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Salivary Characteristics in Children Aged 2 Years Old And Under with Severe Early Childhood Caries (SECC)

Ameta Primasari
Department of Oral Biology
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia
ametaprima@yahoo.com

Essie Octiara
Department of Pediatric Dentistry
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia

Nevi Yanti
Department of Conservative Dentistry
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia

Muhammad Isra Reskitama
Student
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia

***Abstract*–Severe Early Childhood Caries (SECC) is progressive tooth decay with multifactorial etiology, which one of them is saliva. Salivary flow, pH, salivary buffer capacity are critical factors for developmental regulation and regression of the caries process. It is mandatory to comprehend the salivary characteristics possessed by children with SECC to perform prevention programs, given that the high prevalence of SECC in many countries. The objectives of this study were to investigate the salivary characteristics (flow rate, pH and salivary buffer) in children aged 2 years old and under that suffered from SECC and children with caries-free. This research was an observational analytic research with cross sectional design. Sample size was 30 children with SECC and 30 children with caries-free as control group. Sampling was done using purposive sampling method, with age criteria 2 years old and under and good general conditions. Examination of unstimulated salivary characteristics such as salivary flow rate, pH and buffer capacity was done using GC saliva check, with unpaired t-test used for analysis. Results showed that mean salivary flow rate in children with SECC was lower than in caries-free children, mean salivary pH in SECC children was also lower in SECC children compared with caries-free children, and the buffer capacity was also lower in SECC children rather than in control group. As conclusion, salivary characteristics of SECC children had lower quantity and quality rather than caries-free children.**

Keywords–SECC, saliva, flow rate, pH, buffer

I. INTRODUCTION

Early Childhood Caries (ECC) is a pattern of carious lesion that occurs in infants, toddlers and preschool children aged 71 months years and under. Severe Early Childhood Caries (SECC), is a more progressive caries form than ECC. Children under 3 years old are said to be suffering from SECC if there is a caries (lesion or cavity) that occurs in at least one smooth surface of teeth [1].

Dental caries in children is still a quite alarming problems in various countries in the world. Research showed that the prevalence of SECC varied from 9.5% in Germany [2]. 24.7% in Manitoba (Canada) [3], and 2.7% with average dmft score 6.86 in Southern Italia [4]. SECC prevalence is higher in developing countries rather than in developed countries. The researches in India showed that the prevalence of SECC varied between 21% [5]-35.1% [6], while in Northern Thailand the prevalence was higher by 44.1% [7]. Prevalence of SECC in Indonesia is also quite high, in Surabaya 29.2% [8], while in Medan, the prevalence in 3 years old children and under was 16% [9].

The high prevalence of SECC in early childhood has become, a dentist's concern. Therefore, dentist needs to know the risk factors of caries in early childhood. Saliva is one of the factors that play a role in the process of dental caries, but saliva has a unique role because it can also act to prevent caries [10]. The knowledge of saliva as one of the risk factors of caries especially in children with high caries risk can aid/assist dentist in performing prevention therapy and improve dental care to be more effective.

Saliva can maintain oral hygiene by acting as a protective layer against food debris (lubrication), antibacterial activities, pH (6-7) [11], buffers against acid formation, flow related clearance of diet, and salivary viscosity [12]. Salivary flow rate, pH, buffer, and remineralization capacity of saliva are critical factors in developmental regulation and regression of the caries process. If the environment supports, saliva will contribute to strengthening the teeth by building strong apatite structure. Conversely, if the environment is unfavorable, salivary flow can help remove and perform buffer from the acid that forms in the teeth. Unstimulated salivary flow lower than 0.3 ml/min is a risk factors for caries [13].

Research on 25 SECC children and 25 caries-free children aged 3-5 years old showed that unstimulated salivary pH in caries-free group was higher than in SECC children ($p < 0.0001$). Salivary pH had a negative correlation between two groups ($r = -0.47$, $p<0.05$), which means that the more severe the caries is, the lower the child salivary pH [12]. Buffer capacity of SECC children is also lower than in control groups [14], as well as the mean salivary flow rate [15]. Different results obtained by Almushyt (2010) showed that there were no difference between the salivary flow rate and buffer capacity between SECC and caries-free children [16].

Further research is needed because of the different results in the research on pH, buffer capacity, and salivary flow rate between SECC and caries-free children. Besides that, salivary characteristic in children aged 2 years old or under is also not widely published. The purpose of this study was to determine the salivary characteristic (flow rate, pH, and salivary buffer) in children aged 2 years old and under that suffered from SECC and caries-free children.

II. MATERIALS AND METHODS

This research was an observational analytic research with cross sectional design. Population of this research were children who came to the Integrated Service Post in Medan Selayang district. Sampling was done using purposive sampling method, with the sample criteria were children aged 2 years old and under, good general condition, didn't consume any medicine in the near future, and willingly to participate in the study by filling the informed consent. Sample size were 30 children that suffered from SECC and 30 caries-free children as control group. SECC category is based on American Association of Pediatric Dentistry (AAPD) criteria which is a caries in smooth surface of the tooth. Salivary characteristic examination such as salivary flow rate, pH, and buffer capacity was done using GC saliva check. Unstimulated saliva was taken at 9 to 11 o'clock GMT+7 hours, and children didn't consume any food or drinks 1 hour before saliva is taken. Salivary flow rate criteria is divided into 2 which was normal salivary flow rate (≥ 0.3 ml/min) and abnormal salivary flow rate (< 0.3 ml/min). Buffer capacity is categorized with normal (10-12), low (6-9), and very low (0-5), salivary pH is divided into normal (6.8-7.8), acidic (6-6.6), and very acidic (5-5.8). Data analysis was tested with chi-square for categorical data and unpaired t-test for numerical data. Ethical clearance was obtained from the Research Ethics Committees of Faculty of Medicine, University of Sumatera Utara.

III. RESULTS

The age range of subjects in this research was 8 to 24 months. The mean caries experience in children suffered from SECC was 2.73±1.53. Based on the salivary flow rate, there were 4 children (13.3%) suffered from SECC had abnormal salivary flow rate (< 0.3 ml/min), whereas all of the children in control group had normal salivary flow rate (≥ 0.3 ml/min). There was a significant difference in salivary flow rate between children with SECC and caries-free children ($p < 0.001$) (Table I).

TABLE I. DIFFERENT CATEGORIES OF SALIVARY FLOW RATE BETWEEN SECC AND CARIES-FREE CHILDREN

Group	Salivary Flow Rate						P
	Abnormal		Normal		Total		
	n	%	n	%	n	%	
SECC	4	13.3	26	86.7	30	100	< 0.001[a]
Caries-free	0	0	30	100	30	100	

[a.] Chi-Square test

Based on salivary buffer capacity in children with SECC, most of the children, 22 children (73.3%) had very low buffer capacity, followed by 8 children (26.7%) with low buffer capacity and there were no children who had normal buffer capacity. In caries-free children, there were 14 children (46.7%) had normal salivary buffer capacity, 16 children (53.3%) with low buffer capacity and there were no children who had very low buffer capacity. Statistic results showed that there were no difference in salivary buffer between SECC and caries-free children ($p<0.001$) (Table II).

TABLE II. DIFFERENT CATEGORY OF SALIVARY BUFFER BETWEEN SECC AND CARIES-FREE CHILDREN.

Group	Salivary Buffer								
	Very low		Low		Normal		Total		p
	n	%	n	%	N	%	n	%	
SECC	22	73.3	8	26.7	0	0	30	100	<0.001[b]
Caries-free	0	0	16	53.3	14	46.7	30	100	

[b.] Chi-Square test

In children with SECC, most of the salivary pH was very acidic (17 children, 56.7%) and acidic (12 children, 40%) and only 1 children had normal salivary pH, whereas in caries-free children, most of the salivary pH was normal (26 children, 86.7%), only a few had acidic salivary pH (4 children, 13.3%), and there were no children with very acidic salivary pH. Based on the statistical test, there were difference in salivary pH between SECC and caries-free children ($p < 0.001$) (Table III).

TABLE III. DIFFERENT CATEGORY OF SALIVARY PH BETWEEN SECC AND CARIES-FREE CHILDREN.

Group	Salivary pH								
	Very acidic		Acidic		Normal		Total		p
	n	%	n	%	n	%	n	%	
SECC	17	56.7	12	40	1	3.3	30	100	<0.001[c]
Caries-free	0	0	4	13.3	26	86.7	30	100	

[c.] Chi-Square test

Results showed that the mean salivary flow rate in caries-free children was higher than in SECC children, which was 0.80 ± 0.21 versus 0.37 ± 0.12 and this difference was statistically significant. Similarly, the mean of salivary pH and salivary buffer were higher in the caries-free group compared with SECC children,

and this difference was statistically significant (p <0.001) (Table IV).

TABLE IV. DIFFERENT SALIVARY CHARACTERISTIC IN SECC AND CARIES-FREE CHILDREN.

Salivary characteristic	SECC	Caries-free	P
Flow rate (ml/min)	0,37 ± 0,12	0.80 ± 0.21	< 0.001[d]
Salivary pH	5,86 ± 0,51	7.02 ± 0.39	< 0.001[d]
Buffer Saliva	4,93 ± 1,38	9.30 ± 1.23	< 0.001[d]

[d.] Unpaired t-test

IV. DISCUSSION

Saliva is very important to maintain oral health. Salivary flow rate is an independent factor that will affect other salivary defense factors. pH and buffer capacity are dependent variables on salivary flow rate [12].

Results of this study showed that the mean salivary flow rate in SECC children was lower (0.37 ± 0.12 ml/min) than caries-free children (0.80 ± 0.21 ml/min) (p<0.001). This results were in accordance with Animireddy et al. research in 2014 which stated that the mean of salivary flow rate in SECC children is lower than in caries-free children [15].

It had been shown in this research that reduction in salivary flow may lead to an increasing of dental caries lesion in SECC children. Normal unstimulated salivary flow (≥ 0.3 ml/min) is expected to eliminate and neutralize the harmful effect on oral health such as bacteria that causing caries, low pH and food debris that attached to the tooth and oral cavity. However, if unstimulated salivary flow less than 0.3 ml/min, then it was a risk factors that causing caries [13]. This results were in accordance with study which stated that low salivary flow rate (< 0.3 ml/min) was found in 13.3% SECC children, while in caries-free, all of the children had normal salivary flow rate (p<0.001).

The mean of unstimulated salivary buffer was also lower in SECC children (4.93±1.38) rather than in caries-free children (9.30 ± 1.23) (p<0.0001). This results were in accordance with Kuriakose et al (2013) which stated that buffer capacities in SECC children was lower than in caries-free children [14].

Salivary buffer capacity can protect tooth from caries, lower salivary buffer capacity can cause disturbance or failure to neutralize plaque acid and reduced remineralization in early enamel lesion [17]. Salivary buffer ability depends on phosphate system, carbonate acid, and bicarbonate system. Carbonate-bicarbonate acid system is the most important buffer system in stimulated saliva, while in unstimulated saliva, the one that plays the role is phosphate [8].

In this research, the salivary buffer in most of SECC children was very low (73.3%), followed by low buffer capacity (26.7%) and there were no children with normal buffer capacity; while in caries-free children, most of them (53.3%) had low buffer capacity, 46.7% had normal buffer capacity and none of them had very low buffer capacity (p<0.001) (Table II). Because most of SECC children had low buffer capacity (73.3%), this will affect their saliva ability in maintaining oral hygiene.

Buffer capacity is related with salivary flow and salivary pH, the lower the salivary flow, the buffer capacity will also be lower, and vice versa [12]. This is proven in this research that the salivary flow rate in SECC children was lower than in caries-free children, and this will affect the buffer capacity in SECC children with the presence of lower salivary buffer in SECC children than in caries-free children. Buffer capacity act as plaque pH regulator and neutralize acid products from bacteria. Low buffer capacity in SECC children in this research will cause the ability to adjust the plaque pH will also be lower. This is shown from mean salivary pH in SECC children was lower (5.86 ± 0.51) than in caries-free children (7.02 ± 0.39) (Table IV). This results were in accordance with Muchandi et al research in 2015 found that unstimulated salivary pH in SECC group was lower than in caries-free group (p<0.001) [12].

Saliva with low pH can caused loss of calcium phosphate, hydroxyl and crystal hydroxyl apatite ion. Saliva with critical acidity degree 5.5 can cause hydroxyapatite dissolution or tooth demineralization [18]. In this research, mean of salivary pH in SECC children almost near critical pH which is 5.86 ± 0.51, and will be one of caries risk factor that needs attention, because even before child eating carbohydrate, the salivary pH is low enough; different from mean of salivary pH in caries-free children that was in normal category (7.02 ± 0.39). In addition, salivary pH in SECC children mostly was very acid (pH 5-5.8) which was 56.7% and acid (pH 6-6.6) which was 40% and only 1 children had normal salivary pH (pH 6.8-7.8), while in caries-free children mostly had normal salivary pH which was 86.7% and there were no children had very acid pH (Table III).

One ways in improving oral cavity pH is by reducing the acid-producing cariogenic bacteria and also regulating the carbohydrate diet of the child. Dental filling in children with SECC may reduce the number of bacteria in the oral cavity.

Researchers reported that children with SECC had higher S.mutans count than caries-free children [19,20]. Saraithong et al (2015) reported that children who consumed soft drinks at least once a day had higher S.mutans than children that never or occasionally consumed soft drinks [21]. Children consuming sugary drinks at night at least twice a day was likely to get caries (OR = 2.38, Cl = 1.34-5.99) than children who never drink sweet drinks at night [22]. Eating between main meals should also be avoided, because it can kept the acidic pH , because salivary buffer capacity does not have time to neutralize the pH in oral cavity [18]. Therefore, in SECC children it is recommended to do dental treatment as soon as possible and to control the carbohydrate diet.

As a conclusion, three salivary parameters (salivary flow, buffer, and pH) in early childhood contributed in dental caries progression due to the salivary

characteristic in SECC children that had lower salivary quantity and quality than caries-free children. If the child had caries then the salivary pH and buffer capacity will affect the demineralization activities process.

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