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Oral health in a group of sugar-cane chewers

S Harris and P Cleaton-Jones

Dental Research Unit of the South African Medical Research Council and the University of the Witwatersrand, Jan Smuts Avenue, Johannesburg, South Africa, 2001.

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SUMMARY

The oral health of 98 sugar-cane chewers was investigated. There were progressive increases in D M F T values and Ramfjord's P D I scores as age increased but degree of attrition remained constant. The investigation showed that simple oral hygiene procedures were followed, 4-5 Kg of sugar-cane were chewed per day (= 500 g sucrose), and yet the D M F T values were low.

OPSOMMING

Die mondgesondheid van 98 suikerrietkouers is ondersoek. 'n Progressiewe vermeerdering in D M F T-waardes en Ramfjord se P D I-tellings het plaasgevind namate die ouderdom toegeneem het. Die graad van attrisie het egter konstant gebly. Hierdie ondersoek het getoon dat eenvoudige mondhigiëne toegepas is, dat daar 4-5 Kg suikerriet per dag (= 500 g sukrose) gekou is, en tog het die D M F T-waardes laag gebly.

INTRODUCTION

The prevalence of dental caries is lower among populations eating an unrefined diet than those ingesting highly refined carbohydrates. This has been shown in various groups such as South African Bantu (Oranje, Noriskin and Osborn 1935; Staz 1938), Maya and Navajo Indians, Hollanders and Jamaicans (Steggerda and Hill 1936), Indians (Ramfjord 1961), Nigerians (Sheiham 1967), and Finns (Ainamo and Alvesalo 1970).

In 1952 Dreizen and Spies questioned the generally held belief that although refined carbohydrates might be conducive to dental caries, the same foods, if ingested in the raw or natural state, were protective against this disease. They referred to two opposing studies. Osborn and Noriskin (1937) had reported that there was a low prevalence of dental caries among Bantu labourers in the sugar-cane fields of South Africa; in contrast Steggerda and Hill (1936) had reported a high caries prevalence in sugar-cane chewers on the island of Jamaica. Dreizen and Spies then investigated 147 sugar-cane chewers in Cuba 141 of whom were white and 6 negro, and observed a high caries prevalence.

More recently, Künzel *et al* (1973) examined 81 Cuban sugar-cane farm workers and observed high prevalences of both dental caries and periodontal disease. They concluded that the hypotheses which assumed mechanical cleaning effect of sugar-cane, leading to caries reduction, must be rejected.

The present study was undertaken to examine the dental caries prevalence in Bantu sugar-cane chewers in South Africa, some 40 years after the initial study of Osborn and Noriskin (1937).

MATERIALS AND METHODS

The survey was carried out on a group of 98 rural Bantu, all the labourers in the region, living and working on sugar farms in the Pongola district, a subtropical region of the South-eastern Transvaal. All ate a typical Bantu diet consisting of maize meal supplemented by legumes and meat (Walker 1977).

The following data was recorded.

1. Personal details: age, sex, length of residence in area
2. Heights (cm) mass (Kg)
3. Oral hygiene methods
4. DMFT index
5. Plaque index
6. Ramfjord's periodontal disease index (PDI)
7. Amount of dental attrition
8. Sugar-cane chewing habits

Forty-seven of the subjects studied were unsure of their age so the classification of age groups suggested by van Reenen (1964) was used. This comprises children, ado-

lescents, young adults, middle-aged and old-aged individuals. The criteria for these are shown in Table I.

Table I. Details of subjects examined

Age Group (van Reenen 1964)	Males	Females
Old-age (> 60 yrs)	6	1
Middle-aged (40-60 yrs)	7	11
Young adult (+ 3rd molars)	23	15
Adolescent (+ 2nd molars)	26	9
Child (– 2nd molars)	0	0
Total	62	36

All examinations were carried out in natural light using mouth mirror, probe, periodontal probe and disclosing solution. Caries was diagnosed whenever a sharp dental probe 'caught' in a pit, fissure or suspicious area, and any teeth lost due to trauma were regarded as being sound.

The plaque index used was a modified version of the Silness and Löe and Quigley and Hein indices (Glickman 1972), as used in the department of conservative dentistry, University of the Witwatersrand. The six teeth used by Ramfjord (1959) for his periodontal disease index were scored as follows:

1. The teeth were stained with a disclosing solution
2. Each of the six teeth were divided into 4 areas, mesial, buccal, distal and lingual
3. Each of the four areas were scored from 0-3 according to the following criteria:
   (a) 0 = No plaque
   (b) 1 = Plaque covering up to 1/3 of the crown of the tooth
   (c) 2 = Plaque covering from 1/3 to 2/3 of the crown of the tooth
   (d) 3 = Plaque covering whole of the crown of the tooth

The scores around each tooth were totalled and divided by four to determine the mean plaque index for each tooth. These indices were then recorded.

The periodontal disease index was determined according to Ramfjord (1959).

The criteria used for the attrition index were those suggested by van Reenen (1964):

1. The occlusal surfaces of the six teeth were examined
2. The scores were allocated as follows:
   (a) 0 = No attrition of enamel
   (b) 1 = Attrition of enamel
   (c) 2 = Attrition of enamel with exposed dentine
   (d) Devitalized tooth and pulp chamber exposed

The observations were transferred to punch cards and analysed in an IBM 370/158 computer using the Statistical Package for the Social Sciences (Nie *et al* 1975).

In addition water samples from all sources of drinking water, namely boreholes, rivers and canals, were collected for measurement of their fluoride content. The fluoride analyses were performed using a combined fluoride ion selective electrode (Orion Research, Model 96-09) coupled to a digital pH meter (Orion Research, Model 701).

RESULTS

Almost twice as many males as females were examin
No children were investigated and there were only ei
in the old-age group. The majority of subjects fell wit
the adolescent and young adult groups (Table I). T
were a stable population having lived in the area fo
mean of 17,2 ± 11,8 years.

The traditional method of chewing the sugar-cane
practised by all the subjects. The outer hard skin
stripped off with the teeth to expose the fleshy part
the cane containing fibre and sucrose (Fig. 1). In l
the mean composition of this flesh was 14,2 per c
fibre, 13,5 per cent sucrose with the remainder be
organic and inorganic impurities, cellulose and wa
The mean pH of the sugar-cane juice was 5,2 (Sc
Milling Research Institute 1974 – personal commu
cation).



Fig. 1. The outer hard skin is stripped off using the teeth.

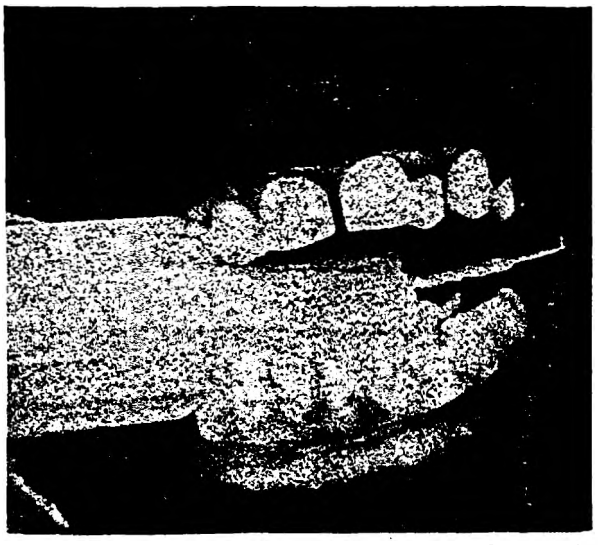


Fig. 2. A substantial bite is taken of the inner, hard, fibre bundle containing the sucrose juice.

A substantial bite of the inner fleshy fibre bundle c
taining the sugar-cane juice was then taken (Fig. 2
produce a bolus of about 1-4 cm. This was then c
templatively chewed and sucked until most of

Table II. Details of dental caries in the subjects (means ± standard deviations)

Index	Sex	Age group: Adolescent	Young adult	Middle-aged	Old-aged	All ages
% subjects caries free	Male	17,3	8,2	1,0	0	25,5
	Female	6,1	4,1	1,0	0	11,2
Decayed teeth	Male	0,7 ± 1,2	1,6 ± 2,0	1,6 ± 1,6	2,0 ± 2,1	1,3 ± 1,7
	Female	0,9 ± 1,7	1,7 ± 2,0	1,6 ± 2,0	5,0 ± 0	1,6 ± 1,9
Missing teeth	Male	0,1 ± 0,3	0,7 ± 1,3	5,4 ± 5,9	5,8 ± 4,7	1,5 ± 3,3
	Female	0,2 ± 0,7	2,5 ± 4,2	3,7 ± 4,1	5,0 ± 0	2,4 ± 3,8
DMFT	Male	0,8 ± 1,3	2,4 ± 2,6	7,0 ± 6,5	7,8 ± 4,9	2,8 ± 4,0
	Female	1,1 ± 2,3	4,2 ± 4,7	5,4 ± 4,6	10,0 ± 0	4,0 ± 4,6

Table III. Plaque index, Ramfjords PDI and attrition indices (means ± standard deviations)

Index	Sex	Age group: Adolescent	Young adult	Middle-aged	Old-aged	All ages
Plaque index (max = 3)	Male	1,4 ± 0,4	1,4 ± 0,5	1,6 ± 0,6	1,6 ± 0,5	1,5 ± 0,5
	Female	1,4 ± 0,3	1,5 ± 0,3	1,6 ± 0,5	2,0 ± 0	1,5 ± 0,4
Ramfjord PDI (max = 6)	Male	0,9 ± 0,7	1,8 ± 1,1	3,3 ± 1,3	2,4 ± 1,1	1,6 ± 1,2
	Female	0,4 ± 0,7	1,3 ± 0,8	3,3 ± 1,0	3,1 ± 0	1,7 ± 1,4
Attrition index (max = 3)	Male	1,2 ± 0,2	1,2 ± 0,1	1,3 ± 0,2	1,2 ± 0,2	1,2 ± 0,2
	Female	1,1 ± 0,1	1,2 ± 0,2	1,2 ± 0,2	1,0 ± 0	1,2 ± 0,2

sweetness had been extracted after which the chewed bolus was discarded and another bite taken.

It proved impossible to record accurately the frequency of sugar-cane chewing which varied considerably from day to day; the labourers chew the cane only during tea and lunch breaks and in off-duty hours. The amount of cane chewed varied with age with the younger individuals chewing more than the older. Usually, however, about 5 metres of cane was chewed per day which is equivalent to 4-5 Kg of sugar-cane and approximately 500 g of sucrose.

In spite of the high sucrose intake the heights and mass of the subjects fell within the norms accepted by the International Biological Programme and the Metropolitan Life Insurance Company (Walker 1977 – personal communication).

Dental caries observations are listed in Table II. Of all the subjects 35,7 per cent were caries free, the greatest number being in the adolescent and old age groups. A greater number of males were free of caries than were females but this difference was not statistically significant. There was an increase in caries with aging, the lowest prevalence was in the adolescent group. No significant differences were found between males and females in this nor any other section of the study. In the adolescents and young adults there were more carious than missing teeth while the opposite was noted in the middle-aged and old-aged groups. The tooth loss was due to both caries and periodontal disease. It was not possible to determine which condition was responsible for the greater loss. No restored teeth were seen.

When the plaque index was calculated this was found to be constant throughout all the groups (Table III).

The values of Ramfjord's periodontal index showed an increase with age (Table III). The value in the middle-aged group was more than double those in the younger individuals, which difference was statistically significant ($p < 0,5$). Careful questioning revealed that a reduced ability to chew the hard sugar-cane due to pain and mobile teeth was associated with this increase in the periodontal index.

Attrition was seen in all the age groups. The amount of attrition did not increase with age.

The various oral cleansing habits used are listed in Table IV. These were rudimentary and mostly consisted of rinsing the mouth with water. Traditional sand and ash cleansing were used by only 11 per cent of the sample. Statistical analyses revealed no significant differences in any of the indices between groups using different cleansing habits.

The water supply in the area was found to be fluoride deficient with a mean value of 0,088 ppm.

Table IV. Oral cleansing habits in the 98 subjects

Method		Agent		Frequency per day
Nil	1	Nil	2	0 – 1
Finger	12	Soap	2	1 – 36
Toothbrush	20	Ash	2	2 – 20
Water rinse only	65	Sand	9	3 – 34
		Toothpaste	17	
		Water only	66	

DISCUSSION

The low prevalence of dental caries in this study confirmed initial clinical impressions. The findings of Oranje and Nöriskin (1937) almost 40 years ago have thus been corroborated. Unfortunately, due to differing terminology, the absolute DMFT values obtained in the present study cannot be directly compared to the results in the investigations of Oranje and Noriskin (1937) and Steggerda and Hill (1936).

Dreizen and Spies (1952) and Künzel *et al* (1973), however, employed similar terminology. They recorded mean DMFT values of 15,1 and 16,5 respectively in Cuban sugar-cane chewers. These values are very much higher than the very low DMFT of 3,2 noted in the present study, which must include teeth lost due to periodontal disease. Age groups and numbers in the present study and those of Dreizan and Spies (1952) and Künzel *et al* (1973) were similar, as was the method of sugar-cane chewing. All of Künzel *et al's* subjects and all but 6 of Dreizen and Spies' subjects were white, however, in contrast to the Bantu in the present study. It has been reported elsewhere that there are differences in caries prevalences in different racial groups e.g. whites and negroes in the United States (Kelly *et al* 1967; Littleton *et al* 1970; Rowe *et al* 1976), whites, negroes and other groups in South Africa (Staz 1938; Retief *et al* 1975). It is therefore conceivable that this variation in caries prevalence may also be present in the sugar-cane chewers. If so, then the DMFT values of 15,1 recorded by Dreizen and Spies (1952) and 16,5 of Künzel *et al* (1973) are similar to those in other non-sugar-cane chewing whites, while the DMFT findings in the present study in the Bantu sugar-cane chewers, are similar to the finding in Bantu non-sugar-cane chewers (Staz 1938; Retief *et al* 1975).

Thus, bearing in mind the low numbers examined, one may suggest that caries prevalence is no worse in Black habitual sugar-cane chewers than in Black non-sugar-cane chewers, in spite of an enormous daily sucrose intake of over 500 g.

The reason for this apparent contradiction of the generally accepted dogma is not clear. The abrasive action of the sugar-cane probably plays little role since the amount of plaque present is considerable. Osborn *et al* (1937) have suggested, following *in vitro* studies on tooth decalcification, that there is a protective agent in crude sugar-cane juice which is removed during processing. This hypothesis however, is not supported by the studies of Dreizen and Spies (1952) and Künzel *et al* (1973).

Use of the teeth to tear and chew the hard sugar-cane stalks over a prolonged period was associated with both attrition and periodontal disease. The attrition, although marked, is less than that seen in Kalahari bushmen living in a sandy environment (van Reenen 1964). No mention of the degree of attrition has been made in the other studies of sugar-cane chewers. The effect of the attrition on dental caries coupled with the lack of information on the frequency of sugar-cane ingestion, the possibility of an extraneous fluoride source and the possible absence of a cariogenic flora must temper the apparent rejection of the dogma.

The amount of periodontal disease seen, does not appear excessively high. The PDI values in our study closely resemble those of Künzel *et al* (1973) as well a those reported in the rural Finnish population by Ainam and Alvesalo (1970). It is probably a "normal" incre ment with advancing age. It is not possible to sa whether the periodontal disease occurred at an earli age in the present study, due to the inaccuracy of th age recordings.

Finally, the normal values for mass seen in this study, spite of a high daily sucrose intake, are probably relate to the heavy manual labour involved in cutting th sugar-cane.

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