CI = 1,65–5,79) i niske zdravstvene obaveštenosti (OR = 217,57; 95% CI = 84,46–560,50). **Zaključak.** Ovom studijom je utvrđena povezanost ispitivanih faktora rizika i visoke prevalencije KRD kod predškolske dece u Vojvodini.

Ključne reči:
zub, karijes; prevalenca; faktori rizika; deca, predškolska; roditelji; ankete i upitinici; ishrana, navike; usta, higijena.

Introduction

Epidemiological studies in the world [1] and in Serbia as well, clearly indicate high trend rate of the early childhood caries (ECC), especially in socially disadvantaged, economically challenged society with poorly health informed parents and their children mainly from the rural environments, who did not understand the official language in the country where they live [2]. Moreover, it is very important to point out that ECC has with no doubt, multifactor etiology but it is still very difficult to present with assurance the reason for its appearance. The American Academy of Paediatric Dentists (AAPD) defined ECC as "the presence of one or more decayed, missing or filled tooth surfaces in any primary tooth in children 71 months of age and younger" [3]. This is a special form of caries of the primary dentition that affects the teeth after the eruption, and it has a rapid progression resulting in a number of symptoms and complications. ECC begins with white-spot lesions in the upper primary incisors along the margin of the gums. If the disease continues, caries can progress, leading to complete destruction of the crown [4]. The upper incisors are most vulnerable, while the mandible incisors are protected by the tongue and by saliva from submandibular and sublingual glands. ECC affects three aspects of daily living, namely systemic health, body weight and growth and quality of life [5]. The specific problem which needs to be especially emphasized is the early age of its appearance and significant negative influence on children's overall health. If ECC is left untreated it can lead to pain, acute infections, nutritional insufficiencies, speech problems and affect the growth and maturation of the permanent dentition. Infants with ECC grow at a slower pace than caries-free infants. Some young children with ECC may be severely underweight because of associated great degree of pain and suffering which is proven to have an impact on general health factors such as child weight, together with their obvious disinclination to eat [6]. Published studies showed higher ECC prevalence figures for 3-year-olds that ranged from 36% to 85% in the Far East Asia region [7], whereas that figure was 45.33% in the East Indian studies [8]. In England, the United States of America and Canada's North, the prevalence of ECC has been documented to vary between 7.0%, 12.0% and from 28% to 98.9%, respectively [9]. Researchers have attempted to expand basic microbiological models for ECC development and to include various social, demographic and behavioral factors such as ethnicity, family income, maternal education level, family status and parental knowledge [10]. Current evidence suggests that use of a sugar-containing liquid in a bottle at night may be an important but not necessarily the only etiological factor. Consequently, today is still a very complex task to determine the precise risk factors for ECC and the unique model for its prevention in regard to the numerous predisposed biological, socioeconomic, cultural, psychosocial and other factors that dictate and interlace with each other. There is a need for serious medical and social researching including sophistically software systems for data evaluation – Synthetic Minority Over-Sampling Technique (SMOTE) classification algorithm [11], support vector machines (SVM), logistic model tree (LMT), Data Mining classification and regression tree (CART) analysis [12], to find out which etiological factors are associated with ECC and its different clinical manifestation. Caries prediction has always been a challenge for both clinicians and researchers. The multifactor nature of the disease necessitates the evaluation and combination of multiple factors 13. ECC remains of particular scientific concern because of its devastating nature, rapid progression and mainly missed public health opportunities for its successful prevention, especially in some socially closed and disadvantaged groups in both developed and developing countries, with Serbia being no exception. In Vojvodina as part of the Republic of Serbia, ECC still has an increasing prevalence rate. The reason for that we can, unfortunately, find firstly, in poverty progression trend of the population, especially in some minority groups than in therapeutic approach to disease treatment and furthermore in specific presence of diverse ethnicities, languages, cultures and social structures, that may be risk factors that are unique to the youngest population in this region [2]. The aim of this study was to estimate the prevalence of ECC in preschool children living in the region of the Republic of Serbia, Vojvodina, to evaluate the correlation of several social and behavioral factors associated with ECC prevalence, and to define a predictive model for ECC.

Methods

Study sample

Vojvodina is an autonomous province of Serbia, located in the northern part of the country, and has a population of approximately 2 million. It has a multiethnic and multicultural identity. In addition to the multiethnic and multicultural characteristics of this region, there are also differences in the education, personal income and unemployment rates in this population. Assessing the presence of these variables is important in determining the correlation between the outlined

demographic, educational and socioeconomic factors and the prevalence of ECC in toddler and preschool children. The fluoride concentration in drinking water is generally low (< 0.3 ppm). The study was conducted from November 2014 to May 2015. The survey was designed as a cross-sectional analytical study of preschool children in Vojvodina. Sample type has been projected as a systematic sample and contained both parents and their children from 13 to 71 months old, of different gender, social status, and nationality (Serbian, Hungarian, Slovak, Russian, Roma etc.). The estimated age of a child was the age at the time of the examination. The dental survey comprised, and recorded within the case file, 862 children and the questionnaire has comprised 1,724 of their parents. The multi-grade type sample (systematic sample) was elected in survey unit definition, which comprised 10% of children of the target population and, as a step of choice the following formula:

k = N/n (k = step of choice; n = number of units within sample; N = number of units in the basic set).

The number of units in the basic set (N) was determined by records of preschool institutions within certain municipalities of the Vojvodina on the number of enrolled children in the 2014/15 school year; a share of 10% of children was established which reflected the number of units within the sample (n). By implementing the step of choice (k), based on the records of the preschool institutions, units for the sample were defined. Parents of all eligible children were informed in writing about the study objectives and invited to participate. The duration of the study was 5 months. In the first stage, the parents were given specially designed questionnaire written in official (Serbian) and minority languages, with the personal data of parents and each child separately. The questionnaire was made up of 64 closed types of questions concerning ethnicity, demographic features and socioeconomic status of the family, knowledge, attitudes and habits of parents concerning diet, oral hygiene, fluoride prophylaxis, behavior towards the oral as well as general health. It also included questions about the importance of preventive measures concerning the parents' health values, as well as questions about the sources of information and their indices on the oral health of children and their parents. The health information level of parents was evaluated with the answers connected with: child's diet, the oral hygiene and fluoride prophylaxis, dental visits, the use of medical and vitamin syrups, diet, oral hygiene and fluoride use during pregnancy, the attitudes concerning oral health, the source of information concerning oral health etc. According to the number of the correct answers the estimation was done about the health information of parents to the following groups: not informed, average informed and well informed. After getting the parents' consent, the second phase was performed, i.e. dental check-ups of children and evidence of the prevalence of ECC. The dental examinations were conducted by a single well-trained and calibrated dentist. The youngest group of children, 13–24 months old, were examined by a visual, non-tactile method, referred to as a "lift the lip" technique. The examiner lifted the upper lip of every child to check up the four maxillary primary incisors and two canines for presence and severity of ECC. All other children were examined with plane dental mirror and probe, using natural light, without previous brushing and drying teeth. Exams were performed in the kindergarten nursing room, except for children that lived in disadvantaged settlements, and who were examined "in the open air". All primary teeth were examined and caries was recorded using World Health Organization, recognized indices of decayed, missing, and filled teeth and surfaces, decayed, missing, and filled teeth (DMFT) and decayed, missing, filled tooth surfaces (DMFS) respectively. Regarding the numerous divisions, the authors decided to use Wine modification by Drury classification, which included: caries lesions on the maxillary incisors and canines with molars being present or not and the lower incisors appearing healthy [14]. The teeth that did not fully erupt or congenitally missing teeth were excluded from the dmft, and dmfs scores. Incomplete data from the parents` questionnaire and/or data on children which could not have been examined were excluded from the following evaluation and statistic analysis.

Pilot Study

The questionnaire, the study design, and the obtained data were initially tested in a pilot study. It included by random selection the preschool children from the kindergarten "Little Bee" in Novi Sad and their parents from different socioeconomic background and nationality. ECC was found in 28 (26.92%) of 104 examined preschool children. The highest disease frequency was found in male children, who didn't speak the Serbian language, in children of part-time employed parents, who had secondary education and were poorly informed about oral health.

This study was approved by Committee on Human Research of the Medical Faculty of Novi Sad, process number: 1206/07. Children were examined after a written consent signed by their parents. All identifiable personal information was adequately disguised in the data in order to preserve the anonymity of the individuals involved.

Statistical analysis

The obtained clinical and questionnaire data were further analyzed using the SPSS for Windows Microsoft Excel, version 21. Descriptive statistics were calculated to determine the percentage caries-free children, mean caries disease severity indices (dmft, dmfs) and the standard deviations of the mean for each variable investigated. The percentage of caries-free children were compared using χ^2 test, and one-way ANOVA was used to compare the mean disease indices at the 5% level of significance. Categorical variables were compared for statistical difference across groups using contingency χ^2 tests together with multinomial logistic regression modeling regarding the predictive model for ECC prevention.

Results

In total 862 children, 13-71 months old were examined, 452 (52.44%) boys and 410 (47.56%) girls, mean age 3.41

year (95% CI = 3.34–3.48 year) and prevalence of ECC was 46.64%. Out of those examined 460 (53.36%) were caries-free. In the maxillary inter-canine section 3,614 deciduous teeth were healthy, 1,514 were decayed, 7 extracted and 32 were filled. Every child had on average 1.81 decayed teeth (dmft) and 3.68 decayed tooth surfaces (dmfs). The basic demographic factors that are linking the social environment and caries prevalence in the early childhood (ECC) are presenting in Table 1. There is statistically significant difference (χ^2 test) in ECC prevalence between male children (56.5%) in relation to female ones (43.5%, $p = 0.027$). The boys had higher ECC frequency comparing to the girls. The third and next born child in the family had a higher probability for ECC (17.7%, $p = 0.023$) in relation to the first and second born child. The statistically significant higher ECC frequency was found in children who were not breastfed or in children who were breastfed more than 12 months (47.3%, $p = 0.000$), or in children who have used a baby bottle with pacifier from birth (51.2%, $p = 0.009$). Our study also showed the significant association between child's dietary habits and ECC prevalence. The low ECC prevalence was observed in children who use food that was not additionally sweetened (25.6%, $p = 0.000$), and in children who did not take sweets (8.0%, $p = 0.000$). The influence of the parent's socioeconomic factors and their oral health status on the ECC prevalence was presented in Table 2. The highest prevalence of ECC was found in children of unemployed parents (29.1%, $p = 0.004$), who had only elementary education (9.7%, $p = 0.025$), and in parents who had an income less than 300.00 € *per* month (29.6%, $p = 0.001$), and parents

Table 1

Influence of child's socioeconomic factors and dietary habits on early childhood caries (ECC) prevalence

Parameter	Children with ECC n (%)	Caries free children n (%)	Subtotal n (%)	Total n (%)	*p*
Sex of the child					
male	227 (50.2)	225 (49.8)	452 (52.4)	862 (100.0)	0.027
female	175 (42.7)	235 (57.3)	410 (47.6)		
Child order in family					
first, second	331 (45.0)	404 (55.0)	735 (85.3)	862 (100.0)	0.023
all others	71 (55.9)	56 (44.1)	127 (14.7)		
History of breastfeeding					
never breastfed or breast feeding after 12 months	190 (55.2)	154 (44.8)	344 (39.9)	862 (100.0)	0.000
6–12 months breastfeeding	212 (40.9)	306 (59.1)	518 (60.1)		
Bottle nursing					
never use of bottle	196 (42.5)	265 (57.5)	461 (53.5)	862 (100.0)	0.009
bottle feeding from birth	206 (51.4)	195 (48.6)	401 (46.5)		
Additional sweeten of food					
never	103 (25.1)	308 (74.9)	411 (47.7)	862 (100.0)	0.000
every day	299 (66.3)	152 (33.7)	451 (52.3)		
Use of sweets					
never use sweets or with meals	32 (8.2)	356 (91.8)	388 (45.0)	862 (100.0)	0.000
use of sweets between meals	370 (78.1)	104 (21.9)	474 (55.0)		

***χ^2 – test with $p < 0.05$ as a level of statistical significance value.**

Table 2

The influence of parent's socioeconomic factors and oral status on the early childhood caries (ECC) prevalence

Parameter	Children with ECC n (%)	Caries free children n (%)	Subtotal n (%)	Total n (%)	*p*
Parents working status					
employed	285 (43.8)	365 (56.2)	650 (75.4)	862 (100)	0.004
unemployed	117 (55.2)	95 (44.8)	212 (24.6)		
Parents education level					
illiterate or elementary school	39 (60.0)	26 (40.0)	65 (7.5)	862 (100)	0.025
middle or high school	363 (45.5)	434 (54.5)	797 (92.5)		
Family income *per* month					
≤ 300.00	119 (56.7)	91 (43.3)	210 (24.4)	862 (100)	0.001
> 300.00	283 (43.4)	369 (56.6)	652 (75.6)		
Parents health information level					
uninformed (low)	388 (64.9)	210 (35.1)	598 (69.4)	862 (100)	0.000
well informed (high)	14 (5.3)	250 (94.7)	264 (30.6)		
Parents oral status					
well	119 (26.9)	323 (73.1)	442 (51.3)	862 (100)	0.000
poor or don't	283 (67.4)	137 (32.6)	420 (48.7)		

***χ^2 – test with $p < 0.05$ as a level of statistical significance value.**

who were uninformed about oral health (96.5%, $p = 0.000$). Moreover, the children of the parents who had poor oral health were also at higher risk for ECC (70.4%, $p = 0.000$). The higher disease frequency (Table 3) was noticed in children with poor oral hygiene ($p = 0.012$) who did not use fluoride toothpaste ($p = 0.000$) and fluoride tablets (p=0.000). Children with oral bad habits (mouth breathing, sucking thumb) or children who were used sweet medical syrups more than 5 times *per* year, had also higher ECC prevalence ($p = 0.000$). Logistic regression model (Forward Stepwise Method) showed (Table 4) that those children who use sweets between meals, in comparison to those who did not, were more likely to have ECC (OR = 181.16; 95% CI = 84.29–389.34), as well as those who use medical syrups more than five times a year in comparison to those who never use medicines (OR = 8.08; 95% CI = 3.78–17.27), among parents with poor oral status (OR = 3.09; 95% CI = 1.65–5.79) and low health informed parents (OR = 217.57; 95% CI = 84.46–560.50).

Discussion

This study analyzed the prevalence of ECC and its relationship with socio-behavioural factors as the risk factors for disease presence. ECC prevalence in Vojvodina of 46.64%, was in the range of moderate values of prevalence compared to Sweden [10]; low prevalence-11.4%) and the recorded higher prevalence in children from Southwest China [8], (85%), and in Canada [15] (high prevalence -98%). Studies from neighborhood countries [16] stated that 40.29% of the children 25–71 months old had ECC and those values were similar with our study. Our research showed that every child had on average 1.81 (dmft) deciduous teeth with caries [(i.e. 3.68 decayed tooth surfaces (dmfs)] and it was in agreement with results reported by Al-Mendalawi and Karan [17] (2.03 ± 1.39) and Borges et al. [18]. Our findings also correlate with those of Anitha et al. [19] who revealed DMFS ≥ 5 in three-year-old children in India.

Table 3

Early childhood caries (ECC) prevalence according to child's oral hygiene habits and use of medical syrups

Parameter	Children with ECC n (%)	Caries free children n (%)	Subtotal n (%)	Total n (%)	*p**
Oral hygiene					
yes from birth	377 (45.8)	447 (54.2)	824 (95.6)	862 (100)	0.012
no	25 (65.8)	13 (34.2)	38 (4.4)		
Use of fluoride toothpaste					
yes	257 (40.5)	377 (59.5)	634 (73.5)	862 (100)	0.000
no	145 (63.6)	83 (36.4)	228 (26.5)		
Use of fluoride supplements					
yes	19 (16.4)	97 (83.6)	116 (13.5)	862 (100)	0.000
no	383 (51.3)	363 (48.7)	746 (86.5)		
Oral bad habits☻					
no	213 (40.2)	317 (59.8)	530 (61.5)	862 (100)	0.000
yes	189 (56.9)	143 (43.1)	332 (38.5)		
Use of medical syrup					
never	214 (34.2)	411 (65.8)	625 (72.5)	862 (100)	0.000
more than five times a year	188 (79.3)	49 (20.7)	237 (27.5)		

***χ^2 – test with $p < 0.05$ as a level of statistical significance value.**

Table 4

Risk factors for early childhood caries (ECC)

Risk factors for ECC	S.E.	Exp(B)	95% CI for Exp(B)		*p*
			lower	upper	
Step 1					
use of sweets between meals	0.215	39.258	25.738	59.881	0.000
Step 2					
use of sweets between meals	0.372	223.817	107.996	463.852	0.000
health information level	0.428	241.585	104.466	558.679	0.000
Step 3					
use of sweets between meals	0.379	172.872	82.273	363.237	0.000
use of medical syrup*	0.371	7.790	3.767	16.110	0.000
health information level	0.465	293.828	118.054	731.317	0.000
Step 4					
use of sweets between meals*	0.390	181.156	84.289	389.344	0.000
use of medical syrup	0.388	8.076	3.776	17.273	0.000
parents oral status	0.320	3.092	1.652	5.788	0.000
parents health information level	0.483	217.573	84.457	560.500	0.000

Ordered logistic regression (n = 862).

***use of medical syrups more than five times a year.**

ECC appeared to be more frequent in male children and this is similar to the results of Abu Hamila [20]. The rationale for the gender difference is unclear but it has been reported that male children have 13 times greater risk of caries development [21] and the possible earlier "vertical" and "horizontal" transmission of mutant streptococci (MS) from mothers to male children [22]. This gender gap might result from genetic, hormonal and cultural influences [23]. Moreover, in our study, the third and every next born child in a family have a higher risk for ECC as confirmed by Prakash et al. [24] study. It is an interesting assumption that was pointed out in Congiu et al. [25] study concerning the families with more children that the "available" free time that parents have to spend with each child was reduced. This may be especially true for working mothers and it may play a role in the caries development in children with siblings.

AAPD declared that breastfeeding and bottle-feeding are a potentially risk factors for ECC [3]. In our study caries prevalence was significantly lower in toddlers who was exclusively breastfed 6–12 months ($p = 0.000$). The children who were bottle-fed from birth or who were breastfed after 12 months of life had more frequently ECC. Recent research by Bahuguna et al. [26] confirmed significantly higher percentage of children developed ECC on having prolonged breastfeeding, bottle feeding, nocturnal bottle feeding containing sweet drink and milk and higher frequency of consumption of sweets. A systematic review of the epidemiological evidence suggests that prolonged breastfeeding after the first birthday may be associated with an increased prevalence of caries. When breast milk is consumed several times during the day and at night it can be linked with ECC [27]. It can be explained by the accumulation of milk residues contained lactose that is a perfect substrate for MS, especially during the night, when the salivary flow rate is reduced. Infant feeding practices greatly influence a child's risk of developing ECC.

In our study, we found that additional sweeten of food and use of sweets between meals can be the significant factors for ECC development and that was also confirmed by Majorana et al. [27]. It is notable that sugary foods and beverages in early childhood are known to lead to the establishment of a habit that persists for a long time [28]. The most important fact is a high-frequency intake of sugary food and drinks, as well as sweetened feeding bottles, particularly at night time instead of quantity of sugar intake [18]. In our study, we noticed that children who used additionally sweetened food had two times more caries compared to other children. Children who used sweets between meals had four times frequently caries in relation to the children who never used them or took sweets with meals.

The evaluation of the results of our study (Table 2) clearly indicates that there was a direct correlation among parents education level, their working status, family income *per* month and ECC prevalence. Those results were also confirmed in other studies [6–8, 10, 18, 20]. ECC frequency in the children of highly educated parents was considerably reduced compared to the children whose parents had elementary or no education at all, as confirmed by Schroth et al. [15] and Borges et al. [18]. Children from working parents had less ECC comparing to the children from unemployed parents. This can be explained by higher education level and better health information level of the employed parents and with the fact that their children more often stay in kindergarten were less ECC prevalence was recorded [2]. Considering the fact that the existing network of educational institutions in Vojvodina is not adjusted to the population demographic, socioeconomic or educational needs, it is quite possible to expect a continued increase of ECC. The influence of parent's socioeconomic status and their oral health on the ECC prevalence was also notable in our study. The children had more frequently ECC if their parents had less monthly income, which is in accordance with the study of Prakash et al. [24] and Borges et al. [18]. They found the linear increase of ECC prevalence and severity with decreasing of parents' annual income. The wealthy parents have more ability to pay for qualitative and quantitative balanced food, fluoride supplements and better oral hygiene for their children who then less socioeconomic status. The parents of low socioeconomic status gave their children the poor quality of food rich in carbohydrates and they didn't have enough money to pay for quality oral hygiene devices and because of the limited income, they couldn't reach adequate dental service. In the Western world, the ECC prevalence at 3 years of age was 19.9%, and strong associations were found with low socioeconomic status and ethnicity [29]. In contrast, a study involving Chinese children reports an association between dental caries and a higher monthly income [30]. Low socioeconomic status of the parents was often connected with their low health information level and that was significant risk factor for ECC in our study. Parents of young children receive very little oral health preventive information from non-dental health care providers. Advising first-time pregnant mothers on the prevention of ECC, decreased disease prevalence at 20 months of child's age 5-fold [31]. In the present study, it was found that low education level of parents was significantly related to the occurrence of caries, which is consistent with other studies [32]. Epidemiological research in Iraq also pointed out that parental education level was found to be a risk factor significantly associated with ECC ($p < 0.01$). Educated parents have better health knowledge and positive attitudes toward oral health, including ECC. Hence, they have children's sound dentition. Oral hygiene habits and dietary habits established during preschool days and parents, particularly the mothers, can function as role models for their children [17]. It can be concluded that low socioeconomic status and poor parental knowledge of how diet affects their children's teeth also contribute to this growing problem [3].

The possible correlation between parental education level and their annual income in relation to ECC occurrence in Vojvodina will probably provide some further investigation especially because the level of education and the working status of the young parents in Vojvodina are not always in direct correlation with their monthly income. Parent's behavior is correlated with children's oral health. The toothbrushing and dietary habits of the mother are associated directly with those of her child. Children's dietary habits vary

according to their mothers' educational level, resulting in low-income families consuming diets higher in added sugars than diets of higher income families [32]. Cariogenic bacteria, such as MS and *Lactobacilli* (LB), are typically transmitted from the mother to her child by behaviors that directly pass saliva, such as sharing a spoon when tasting a baby food, cleaning a dropped pacifier by mouth, or wiping the baby's mouth with saliva. Our study showed two times more ECC prevalence in children from parents who had bad oral health. Children with a history of dental caries, whose primary caregiver or siblings have severe dental caries, are regarded as being at increased risk for the disease [33]. Vertical transmission of MS from caregiver to a child has been reported [34]. The major reservoir of MS is the mother, from whom the child acquires it during a window period of around 2 years of age. At this time, the child is probably most susceptible to acquiring MS. Successful infant colonization of maternally transmitted MS may be related to several factors, which include the magnitude of the inoculum, the frequency of small-dose inoculations, and the minimum infective dose. Mothers with dense salivary reservoirs of MS are at high risk of infecting their infants very early in life [35]. Thus, poor maternal oral hygiene and higher daily frequencies of snacking and sugar exposure increase the likelihood of transmission of the infection from mother to child. In addition to maternal transmission of MS, the father-to-child transmission has been studied. Horizontal transmission was also examined; transmission of microbes may occur between members of a group (e.g., siblings, toddlers at a nursery).

Many studies have indicated that ECC is largely preventable by good oral hygiene of parents and children and proper eating habits instituted by parents early on [31]. It is better if prevention of ECC begins in the prenatal and after birth periods and addresses the health of both the mother and the infant, so the mother's or caregiver's teeth should be examined. Infants whose mothers have high levels of MS due to untreated dental decay are at greater risk of acquiring cariogenic microorganisms. Better oral health education of the mother can delay infant inoculation [36]. The strategy to battle the early MS transmission from parents to their child is often named primary-primary prevention. The preventive intervention is most often directed to pregnant women and/or mothers of newborn babies. The goal is to prevent or delay children as long as possible from acquiring the bacteria that cause tooth decay. Reduce the bacteria in the mouth of the mother could be possible by use of chlorhexidine digluconate in the form of mouth rinses, gels, and dentifrices [37]. Early screening for signs of dental caries development, starting from about 7–8 months of age, could identify infants who are at risk of developing ECC, assist in providing information for parents about how to promote oral health and prevent the development of tooth caries. High-risk infants include those with early signs of ECC, poor oral hygiene, limited exposure to fluoride, and frequent exposure to sweet beverages. These infants should be targeted with a professional preventive program that includes oral hygiene instructions for the parents and child, fluoride use, and diet counseling [36].

Our study showed three times higher frequency of ECC in children who did not maintain the proper oral hygiene and two times higher ECC prevalence in children who never used fluoride toothpaste as well as other fluoride supplements. On oral hygiene significance as the risk factor for ECC development was also pointed out in the research of Al-Mendalawi and Karam [17], who emphasized that there was a significantly higher statistical correlation between tooth brushing frequency and ECC. There was a significantly higher statistical correlation between tooth brushing frequency and ECC ($p < 0.001$). This augments the notion that low frequency and improper tooth brushing methods are closely associated with ECC [17].

Development of oral hygiene habits may be sensitive to the economic environment in which children live. Such environmental factors include caregivers' social status, poverty, ethnicity, deprivation, the number of years of education, and dental insurance coverage. There are numerous studies that support the benefits associated community water fluoridation [38]. Research from Kavvadia et al. [13] of the children from 2–6 years old revealed the high ECC prevalence as the result of use the cariogenic diet (83%) and the fact that 17% of the children did not use any form of fluoride. Moreover, less than satisfactory oral hygiene was recorded in 67% of all children and 23% displayed poor oral hygiene. Thus, emphasizing daily supervised toothbrushing with fluoridated toothpaste is of great importance for the youngest individuals residing in a non-fluoridated area and without access to regular dental care. The exposure to fluoride provides an important protective factor against dental caries. It inhibits demineralization and drives remineralization by incorporating into the enamel crystals at the tooth surface as fluoride apatite. Fluoride enhances remineralization of enamel by attaching to the surface and absorbing calcium and phosphate ions from the saliva. In high concentration, it also inhibits the plaque bacteria's metabolism, therefore decreasing acid production [39]. Fluoride varnish works by increasing the concentration of fluoride in the outer surface of teeth, thereby enhancing fluoride uptake during early stages of demineralization [37].

Sweetened medicine usage is another important risk factor in the ECC development. It was noted the statistically significant difference in ECC frequency in children who took medical syrups in relation to the others who never used them. Our research showed more than two times higher ECC prevalence in children who took five times *per* year sweet medical syrups ($p < 0.01$). In relation to this, Ölmezz and Uzamris [40] pointed out that irregular and self-initiative usage of medicine can be the significant predictor of ECC. This paradoxical situation where medical syrups treated well some illness and at the same time increase the risk for ECC, impose at the first place need for further better cooperation between physicians and dentists. Furthermore, the whole community together with all health care providers will be needed to try to reach somehow policy makers and to provide the regulations of the medical syrups manufacture by the law. In relation to this, it will be of great importance that pharmaceutical industries in their production assortment of all medical syrups substitute sucrose with the sanitary safe sugar substitutes which will not have at the same time the si-

de effects. The Recent publication of Alaki et al. [41] noted that children who used systemic antibiotics during the first year of life had a significantly greater risk of ECC compared with children who did not use antibiotics.

Logistic regression model in our study showed that those who use sweets between meals, in comparison to those who did not, are more likely to have ECC (OR = 181,16; 95% CI = 84.29–389.34), as well as those who use medical syrups more than five times a year in comparison to those who never use that (OR = 8.08; 95% CI = 3.78–17.27), among parents with poor oral status (OR = 3.09; 95% CI = 1.65–5.79) and low health informed parents (OR = 217.57; 95% CI = 84.46–560.50), which is in accordance with the similar research [18, 33, 36]. Sex and age of the child, age of the parents, child order in family, parents education level and working status, family income *per* month, child weight at birth, nursing and bottle feeding, additional sweeten of food, use of fluoride toothpaste and tablets and oral bad habits etc. did not show statistical significance in applied statistical model. High confidence level values in statistical model used, refer on two among four variables (in the model which compared 20 variables) – "regular use of sweets between meals" and "low health informed parents"– can be explained with a probability of unexplored confounders. Those "hidden factors" should be more investigated in further research.

Conclusion

ECC is a serious widespread health problem in Vojvodina with increasing trend rate. We found a strong association between certain sociobehavioural risk factors like low parental health information level and their poor oral health status on ECC prevalence. The use of sweets between meals as a common bad habit in general population has also a significant influence on disease development along with the use of sweet medical syrups more than five times *per* year. There is an urgent need for changes in primary health care activities particularly in parental prenatal and postnatal counseling, addressing at the first place mothers awareness that their better oral hygiene, knowledge and positive attitudes toward oral health could significantly improve child oral health and decrease ECC prevalence.

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