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The bearing of dietary sucrose on the deciduous dentition of pre-schoolchildren in the Transvaal

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INTRODUCTION

There is a paucity of information on the daily sucrose intakes and the relationship of this to the dental health of South African pre-schoolchildren. In order to learn more of the situation and to compare data with that reported by overseas workers (Weiss and Trithart, 1960; Bagraiman *et al*, 1974), studies on sucrose intake and dental health have been undertaken in 4 racial groups, namely Black, Coloured, indian and White pre-schoolchildren. Studies on 2 groups, namely the Coloured and Indian communities are still underway and consequently studies on only Black and White groups will be discussed in this communication. It is not the purpose of the present paper to discuss either total sucrose intake patterns (Richardson *et al*, 1978a; Richardson *et al*, 1978b) nor dmft scores (Cleaton-Jones *et al*, 1978; Cleaton-Jones, Richardson and Rantsho 1978) as these have been adequately described elsewhere, but to relate observed sucrose intake patterns with prevalences of caries, and more particularly labial caries (decay on the surface of one or more incisor or canine teeth).

SUBJECTS

As both the subjects and methodology have been described elsewhere, only a brief outline will be given (Richardson *et al*, 1978; Cleaton-Jones *et al*, 1978).

Black rural group

This group comprised 427 children aged 1-6 residing in the north-west and western Transvaal. Children lived in two villages, Tlaseng and Motlatla, or attended the only 2 nursery schools in the Rustenburg area, at Phokeng and Thlabane.

Black urban group

This group consisted of 250 children aged 1-6 years chosen from areas randomly selected from points on a grid map of Soweto.

White urban group

This group of 467 children aged 1-6 years were drawn from five nursery schools in Johannesburg as well as children in the general population living in close proximity to the schools.

METHODS

All children were weighed and measured. Teeth were examined in natural light, using mirror and probe and dmft scores recorded. If the probe 'caught' in suspicious areas, pits or fissures, teeth were considered decayed (Cleaton-Jones *et al*, 1978).

Trained interviewers completed sugar questionnaires during visits to children's homes in Black rural, urban and White general population groups. As most parents of White nursery schoolchildren were working, children took a questionnaire with an explanatory letter home for completion (Richardson *et al*, 1978). These were later collected. The information gathered was considered reliable as mean sucrose intake was nog significantly different from that collected by individual interview.

A detailed analysis of sucrose intake patterns and amounts taken in liquid and solid form was undertaken and related to the prevalence of caries, particularly labial caries. Infant feeding practices were also investigated in order to throw more light on the alleged detrimental role of sucrose, particularly that derived from fruit syrup concentrates, in feeding bottles in the causation of labial decay which has been graphically described by Shelton, Berkowitz and Forrester (1977) as making 'dental cripples' of young children. Dental hygiene as practised by the various groups will only be briefly touched upon.

Data were analysed using the Statistical Package for Social Sciences (Nie *et al*, 1975) on a 370/158 computer. The Students' t test was used and $p<0,01$ was chosen as the level of statistical significance.

RESULTS

Sucrose intake patterns

These can be divided into (1) patterns observed from birth to 2 years termed the infant group. This was largely retrospective data in the case of most subjects, except those children not yet 2 years of age; and (2) patterns for the child older than 2 years but not exceeding 6 years, referred to as the pre-school group.

In Table I mean daily sucrose intakes in grammes from liquid and solid fractions of the diet are given for infants. The table shows sucrose intakes derived from various sources, namely, feeding bottles or cups, also from food and sweets.

Mean daily sucrose intakes derived from liquid and solid fractions of the diet for older children are shown in Table II.

Table I Mean daily sucrose intakes in grammes from liquid and solid fractions of the diet in infants (0-2 years)

Group	Number subjects		Mean sucrose intake in g/d				
			Liquids		Solids		Total
			Bottle	Cup	Food	Sweets	
Black rural	427	$\bar{X}$	17,6^{+}	6,6^{+}	6,8	7,4^{+}	38,4^{+}
		S.D.	7,9	5,8	6,8	8,6	31,5
Black urban	250	$\bar{X}$	27,8^{+}	4,4^{+}	6,8	12,1	51,1
		S.D.	7,2	4,3	3,3	9,8	21,5
White urban	436	X	23,0^{+}	12,0^{+}	8,4$^{\bar{x}}$	10,9	54,3
		S.D.	11,7	12,2	8,4	17,3	40,9

$\bar{x}$ $p<0,01$
\+ $P<0,001$
S.D. — standard deviation
$\bar{x}$ — Mean

Table II Mean daily sucrose derived from liquid and solid fractions of the diet in pre-school children (2-6 years)

Group	Number subjects		Mean sucrose intake in g/d			
			Liquids	Food	Sweets	Total
Black rural	375	$\bar{X}$	27,2	15,8^{+}	11,1	54,1
		S.D.	11,7	15,1	11,1	33,6
Black urban	215	$\bar{X}$	27,3	24,1	12,9	64,3
		S.D.	6,1	6,0	10,0	15,9
White urban	436	$\bar{X}$	41,1^{+}	23,9	23,6^{+}	88,6^{+}
		S.D.	18,5	15,4	25,9	48,0

\+ $P<0,001$
S.D. — Standard deviation
$\bar{X}$ — Mean

The histograms depicted in Figure I show the relative proportions of mean daily sucrose intakes from bottles and cups and those of caries and labial caries in the various groups.

Figure 2 shows the relative percentages of sucrose derived from the various liquid fractions of the diet of infants taken in feeding bottles or cups.

DISCUSSION

As previously cited, it is not the intention to discuss either total sucrose intake patterns nor dmft scores. It is necessary to give a brief summary of these findings.

SUMMARY OF PREVIOUSLY REPORTED FINDINGS

Total sucrose intake and dental caries

It was found that mean total sucrose intake was lower in children under 2 than those aged 2-6 years. Black rural children had significantly lower mean sucrose intakes than their urban counterparts, and both groups had significantly lower mean sucrose intakes compared with those of White children. Mean dmft scores followed a similar pattern, being significantly lower in Black compared with White children.

In both urban Black and White children, those consuming greater amounts of sucrose had significantly more caries than those with lower intakes. However, in the Black rural group, low consumers, with intakes one tenth that of high consumers, i.e. 10 g/d compared with 122 g/d, had similar caries prevalences. The 'high total sucrose intake — high caries hypothesis' was found to have a measure of support in both White and Black urban groups, but not in the Black rural groups, for which there is no ready explanation.

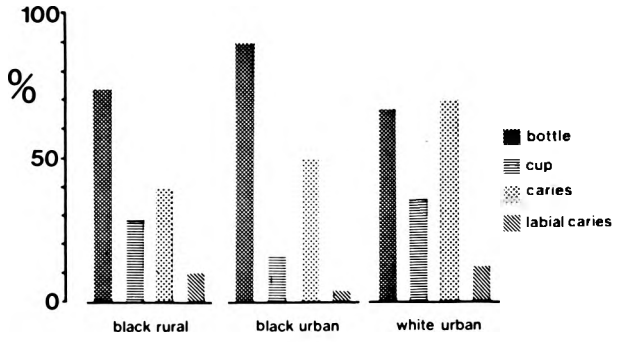

Fig. 1 Histogram showing the relative proportions of mean daily sucrose intakes from feeding bottles and cups and those of caries and labial caries

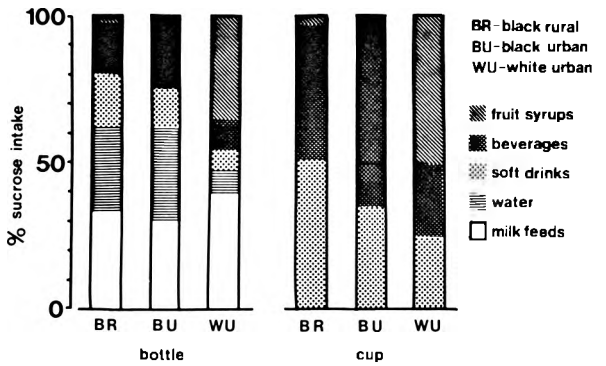

Fig. 2 Relative percentages of mean daily sucrose intake derived from the various liquid fractions of the diet of infants taken respectively in feeding bottles and cups

Total sucrose intake and labial caries

The finding of exceptional interest was the high prevalence of labial caries in Black rural children, who had the same prevalence as White children, 11,7 per cent and 12,0 per cent, respectively; this prevailed in spite of significantly different sucrose intake patterns. Black urban children had a very low labial caries prevalence, 4,0 per cent. No support was found for the generally accepted hypothesis that large amounts of sucrose in feeding bottles, in particular fruit syrup concentrates, was the principal aetiological factor of labial decay (Richardson and Cleaton-Jones, 1977), as is believed by many workers (Winter, Hamilton and James, 1966; Goose and Gittus, 1968; Shelton, Berkowitz and Forrester, 1977). In a monograph by Jackson (1978), this hypothesis has recently been questioned. The present observations supported Jackson's view as we found that Black infants consumed no fruit syrups compared to 15 g/d intake of White infants and yet had the same prevalence of labial caries.

Present findings

By far the more important period in any consideration of labial decay is the sucrose pattern pertaining during the earliest years, thus infant feeding methods are obviously of primary importance. Solid sucrose intake, especially from sweets, is of lesser importance, but is considered to be the caries 'culprit' in the older child.

Infant feeding methods

In Western communities breast-feeding for periods of 3 months or longer has been previously considered satisfactory; 6 months are now thought to be more desirable (Jelliffe and Jelliffe, 1978). In the groups of Black rural and urban mothers studied, 73 per cent and 72 per cent, respectively, breast-fed for 6 months or longer, but only 8 per cent of White mothers; mean periods were 50 ± 35 weeks in the case of Black rural, 49 ± 34 weeks for Black urban, i.e. an approximate mean period of 11 months for Black mothers, and only 8 ± 9 weeks, i.e. about 2 months, for White mothers. Percentages of babies fed entirely by bottle were 10 per cent in Black rural, 1 per cent in Black urban and 27 per cent in White groups (Richardson, 1978).

Liquid sucrose intake

Infants

The daily sucrose intake of infants from various sources, such as soft drinks and beverages (tea or coffee), was divided into that given per bottle or per cup. This amount varied, but approximately three quarters to two thirds was given in bottles, the rest, a surprisingly high proportion, was given in cups (Fig. 1). The patterns of sucrose given per bottle (Fig. 2) and derived from the various liquid fractions of the diet in infancy were closely similar for both rural and urban Black groups. Sucrose added to drinking water, was offered in significantly greater proportions to Black compared to White infants, also that from soft drinks and beverages. On the other hand, White compared to Black infants were offered significantly greater amounts of fruit syrups concentrates, which formed more than one third of the sucrose intake of White infants. The amounts of sucrose, approximately one third, derived from milk feeds, was much the same for all groups. Sucrose offered in drinking water was of course far less concentrated than that in fruit syrup drinks.

The amount of sucrose given per cup, although surprisingly high, has not been accorded the same aetiological significance in causing labial decay, as that from feeding bottles. It is of interest that the White infant was offered large amounts of fruit syrups in cups, almost as much as in bottles — 8,6 g/d compared to 6,2 g/d, respectively. Fruit syrups thus contributed about half of the daily cup sucrose intake in Whites; beverages two thirds that of urban Black; and approximately equal amounts of beverages and soft drinks that of rural Black infants (Fig. 2).

Pre-school

Older White children had significantly greater ($p<0,001$) amounts of sucrose in the liquid portion of their diets compared to Black children (Table II).

Sucrose intake from food and sweets

Infants

White infants had a significantly higher ($p<0,01$) food sucrose intake compared to Blacks, but both urban Black and White infants had a significantly greater intake of sweets ($p<0,001$) than rural Black infants (Table I).

Pre-school

Black urban and White children had significantly higher ($p<0,001$) intakes of sucrose from food compared to rural Black children, but in the case of sweets, White children ate significantly greater ($p<0,001$) amounts than Black children (Table II).

Feeding bottle sucrose and labial decay

Surprisingly, Black urban mothers used the bottle as the vehicle for sucrose more frequently than other groups (Fig. 1); respective percentages were 73 per cent for Black rural, 87 per cent for Black urban, and 66 per cent for White groups. The Black rural group, who had a high labial caries prevalence which was associated with a nil fruit syrup intake, had a fairly high percentage of sucrose in bottles; the Black urban group, with a very low labial caries prevalence, had no fruit syrups but had the highest percentage of sucrose in bottles. It must, however, be borne in mind that very few Black mothers used the bottle frequently before 3 months, but the majority of White mothers bottle-fed their infants. This further emphasises the lack of correlation between sucrose intake, from whatever source, and prevalence of labial caries.

CONCLUSION

The respective roles of sucrose intake from feeding bottles in infants, and sucrose intakes in older children, on the caries and labial caries prevalences, may be summarised and graphically illustrated in the following diagrams (Figs. 3 and 4).

These diagrams serve to emphasize the marked differences in sucrose intake patterns and their lack of association with labial or 'bottle-feeding' caries, particularly in Black rural and urban groups. The contradictory situation emerged of a low labial caries and a fairly high

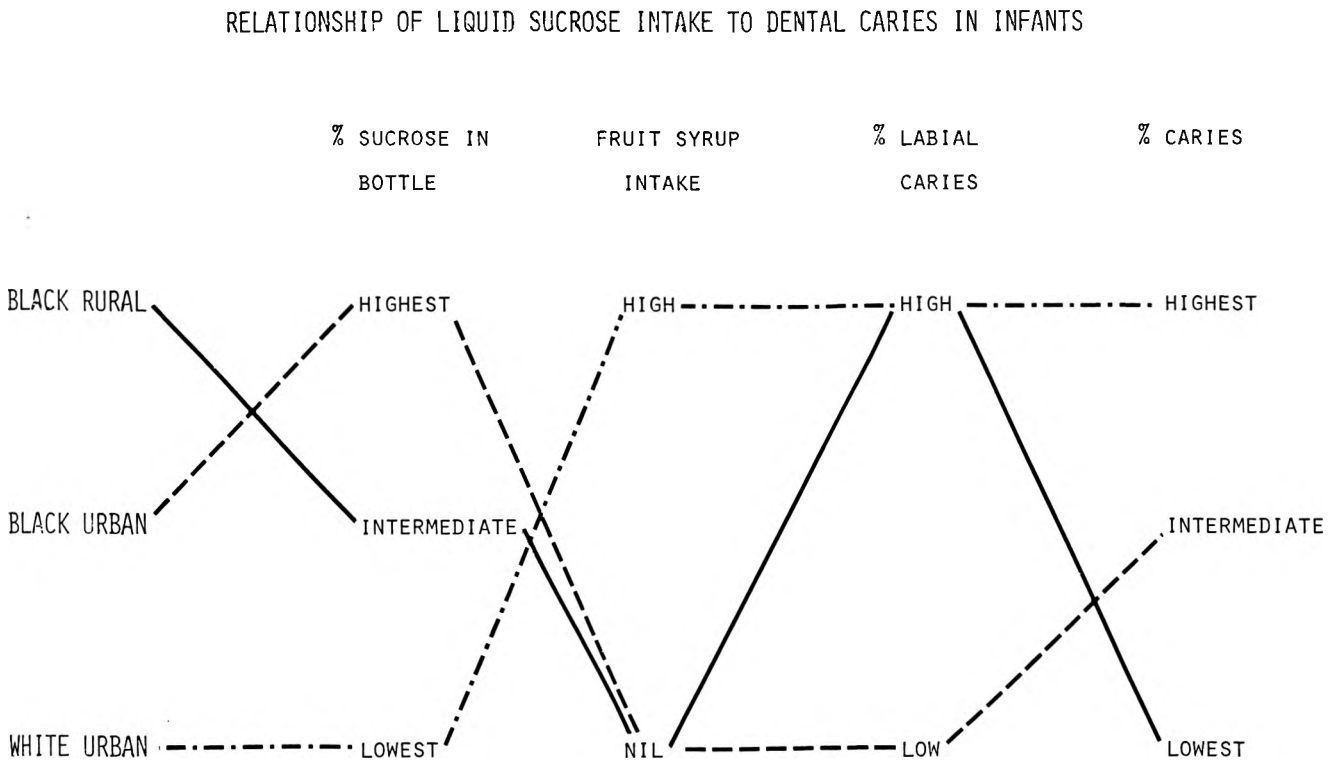

Fig. 3 Flow diagram showing the relationship of liquid sucrose intake to dental caries in infants

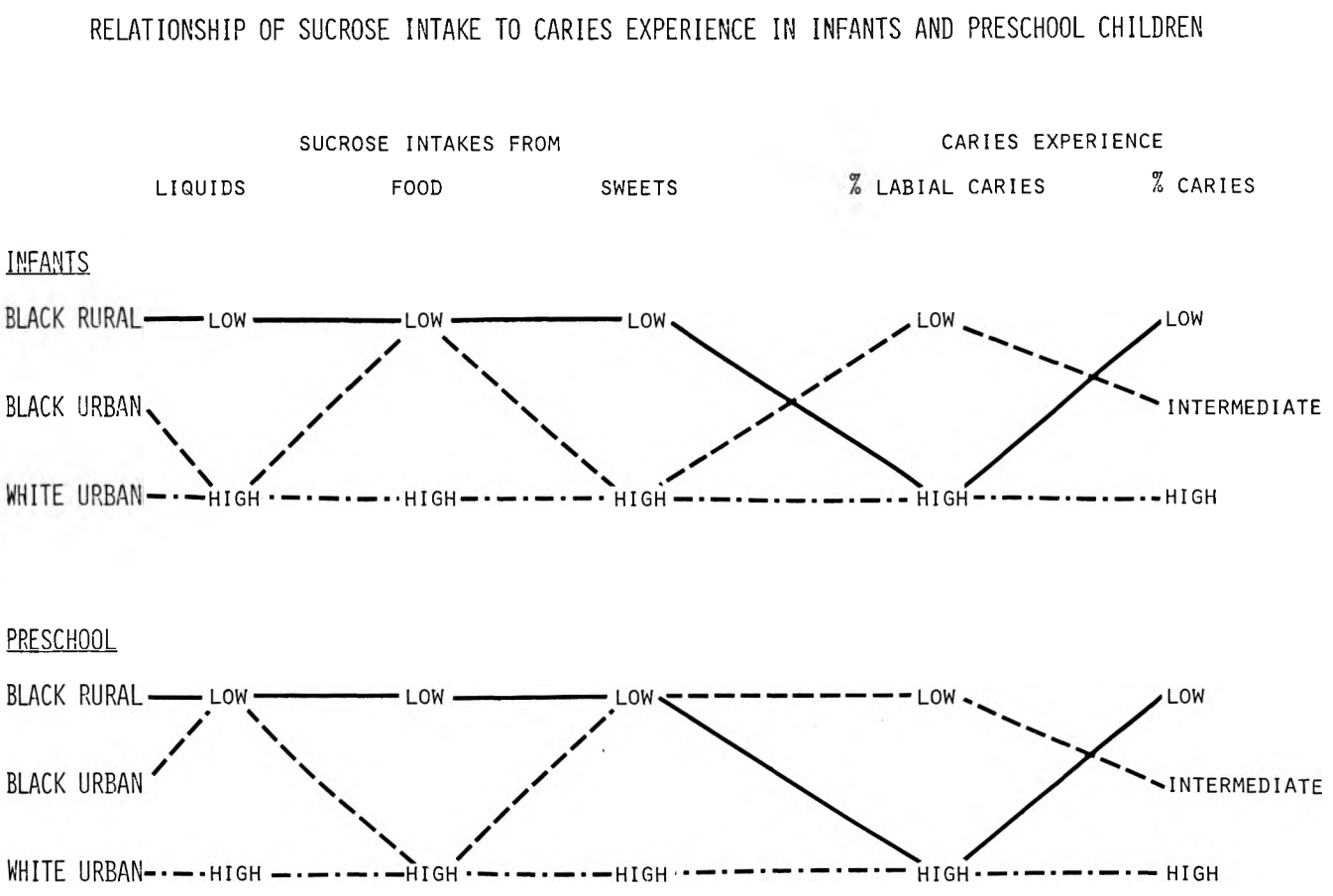

Fig. 4 Flow diagram showing the relationship of sucrose intakes to labial caries and caries experience in infants and pre-schoolchildren

caries prevalance in the urban Black, and the opposite in the rural group, with no consistent pattern of sucrose intake from liquids, food or sweets in these groups. White children were the only followers of the classical high sucrose high caries hypothesis.

These findings are further complicated by the finding that 79 per cent of Black rural children practised poor dental hygiene, i.e. cleaned their teeth once or less a day. The majority namely 99 per cent of Black urban children and 42 per cent of White children practised no dental hygiene at all. Yet this situation is compatible in the Black urban child with little labial decay, but with much labial decay in his rural counterpart, whereas the White child with by far the best teeth cleaning habits had the highest prevalence of dental decay.

In conclusion, no obvious correlation could be found between daily bottle sucrose intake and labial caries in Black children, nor between dental caries and mean daily sucrose intake from various sources, nor with hygiene practices.

SUMMARY

The relationship of the sucrose intake of 677 Black (427 rural and 250 urban) and 467 White pre-schoolchildren, aged 1-6 years, to their dental health has been investigated. Although marked differences were found between Black and White groups for both mean sucrose intakes from various sources, and infant feeding practices, there was a lack of association with the prevelance of caries, particularly that of labial caries. In spite of being predominantly breast-fed, having no fruit syrup intake, as well as a lower sweet consumption, Black rural children had a similar prevalence of labial caries (11,7 per cent) to that of White children (12,0 per cent), who were predominantly bottle-fed, had a high fruit syrup intake, and a higher sweet intake. On the other hand, Black urban children who had also been predominantly breast-fed, had consumed no fruit syrups, and as infants had a high sweet consumption similar to that of White infants, although they ate fewer sweets in pre-school years, and had a very low prevalence of labial caries, namely 4,0 percent.

It is concluded that sucrose *per se* in whatever form given could not be considered a major aetiological factor in caries of the deciduous dentition in the groups studied.

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