Prevalence of Caries among Schoolchildren in the Interior of Suriname

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Abstract. The aim of this study was to determine the prevalence of caries among children living in the interior of Suriname and to investigate the influence of the reachability of their habitats and different ethnicities on the prevalence of caries. As part of children's regular dental check-ups, data on the prevalence of caries were registered for schoolchildren ($n = 1,309$) living in four different regions. Prevalence of caries was expressed by the number of decayed, missing, and filled teeth (DMFT index). Consequences of severe caries were recorded by counting the number of teeth with pulp involvement, ulcerations, fistulas, and abscesses. Depending on the habitat, the number of children with caries in their primary dentition varied between 68% and 100%, in the mixed dentition between 79% and 98%, and in their permanent dentition between 54% and 94%. After the World Health Organization criteria, the average scores of dmft were high in children with primary teeth (except for Brokopondo), moderate to high in children with mixed dentition and low to moderate in children with permanent teeth. Children in more remote areas had a greater prevalence of caries than children in less remote regions. Severe consequences of caries were seen in 14–75% of the children. Treatments were rarely performed. Children in the interior of Suriname are in great need of preventive and curative dental treatments.

INTRODUCTION

Dental caries (tooth decay) is the most prevalent oral disease, which occurs worldwide and is considered a major public health problem.¹ Tooth decay is a multifactorial infectious disease with crucial factors, such as frequency of sugar/carbohydrate intake, use of fluoride, and buffering capacity of saliva.² Poor oral health is related to general health and influences well-being by causing pain, suffering, and malfunction. People with poor oral health can present problems with eating, chewing, smiling, and communication, which influence the quality of life. Ninety percent of schoolchildren worldwide are affected by dental caries, which often results in decreased activities at school, poor school performance, and school absence.^{3,4} To express the prevalence of caries, the DMFT index is used. The DMFT index is the sum of the number of decayed teeth (DT), filled teeth (FT), and missing teeth (MT) due to caries. The World Health Organization (WHO) defines a DMFT < 1.2 as very low and > 4.4 as high prevalence of caries. In 1982, the WHO formulated goals concerning oral health in children as follows: 1) the mean number of teeth that are decayed, missing, or filled due to caries (DMFT) in 12-year-olds should be no more than 3 (DMFT ≤ 3) and 2) at least 50% of the 5–6-year-old children should be caries free (dmft = 0).

Oral health is strongly related to socioeconomic status. Individuals with low socioeconomic status show higher risk of oral diseases than people with higher socioeconomic status. Children from families with low socioeconomic status had less access to oral health services or oral hygiene products and their parents often had poor knowledge regarding oral hygiene. This situation applies to most people living in developing countries. In addition, people who live in developing countries are developing increasingly unhealthy dietary habits (growing consumption of sugar), their use of fluoride is highly limited and dental care is hardly accessible. The environment

in which children live and grow up influences their dental health behavior and outcomes.^{5–12}

Race and ethnicity have also been investigated as factors for oral health status. Inequalities in risk of caries are reported between different ethnicities. Ethnicity could be associated with dental caries because members of an ethnic group often have similar diets, care-seeking behaviors, oral hygiene routines, and use of home remedies. Moreover, education and income are related to ethnic inequalities; therefore, ethnic differences are related to the socioeconomic opportunities associated with the prevalence of dental caries. There seemed to be a higher risk for the prevalence of caries among children in ethnic minority groups.^{11,13,14}

Children in rural environments compared with children in non-rural areas have worse oral health, show less adequate dental behavior due to the absence of preventive aids (such as toothbrushes and fluoridated toothpaste), and have less access to dental health care.^{15–19} Dental visits in remote areas are mostly carried out for emergency care, which consists of tooth extraction.²⁰

In the present study, we focused on minorities in isolated areas in Suriname. Suriname is a multiethnic country in South America that became a Dutch colony in 1674 until her independence in 1975. Paramaribo is the capital, and there are 10 different districts. Paramaribo contains almost half of the total 492,000 inhabitants of Suriname. Suriname is divided into the coastal area and the interior area. The largest districts of the interior of Suriname are Sipaliwini and Brokopondo. The two most common ethnicities in the interior are Amerindians, the original inhabitants of Suriname, and people of Creole origin (Maroons), with roots from Africa.²¹ In the interior of Suriname, the socioeconomic status is lower than in the coastal area. There is a lack of infrastructure, electricity, and running water. Inhabitants depend on hunting, fishing, and agriculture.

Health care in the interior part of Suriname is provided by a nonprofit organization called Medical Mission Primary Health Care Suriname, which is funded by the Ministry of Health. However, the resources are not sufficient, and the Medical Mission is therefore also dependent on (financial) donors. There are 59 Medical Mission polyclinics distributed over the

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interior of Suriname. The employees at those clinics are mostly local people who are educated as medical assistants or polyclinic assistants and are the initial contact toward patients. Licensed doctors, pharmacists, and dentists visit those clinics on a regular basis and on emergency call, or people travel into Paramaribo to visit the doctor, dentist, or pharmacist.

There is no permanent dental staff at those clinics. Medical assistants are responsible for the oral health care of children attending the primary schools located nearby the polyclinic. Medical assistants should carry out oral health screenings every 6 months in primary schools and give plenary and individual information regarding oral health promotion and prevention of caries. Toothbrushing instructions should be commonly provided because almost all medical assistants are educated in (oral) health promotion activities. In the case of a carious lesion, these health providers should be able to restore the tooth by atraumatic restorative treatment (ART) method or to extract the tooth. Those treatments could be performed with only hand instruments and do not require dental devices or electricity.²² However, the reality is different: the absence of simple tools, such as toothbrushes and toothpaste, greatly limit the effectiveness of oral health-promotion programs. The level of knowledge among medical assistants about oral health and disease is low, which causes the failure to perform the usual dental screening. Only a small number of employees are trained to carry out adequate oral screening and only a handful can fill teeth using the ART method. Hence, as in most developing countries, emergency oral care and pain relief seem to be the primary allocated treatments.

Little is known regarding the oral health status of children in the interior of Suriname. Since the Medical Mission has oral health in its portfolio, they wanted to map the oral health situation in schoolchildren in the interior of Suriname. The aim of this study was, therefore, to determine the prevalence of caries in children living in different parts of the interior of Suriname and to study the association between the ethnicity of inhabitants and remoteness of the habitat with the prevalence of caries prevalence.

MATERIAL AND METHODS

The Medical Mission selected polyclinics in four regions in the interior of Suriname for the study (Brokopondo, Upper Suriname, West Suriname, and South Suriname). The regions were selected because they were, in turn, for dental screening and travel costs could be shared with medical doctors visiting the regions. The inhabitants of West and south Suriname are mostly Amerindians, and in Brokopondo and Upper Suriname the inhabitants are mainly of Creole origin (Maroons). The four different areas are assumed to be representative of the interior of Suriname due to the comparable living conditions in other regions.

The villages that were involved were Brokopondo, Afobaka, Asigrón, Balingsoela, and company in the region of Brokopondo; Pikin Slee in the region of Upper Suriname; Donderskamp in the region of West Suriname and Palumeu, and Pelele Tepoe in the region of South Suriname. West Suriname and Brokopondo are easier to reach from the capital, Paramaribo, than South and Upper Suriname. Brokopondo is the easiest to reach, being a 1-hour drive by car, and locals travel by public bus, which is relatively inexpensive. Donderskamp in West Suriname and Pikin Slee in Upper Suriname are

reachable by bus and boat, which is more expensive than a trip to Brokopondo. Palumeu and Pelele Tepoe in South Suriname are very remote areas that are best to reach by plane, which is quite expensive. The region could also be reached by bus and boat; however, because of the long travel time, this journey is highly uncomfortable and is still an expensive trip from Paramaribo. The characteristics of the four regions are summarized in Table 1.

All schools ($n = 10$) for which the polyclinics were responsible were included in the study, except for one school in Pikin Slee in which the screening could not be scheduled into the timeframe of the study. All examinations were performed in 2016 during school hours.

Because the monitoring of oral health is a part of the standard provided health care, no medical approval for this screening was requested. No dental treatments took place during the screening. Instead of undergoing the regular screening by the medical assistants of the Medical Mission, schoolchildren between the ages of 4 and 15 years in the nine selected schools were examined by a dentist or a Dutch final year dental student, who was all calibrated in recording dental caries. The data were handed over to the data files of the Medical Mission. In case of objective need of treatment, an appointment for subsequent treatment was scheduled at a later time. Employees of the Medical Mission (a medical assistant or a polyclinic assistant) assisted the researchers during the examination. Children were examined on a portable dental chair, on a table, or sitting on an ordinary chair in a classroom at the primary school or at a medical clinic. The oral examination was performed with the aid of a headlamp, mouth mirror, and probe.

The caries was recorded according to the WHO criteria, which means that a tooth is recorded as decayed if any lesion in a pit, or fissure or smooth surface has a detectable softened floor or wall, palpable with the probe. The DMFT index was used to assess the prevalence of dental caries. The DMF score is the sum of decayed (D), missing (M), and restored (F, filled) teeth (T). Uppercase letters refer to permanent teeth and lowercase letters to deciduous (primary) teeth. Severe consequences of caries were registered by using the PUFA index (pulp involvement, ulcerations, fistulas, and abscesses).²³ This index scores the presence of visible pulp chamber, an ulceration of the oral mucosa, as a result of root fragments, a fistula, or abscess.

Statistical analyses were performed using SPSS for windows, version 23 (IBM SPSS Statistics for Windows, Armonk, NY). Because the eruptions of teeth follow a common pattern,[†] children in our study were stratified according to their dental developmental status in three groups: 1) children with their primary dentition only (0.5–6 years), 2) with permanent dentition only (12+ years), and 3) children with a mixed dentition (6–12 years). The mean, standard deviation, and frequencies were used to describe the oral health situation in the participants regarding their dental developmental status and region. Pearson's chi-square test and Kruskal-Wallis one-way analysis of

[†] At the age of 6 months, the first primary teeth erupt, and at 2 years, the full primary dentition is erupted. Children start to get permanent teeth at the ages of 5–6, which will replace the primary teeth. When 11–12 years old, a full permanent dentition is erupted, and all primary teeth are replaced.

TABLE 1
Characteristics of the four selected regions

Region	Ethnicity	Attainability	Surface (km ²)	No. of inhabitants	No. of children (4–12 years)
Brokopondo	Maroons	Easiest	7,364	11,387	3,150
Upper Suriname	Maroons	Difficult	7,512	17,404	4,765
West Suriname	Amerindians	Easy	15,839	578	116
South Suriname	Amerindians	Hardest	42,199	1,157	275

variance were used to test differences between the four groups. A *P*-value < 0.05 was considered to be significant.

RESULTS

The total number of children examined was 1,309 (41 in West Suriname, 754 in Brokopondo, 335 in Upper Suriname, and 179 in South Suriname). Table 2 shows the prevalence of caries (dmft and DMFT) and the separate components (dt, DT, ft FT, mt, and MT) in children with primary dentition only, mixed dentition, or permanent dentition according to the four different regions.

Table 2 shows that one-third of children with a primary dentition from Brokopondo were caries free (dmft = 0) and none of the children from West Suriname and Upper Suriname was caries free. There was a significant difference in the mean number of decayed teeth (dt) and the total prevalence of caries (dmft) between the areas. Brokopondo showed the lowest dt and dmft. None of the children had received fillings, and a small number of children were found to have missing primary teeth due to caries. The prevalence of caries (DMFT + dmft) in children with a mixed dentition was primarily caused by the number of decayed primary teeth (dt). Two percent of children from South Suriname and 8% from Upper Suriname were caries free (DMFT + dmft = 0). Brokopondo and West Suriname showed barely better rates. Upper Suriname and South Suriname showed significantly less caries-free dentitions (DMFT = 0) among children with permanent dentitions compared with West Suriname and Brokopondo. There was a significant difference in DMFT-rates; West Suriname and Brokopondo had lower DMFT rates than South Suriname and Upper Suriname. Overall, it was shown that children in Brokopondo had the lowest average dt or DT compared with the other regions; children in Upper Suriname had the highest average mt or MT compared with the other regions; and children in Brokopondo had the lowest total prevalence of caries (dmft or DMFT), except for the permanent DMFT in permanent teeth, which in West Suriname also scored low. Any restorations registered were registered in Brokopondo and Upper Suriname only.

Table 3 shows the percentage of children with prevalence of caries (dmft > 0 or DMFT > 0), who had severe dental decay resulting in pulp involvement, ulcerations, fistulas, or abscesses in primary teeth (pufa > 0) and/or permanent teeth (PUFA > 0).

West Suriname had the highest score (75%) for pufa in children with primary dentition. Brokopondo had the lowest amount of decayed primary teeth (dt) per individual of all areas but still had a high percentage of teeth that exhibited serious problems. For children with permanent dentition, Upper Suriname and South Suriname showed the highest number of DT and the highest percentage in the presence of PUFA. Children in West Suriname appeared to be 46% caries free, and 14% of

the children with caries had one of the complications of PUFA, which were the best outcomes compared with the other areas. Children with a mixed dentition in Upper Suriname and South Suriname showed the highest score of pufa + PUFA. In more than 60% of the children, decayed teeth had led to more serious problems. Overall, children with mixed dentition scored the lowest percentage of being caries free; had the highest number of decayed, missing, or filled teeth on average; and the highest percentage of decayed teeth that evolved into pulp involvement, ulcerations, fistulas, or abscess.

For the Amerindians, the area that was more difficult to reach, South Suriname, showed a higher prevalence of caries and higher percentage of PUFA/pufa than the area located closer to Paramaribo, namely, West Suriname. For the Maroons, this outcome seemed to be similar: Upper Suriname showed higher prevalence of caries and higher percentage of PUFA/pufa than Brokopondo.

DISCUSSION

The results of this study showed that the prevalence of caries (dmf or DMF) and complications due to caries (pufa or PUFA) were clearly present in schoolchildren in Brokopondo, Upper, West, and South Suriname. It seemed that more dental problems existed in remote areas than in the more easily reachable areas. Because of the lack of variation in ethnicity within the different regions, it was impossible to draw conclusions regarding the influence of ethnicity on dental health in those regions.

More than one-third of the children with caries encountered serious problems in at least one tooth (pufa or PUFA > 0) with all consequences described previously. It seemed that the poor implementation of treatment, which can be concluded from the low scores of ft, FT, mt, and MT, often causes caries with pulp involvement, ulceration, fistula, or abscess. Obviously, there is a great need for the prevention of caries and curative treatment in Suriname.

Regarding the WHO criteria concerning oral health in children, no region met the WHO criterion, in which at least 50% of 5-year-olds should be caries free. According to the WHO criterion concerning 12-year-olds with DMFT < 3, children with a permanent dentition only, living in West Suriname and Brokopondo, met this criterion, whereas children living in Upper and South Suriname did not.

It could be hypothesized that Brokopondo and West Suriname are more influenced by the capital, Paramaribo, because both areas are closer to Paramaribo than the other two regions. These areas are assumed to not only have greater access to sugar-containing nutrition, resulting in a higher risk of caries but also, on the contrary, to have easier access to toothbrushes, toothpaste, and other dental tools for adequate oral hygiene routines. Even though their way to a dental clinic in Paramaribo is shorter, it is unlikely that additional care for

TABLE 2

Percentage of caries-free children and the mean numbers of dmft, DMFT, dmft + DMFT and their separate components in children with primary dentition only, mixed dentition, or permanent dentition according to the four different regions

dentition only, mixed dentition, or permanent dentition according to the four different regions										
		Caries free	dt		mt		ft		dmft	
N		%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Children with primary dentition only										
Brokopondo	105	32	3.2	3.4	0.1	0.8	0.0	0.1	3.3	3.6
Upper Suriname	4	0	7.0	3.6	1.8	2.9	0.0	0.0	8.8	6.2
West Suriname	8	0	7.0	3.5	0.3	0.5	0.0	0.0	7.3	3.4
South Suriname	24	21	5.8	4.3	0.3	0.9	0.0	0.2	6.0	4.5
		df = 3 $\chi^2 = 6.317$ P = 0.097	df = 3 H = 17.067 P < 0.001		df = 3 H = 19.440 P < 0.001		df = 3 H = 1.621 P = 0.655		df = 3 H = 17.875 P < 0.001	
		Caries free	dt		mt		ft		dmft	
N		%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Children with mixed dentition										
dmft primary teeth										
Brokopondo	397	26	2.5	2.7	0.3	0.8	0.1	0.4	2.9	2.9
Upper Suriname	206	13	4.0	3.3	0.6	1.3	0.1	0.5	4.7	3.6
West Suriname	20	15	3.7	2.7	0.1	0.2	0.0	0.0	3.8	2.8
South Suriname	94	9	4.6	3.5	0.3	1.0	0.0	0.0	4.9	3.6
		df = 3 $\chi^2 = 51.976$ P < 0.001	df = 3 H = 55.499 P < 0.001		df = 3 H = 12.466 P = 0.006		df = 3 H = 7.939 P = 0.047		df = 3 H = 54.330 P < 0.001	
		Caries free	DT		MT		FT		DMFT	
N		%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Children with mixed dentition										
DMFT permanent teeth										
Brokopondo	397	75	0.4	0.9	0.0	0.1	0.0	0.2	0.5	1.0
Upper Suriname	206	51	1.2	1.5	0.0	0.2	0.0	0.1	1.3	1.6
West Suriname	20	65	0.7	1.1	0.1	0.2	0.0	0.0	0.8	1.2
South Suriname	94	44	1.5	1.9	0.0	0.1	0.0	0.0	1.5	1.9
		df = 3 $\chi^2 = 51.976$ P < 0.001	df = 3 H = 68.612 P < 0.001		df = 3 H = 4.028 P = 0.258		df = 3 H = 2.395 P = 0.495		df = 3 H = 64.604 P < 0.001	
		Caries free	dt + DT		mt + MT		ft + FT		Dmft + DMFT	
N		%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Children with mixed dentition										
dmft + DMFT primary and permanent teeth										
Brokopondo	397	21	2.9	2.8	0.3	0.8	0.1	0.4	3.3	3.0
Upper Suriname	206	8	5.3	3.5	0.6	1.3	0.1	0.5	6.0	3.9
West Suriname	20	10	4.4	2.9	0.1	0.3	0.0	0.0	4.5	3.0
South Suriname	94	2	6.1	3.6	0.3	1.0	0.0	0.0	6.4	3.7
		df = 3 $\chi^2 = 38.853$ P < 0.001	df = 3 H = 103.851 P < 0.001		df = 3 H = 12.213 P = 0.007		df = 3 H = 10.447 P = 0.015		df = 3 H = 100.500 P < 0.001	
		Caries free	DT		MT		FT		DMFT	
N		%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Children with permanent dentition only										
Brokopondo	252	39	1.3	1.6	0.2	0.6	0.1	0.5	1.6	1.8
Upper Suriname	125	8	3.1	2.3	0.4	0.7	0.0	0.3	3.6	2.5
West Suriname	13	46	1.4	1.5	0.2	0.4	0.0	0.0	1.5	1.8
South Suriname	61	13	3.0	2.3	0.3	0.9	0.1	0.5	3.3	2.5
		df = 3 $\chi^2 = 49.294$ P < 0.000	df = 3 H = 77.581 P < 0.001		df = 3 H = 21.077 P < 0.001		df = 3 H = 9.157 P = 0.027		df = 3 H = 72.101 P < 0.001	

children had been sought because oral health care provided by Medical Mission is free for schoolchildren, and medical assistants provide mostly emergency care in all areas. However, during the visits to the remote areas, it was remarkable that many urban influences in eating and drinking habits were seen, of which the use of soft drinks was

particularly striking. It seemed that those influences reached the remote areas, although the necessary adequate oral health routines did not reach in the same grade. To what extent these findings explain the differences in oral health between the regions could not be determined in our research.

TABLE 3

Percentages of children with caries prevalence (dmft > 0 or DMFT > 0) who had severe dental decay

	Primary dentition		Mixed dentition		Permanent dentition	
	n	Pufa > 0 (%)	n	PUFA + pufa > 0 (%)	n	PUFA > 0 (%)
Brokopondo	71	37	314	46	154	27
Upper Suriname	4	50	190	63	115	39
West Suriname	8	75	18	50	7	14
South Suriname	19	21	92	61	53	38
	$\chi^2 = 7.300$		$\chi^2 = 17.210$		$\chi^2 = 5.897$	
	df = 3		df = 3		df = 3	
	P = 0.063		P = 0.001		P = 0.117	

pufa = pulp involvement, ulcerations, fistulas and abscesses of primary teeth; PUFA = pulp involvement, ulcerations, fistulas and abscesses of permanent teeth.

In terms of generalizability, one should consider that our study population was from preselected regions, and our study population was a small proportion of the total child population in the interior of Suriname. However, there is no reason to assume that the schoolchildren in the selected villages included in our study had different living conditions than the schoolchildren in comparable regions, as these children had little to no accessibility to electricity, limited infrastructure, and little dental care. The selected regions were in need of the oral health screening because adequate screening is performed rarely in all areas of the interior (Figure 1). This screening

should be a continuous process in the interior of Suriname, but because of an absence of knowledge, only emergency care is provided in most areas. Thus, this study will give insight to the oral health status and treatment needs of children that are in turn for screening. As the oral health examinations were performed during school hours, all children, except for a small number of children who were sick, participated in this study. No response bias was therefore assumed. However, the results from some groups with low numbers of individuals should be regarded with caution.

CONCLUSION

The prevalence of caries of schoolchildren in the interior of Suriname was moderate to high according to the WHO criteria. Far less than 50% of the children were caries free, and the average DMFT in two of the four regions was more than 3, implying that the WHO goals have not been achieved. Treatments were rarely performed, and untreated caries often resulted in serious dental problems in which the tooth pulp was involved. Children living in more remote areas were more likely to have a high prevalence of caries and its severe consequences. This study showed a great need for preventive and curative treatment of caries in the interior of Suriname. Future research should focus on determinants to prevent oral diseases and to promote (oral) health with emphasis on promoting healthy

FIGURE 1. Selected regions in the study.

behaviors regarding food and nutrition and, in this case, oral health routines. The developed interventions should be tailored to target the different ethnic groups.

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