Dental caries and microbial and salivary conditions in Uruguayan children from two different socioeconomic areas

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Dental caries, microbial and salivary conditions, dietary habits, and socioeconomic conditions were studied in 100 12- to 13-year-old children from 2 different socioeconomic areas in Montevideo: Pocitos and Piedras Blancas. The residents of Pocitos had a higher educational level, better housing conditions, and occupations involving higher earnings than those of Piedras Blancas. The caries prevalence in the two areas was about the same, but the children in Piedras Blancas had more decayed surfaces and fewer filled surfaces than the children in Pocitos. The mean values for caries in Piedras Blancas and Pocitos were, DMFT, 4.2 and 4.2; DMFS, 8.1 and 7.8; DS, 4.7 and 2.5; and FS, 1.7 and 4.7, respectively. The differences in DS and FS were statistically significant. The frequency of sugar intake and the salivary secretion rate were similar, but the buffer capacity was significantly higher in Pocitos than in Piedras Blancas. The plaque index was the same, but the distribution of cariogenic microorganisms differed significantly. Fifty-eight per cent of the children in Piedras Blancas had more than 10^6 CFU of mutans streptococci per milliliter saliva, compared with 17% of the children in Pocitos. Similar differences were found with regard to the lactobacilli. The percentage of children with high numbers of mutans streptococci was higher in Piedras Blancas and lower in Pocitos than in previous epidemiologic studies in Scandinavia. It was, however, higher than that recently noted in Finland. □ *Epidemiology, oral; lactobacilli; mutans streptococci; saliva*

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In some South-American countries, restricted epidemiologic studies have been conducted on dental caries (1, 2). Gomes Pinto (3) reported a mean number of decayed, missing, and filled teeth (DMFT) of 6.6 in groups of 12-year-old Uruguayan children and DMFTs of 3 and 4.8 for 8- to 10-year-old Argentinian and 12-year-old Chilean children, respectively. Muñiz (2) found similar values in 12- to 13-year-old Argentinian children (DMFT, 3.2 to 3.9). Moreira et al. (1) stated that dental caries is the most prevalent oral disease in Brazil, with DMFT values of about 7–9 in 12-year-old children. In Uruguay no recent epidemiologic studies have been conducted.

Studies in Scandinavian countries have shown that dental caries and the oral status in general vary with the socioeconomic conditions (4, 5).

Mutans streptococci and lactobacilli have been closely associated with the development of dental caries in many studies, but in some no correlation was found (for a review, see Ref. 6). Recent observations show that mutans streptococci are also widespread in populations with an extremely low prevalence of dental caries in Africa and Asia (7). The distribution of these microorganisms and their relationship to dental caries have not been examined in Uruguay.

In this paper, dental caries and the microbial and salivary conditions of children

from two different socioeconomic areas in Montevideo are described.

Materials and methods

Subjects

In 1988, 100 12- to 13-year-old school children from the public schools in two different socioeconomic areas in Montevideo (Pocitos and Piedras Blancas) were selected for the study. Every fifth child from the class registers of all the schools in the two areas was asked to participate. Case history, dietary habits, and socioeconomic conditions were registered at the start of the study.

Pocitos is situated on the southern coast of Montevideo. It is the most densely populated area of the city; the buildings are high and spread along the coast. Piedras Blancas is a neighborhood in the northern part of Montevideo, situated far away from the coast and close to the city limit. The buildings are run down, some of them delapidated. The dental service in Pocitos is provided exclusively by private practitioners, whereas in Piedras Blancas both public dental clinics and private practitioners provide the dental service. Only emergency cases are treated in the public clinics. Both communities have the same drinking water, with a low fluoride content. Fluoride toothpastes are generally accepted, and various fluoride supplements have been introduced. Their use depends on the family income and the parents' interest in dental health.

Socioeconomic analysis

The living conditions of the 12- to 13-year-old children in both areas (Piedras Blancas and Pocitos) were recorded by one of the examiners. The parents' occupation was recorded on a scale of 0 to 3: 0 = unemployed parents; 1 = public or private employee, laborer; 2 = company owner without employees, independent worker; qualified employee, technician, teacher; 3 = university graduate, company owner with employees.

The parents' education level was recorded on a scale of 0 to 4: 0 = incomplete primary school; 1 = complete primary school; 2 = complete secondary school; 3 = teacher training; 4 = university education.

The subjects were also asked about the kind of housing conditions—that is, the number of persons who lived in the house, the number of persons who slept in the same room.

Clinical examination

A clinical examination was performed by one examiner in natural light, using plane mouth mirrors and sharp probes. Dental caries was diagnosed only when definite cavitation was present in accordance with the criteria issued by the World Health Organization (8). The occurrence of fissure caries, approximal caries, or free smooth surface caries was recorded for each tooth. Radiographs were not taken.

The caries experience was calculated as the sum of decayed, missing, and filled permanent teeth (DMFT) for each child. Decayed, missing, and filled permanent tooth surfaces (DMFS) were also calculated. Missing teeth were estimated as three missing surfaces for incisors and as five for premolars and molars.

The plaque index was recorded in accordance with Silness & Löe (9) and calculated on the buccal surfaces of six selected teeth: the upper and lower first molars, upper right first incisor, and lower left first incisor.

Dietary examination

The standard method described by Holm et al. (10) was used for the recording. The dietary examination included the frequency of sucrose intake—that is, drinks, fruits, cakes, jams, medicines, sweets, and the beverages consumed between meals.

Bacteriologic examination

Two saliva samples were obtained on two occasions from 78 of the 100 children examined clinically. In these samples the number of mutans streptococci and lactobacilli, in colony-forming units (CFU) per milliliter of saliva, secretion rate, and

buffering capacity were examined. The saliva samples were collected at mid-morning, about 2 h after the last meal. The children were asked to chew on a piece of paraffin wax for 5 min, and the saliva produced in this manner was collected in a sterile bottle and put in an icebox. Within the next 3 h the saliva samples were analyzed using the micromethod for quantitative estimation of mutans streptococci and lactobacilli described by Westergren & Krasse (11). The samples were dispersed on a Whirlimixer for 1 min and diluted in 10-fold steps in 0.05 M phosphate buffer (pH 7.3). They were then spotted in duplicate on mitis salivarius bacitracin (MSB) agar and in Rogosa selective lactobacillus agar (Difco). The agar plates were incubated for 48 h at 37°C in 5% CO_2. Counts of colonies with a morphology characteristic of mutans streptococci were made on MSB agar (12) and of lactobacilli on Rogosa agar. Questionable colonies on the MSB agar plates were isolated and biochemically tested, using the method described by Shklair & Keene (13). The two samples were collected from every child at an interval of about 1 week. The prevalence of mutans streptococci and lactobacilli in saliva was expressed as the number of CFU/ml of saliva. Of the two values, the highest was used in the classification.

Analysis of secretion rate and buffer capacity

The samples collected at school were transported in a cooler to the dental school laboratory. The secretion rate was estimated after the disappearance of the salivary foam and expressed in ml/min. The buffer capacity was determined with the method described by Ericsson (14). Three milliliters of 0.005 M HCl and one drop of octyl alcohol were added to 1 ml of saliva. A stream of carbon-dioxide-free air was passed slowly through the mixture for 20 min, and the pH was then determined electrometrically.

Statistical analysis

The differences in educational level, living conditions, occupation, and microbiologic and salivary conditions between the two populations were examined by using the chi-square test.

The differences between Pocitos and Piedras Blancas with regard to the prevalence of dental caries (DMFT, DT MT, FT, DMFS, DS, MS, and FS) were examined by means of Student's unpaired t test. The differences were considered statistically significant at $p < 0.05$.

Results

The residents of Pocitos had a higher edu-

Table 1. Distribution of the children in each geographic area on the basis of their parents' occupation and educational level (percentages in parentheses)

	Occupation			Education	
Code*	Piedras Blancas, *n* (%)	Pocitos, *n* (%)	Totals, *n*	Piedras Blancas, *n* (%)	Pocitos, *n* (%)
0	—	—	—	10 (20)	0
1	40 (82)	16 (32)	56	32 (65)	14 (27)
2	6 (12)	19 (37)	25	5 (10)	23 (45)
3	3 (6)	16 (31)	19	2 (4)	10 (20)
4	—	—	—	0	4 (8)

* Code for occupation: 0 = unemployed; 1 = public or private employees, laborer; 2 = company owner without employees, independent worker; 3 = university graduate, company owner with employees. Code for education: 0 = incomplete primary school; 1 = complete primary school; 2 = complete secondary school; 3 = teacher training; 4 = university education.

Table 2. Prevalence of DMFS, DMFT (means, standard deviations (SD), and range) and their components analyzed separately in both areas

	Piedras Blancas		Pocitos		
Index	Means ± SD	Range	Means ± SD	Range	P^*
DS	4.7 ± 4.8	0–18	2.5 ± 4.4	0–23	<0.01
MS	1.8 ± 2.7	0–12	0.6 ± 1.9	0–9	<0.01
FS	1.7 ± 3.2	0–17	4.7 ± 5.0	0–19	<0.001
DMFS	8.1 ± 6.9	0–25	7.8 ± 6.9	0–23	NS
DT	2.8 ± 2.3	0–10	1.6 ± 2.1	0–10	<0.01
MT	0.6 ± 0.9	0–4	0.2 ± 0.6	0–2	<0.01
FT	1.0 ± 1.9	0–10	2.4 ± 2.4	0–8	<0.05
DMFT	4.2 ± 3.3	0–14	4.2 ± 3.0	0–10	NS

* The probabilities refer to the differences between the two areas.

cational level, better housing conditions, and occupations involving higher incomes than those living in Piedras Blancas (Table 1). The educational level of most of the parents of the children from Piedras Blancas was 'complete primary school' (65%), whereas the largest group of the parents in Pocitos had 'complete secondary school' (45%). The differences were statistically significant ($p < 0.001$). With regard to the parents' occupation, most parents in Piedras Blancas were employees or laborers (82%). In Pocitos the distribution was more scattered: 32% were public or private employees; 37% were company owners without employees, independent workers, qualified employees, technicians, or teachers; and 32% were university graduates or company owners with employees ($p < 0.01$) (Table 1). With regard to living conditions, three or more and two or less persons slept in the same room in most families in Piedras Blancas and Pocitos, respectively ($p < 0.001$).

The caries data for the two areas are given in Table 2. The mean values of DS and MS were significantly lower ($p < 0.01$) and the FS values significantly higher ($p < 0.001$) in Pocitos than in Piedras Blancas, but the total DMFS values were almost the same, 7.8 and 8.1. The mean number of DMFT was the same, 4.2, but the mean values of DS and FS differed significantly (Table 2). Sixteen per cent of the children in Piedras Blancas had more than 10 DS, whereas in Pocitos the corresponding figure was 4%. Whereas 65% of the children in Piedras Blancas had open lesions and no restorations, 73% of the children in Pocitos had between 1 and 12 filled surfaces.

The distribution of children on the basis of the frequency of intake of foods containing sucrose was very similar in the two socioeconomic areas. Eighty per cent of the children in Piedras Blancas and 69% in Pocitos ate sweets between meals.

The average salivary secretion rate was almost the same in the two areas, 1.5 ml/min in Pocitos and 1.4 in Piedras Blancas, but the buffer capacity differed significantly. The average final pH was 5.4 in Piedras Blancas and 6.6 in Pocitos. The average plaque index in Piedras Blancas and Pocitos was 1.2 and 1.1, respectively.

The levels of mutans streptococci and lactobacilli in children from Piedras Blancas were higher than those in Pocitos. In Piedras Blancas 58% of the children had more than 10^6 CFU mutans streptococci per milliliter saliva, whereas only 17% of the children in Pocitos had this high value. The difference between the two areas was statistically significant ($p < 0.005$). Similar differences were found with regard to lactobacilli.

In Piedras Blancas 40% of the children had the highest salivary values of both microorganisms, whereas 40% of the children in Pocitos had the lowest values ($p < 0.005$). The correlation between these microorgan-

Table 3. Average number of decayed surfaces in groups of children (number of children in parentheses) with different levels of mutans streptococci and lactobacilli in saliva (78 children)

Mutans streptococci	Lactobacilli			
	$<10^3$	$>10^3$–$<10^4$	$>10^4$–$<10^5$	Total
$<10^5$	2.1 (18)	2.2 (7)	2.0 (9)	1.8 (34)
$>10^5$–$<10^6$	2.0 (2)	0.0 (1)	1.0 (1)	1.2 (4)
$>10^6$	2.1 (14)	3.3 (4)	6.9 (22)	4.9 (40)
Total	2.1 (34)	3.7 (12)	5.3 (32)	3.7 (78)

isms and the prevalence of decayed surfaces is shown in Table 3. Twenty-two children with the highest numbers of the microorganisms had an average of 6.9 DS, and 18 of the children with the lowest numbers of the microorganisms had an average of 2.1 DS.

Discussion

The prevalence of dental caries in the children in Montevideo was of the same order of magnitude as that reported in children from Argentina (2) but considerably higher than in Scandinavia today. In Montevideo the socioeconomic conditions are completely different from those in the Scandinavian countries (15). During the first decades of this century Uruguay was developed into a welfare state. An 8-h working day was introduced already in 1915, and to retire on a pension only 9 years of work was required. In the 1930s Uruguay was considered to be one of the wealthiest countries in the world. In the 1950s, however, the export of meat and wool stagnated, and now Uruguay is considered to be a third-world country with high inflation and great poverty. During the last few years the socioeconomic conditions have improved, but, as mentioned earlier, only emergency cases are treated in the public dental clinics. Organized dental care for children does not exist.

In the two areas in Montevideo, Pocitos and Piedras Blancas, the socioeconomic conditions differed significantly (that is, with regard to educational level, occupation of the children's parents, and family housing conditions). The DMFS index was similar in the two areas, but the number of decayed surfaces was not. The number of children with no DS in Pocitos was almost twice as high as that in Piedras Blancas (Table 1). In Piedras Blancas, on the other hand, four times as many children as in Pocitos had more than 10 DS. This means that, whereas DS prevailed in the DMFS index in Piedras Blancas (4.7 of 8.1, on an average), FS predominated in Pocitos (4.7 of 7.8). On an average, the children in Piedras Blancas had 2.4 more DS than the children in Pocitos; whereas the children from Pocitos had 2.8 more filled surfaces than those from Piedras Blancas. Consequently, the two populations were quite different; one had received general dental care, and the other had only obtained emergency treatment. The difference found between the two areas with different socioeconomic conditions with regard to the caries picture is largely in agreement with observations made by other investigators (4, 16, 17). In Pocitos, the proportion of filled surfaces remained the same when the DMFS index increased, whereas in Piedras Blancas an increase in the DMFS index corresponded to a proportional increase in decayed and missing surfaces. Not only restorative treatment but also preventive measures were virtually absent in Piedras Blancas. In Pocitos, on the other hand, treatment and some preventive measures were applied, but the prevention had not resulted in a lower total DMFS level than in Piedras Blancas.

The distribution of mutans streptococci and lactobacilli also differed significantly. Higher numbers of both organisms were found in Piedras Blancas than in Pocitos. The percentage of children with high numbers of mutans streptococci was higher in Piedras Blancas and lower in Pocitos than that found in previous epidemiologic studies in Scandinavia (18–20). It was, however, higher than that recently noted in Finland by Alaluusua et al. (21). The differences in microbiologic conditions between the two socioeconomic areas reflect the differences in decayed surfaces and may be due in part to the fact that carious lesions harbor large numbers of lactobacilli and mutans streptococci. The DS could act as infectious foci from which highly cariogenic microorganisms spread to the erupting permanent teeth (22). This would then mean that the children in Piedras Blancas run a higher risk of developing caries in the future than the children in Pocitos. Longitudinal studies have shown that early establishment of mutans streptococci increases the risk of caries in both the deciduous and the permanent dentition (23–26).

Although the salivary secretion rate was similar, the buffer capacity was significantly lower in the low socioeconomic area, Piedras Blancas, than in Pocitos. The reason for this might be nutritional differences, but no significant differences were observed.

Caries-preventive measures are much needed, and methods such as supervised use of fluorides, which have been used in Scandinavia (26), ought to be tested. However, as the resources for dental care are very limited, an additional preventive program may be needed. This could involve examination of mutans streptococci and measures aimed at reducing the cariogenic challenge. This seems important, as additional topical fluoride applications have a limited effect in children highly infected with cariogenic microorganisms (28).

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