Dental caries experience and its relationship to social and behavioural factors among 3–5-year-old children in Uganda

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Summary. *Objective*. The aim of this study was to assess the socio-demographic and behavioural correlates of caries experience and sugar intake patterns among pre-school children in Uganda.

Methods. Five hundred and eighty-nine, 3–5-year-old children (51% boys, response rate = 85%), attending nursery schools in urban and peri-urban settings in central Kampala and Nakawa, respectively, were clinically examined for dental caries using the dmft index. Visible plaque on the labial surfaces of their maxillary incisors was recorded as a proxy for oral hygiene habits. A questionnaire designed to assess socio-demographic factors and sugar habits was completed by their caregivers in face-to-face interviews.

Results. The mean dmft scores were 1·7, 2·4 and 3·1, and 42%, 44% and 42% had visible plaque among 3-, 4- and 5-year-olds, respectively. In Nakawa, a total of 64%, 62% and 22% of the subjects had dmft > 0, decayed teeth (dt) > 0 and missing teeth > 0, respectively. The corresponding rates in central Kampala were 56%, 55% and 17%. Multivariate analyses revealed that attending school in Nakawa, having a mother with a lower level of education, reporting the intake of cough syrup, visiting a dentist and scoring positively for plaque were associated with higher odds (1·6, 1·5, 3·7 and 2·7) for having dmft > 0. The adjusted mean frequency sugar scores varied systematically between mothers with low and high levels of education (mean scores = 11·0 *vs*. 10·4), and for children with negative and positive plaque scores (mean scores = 10·6 *vs*. 10·9).

Conclusion. The caries experience was highest among children attending nursery schools in Nakawa and those who had had longer periods of cough syrup consumption, whereas children from the two locations were equally exposed to sugar consumption generally. Both caries experience and frequency of sugar consumption was highest among children of less-well-educated mothers.

Introduction

Early childhood caries (ECC), a term suggested at a 1994 Centre for Disease Control and Prevention workshop [1], denotes any form of caries occurring in the primary dentition of infants and youngsters. So far, there are no universally accepted criteria for the diagnosis of ECC [2], and those that have

been employed have varied among epidemiological surveys [3]. In this study, ECC has been defined as the presence of visual caries on at least one primary tooth in 3–5-year-old children. Early childhood is an important period for instituting preventive programmes because primary teeth erupt, bacteria colonize tooth surfaces and dental behaviour starts to develop during this time [4–6]. Children who have caries in their primary teeth in infancy or as toddlers tend to develop additional dental decay in their primary teeth, and are also more likely to develop dental caries in their permanent dentition [3].

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Caries experience in the primary dentition has been reported to be on the decline in industrialized countries [7], although studies have observed a levelling off of this trend and a slight increase during the 1990s [8,9]. In developing countries, both high and low levels of caries have been documented, as well as increases and decreases in caries experience over time [2,10,11]. Milnes' review of global studies of the epidemiology of caries in maxillary anterior primary teeth [2] suggested that the highest prevalence is found in Africa and South-east Asia. Moreover, there is evidence that caries experience has remained high in pre-school children in several sub-Saharan countries, with prevalence rates ranging from 25% to 85% in Zimbabwe [12] and Madagascar [13], respectively. In Uganda, the oral health of pre-school children has been poorly documented even though they are a potential priority target group for preventive programmes. A few previous studies considering broad age groups from which data can be extracted for 5–7-year-olds have reported caries experience in the 7–20% range [14,15]. A more recent study conducted in 1999 recorded a higher prevalence (59%) among children aged 5–7 years [16].

Factors of importance for the initiation and development of ECC have been described in several review papers [17,18]. While some studies have demonstrated a clear relationship with social class [19,20], others have been inconclusive, reporting high levels of caries in children of higher as well as lower social class backgrounds [21,22]. Moreover, evidence suggests that brushing at least once a day, the presence of visible plaque and frequent sugar intake is involved in the development of ECC [17,23]. *In vitro* experiments with laboratory animals have provided evidence that glucose syrups are associated with unexpectedly high levels of dental caries [24]. Nevertheless, from an oral health educational point of view, the paucity of studies describing and analysing the social and behavioural antecedents of ECC, such as high-risk behaviours, cultural beliefs and health care delivery factors, is a problem [23]. This is particularly so in socio-economically developing countries where changes from a traditional to a more Western-style diet have implicated increased sugar consumption from food, beverages and sweets [25].

Focusing on 3–5-year-old children attending nursery schools in Kampala, Uganda, and their respective parents/caretakers, this study aimed to identify:

- the socio-demographic and behavioural indicators of ECC; and
- the socio-demographic variation in frequency of children's intake of sugared snacks and drinks.

Subjects and methods

Study population and sampling method

The study area is Kampala, the capital city of Uganda, which covers an area of 197 km². Kampala has a population of 1·2 million people (49% male, 18% below the age of 5 years) who are considered to be urban residents [26]. The city has five divisions, two of which, central Kampala (area 14·7 km²) and Nakawa (area 40·7 km²), were purposively selected for this study [27]. All nursery schools in Kampala are privately owned. However, within central Kampala, the schools are expensive and serve children from higher socio-economic backgrounds. In contrast, the nursery schools in Nakawa are relatively cheap and cater for children from families with a lower socio-economic background. The study population consisted of 3–5-year-old children attending nursery schools in central Kampala and Nakawa, and their respective caregivers. Since children have all their primary teeth by the age of 3 years and since the focus of this study is on ECC, only children aged between 3 and 5 years were considered. To obtain a group of participants from mixed socio-economic backgrounds, a total of 52 and 64 primary schools were identified in central Kampala and Nakawa, respectively. Nursery schools with more than 150 children were not included in the sampling frame. Using an estimated sample size of 600 pre-school children, allowing for design effect and the required precision, and assuming a prevalence of dental caries of 25%, four schools in central Kampala and five in Nakawa were selected by systematic random sampling. All children aged between 3 and 5 years attending the selected schools during the period of data collection and their respective parents/caregivers were invited to participate in the study. Five working days were spent at each school, and during this period, the caregivers were interviewed at any time of the day (0700–1800 h) when they passed by to drop off or pick up their children. Of 694 children attending the selected nursery schools, a total of 618 children were eligible for participation. A total of 29 children were excluded randomly from the study (by tossing a coin) since

they were the second eligible child of the same mother/caregiver, giving a final number of participants of 589 children and their respective mothers/caregivers (participation rate = 85%). The main reason for not participating was the failure of the caregivers to turn up for the completion of the questionnaire at the school. For appropriate analysis, similar identification numbers were used for the parental questionnaire and the respective child's clinical form.

Ethical considerations

Ethical clearance was obtained from ethical research committees in Norway and Uganda. Written permission to conduct the study was obtained from the Ministries of Health and Education in Uganda, local administration authorities, and the school authorities. Written and verbal informed consent was obtained from the caregivers before clinical examination of their children.

Survey instrument

The caregivers were given written invitations through the school authorities to participate in the study. A structured questionnaire was administered by three trained research assistants and completed by the caregivers in face-to-face interviews. The questionnaire was constructed in English. For the majority of the respondents, the questionnaire was performed in English (the official language of Uganda), whereas translation (and back translation) into Luganda, the main local language, was necessary for only a small number of the participants. Oral health professionals reviewed the survey instrument for semantic, experiential and conceptual equivalence. Sensitivity to culture and selection of appropriate words were considered. The interview schedule was piloted and adjusted accordingly before being used in the field. Each interview was conducted in a private and quiet place, with both interviewer and interviewee seated facing a horizontal work surface. Information was collected on the socio-demographic characteristics and oral-health-related behaviours of the children. The age of the child was recorded as their age at their last birthday and categorized as (1) 3, (2) 4 and (3) 5 years. Gender was coded as (0) male and (1) female. The location of school was coded as (1) central Kampala (urban area) and (2) Nakawa (peri-urban area). The father's

and mother's highest level of education was assessed on scales ranging from (1) 'no formal education' to (5) 'university/higher learning institution'. Two dummy variables were constructed yielding the categories (0) 'lower education' (no formal education, or only primary and secondary education) and (1) 'higher education' (college or university, or higher learning institution). The frequency of sugar intake was assessed by a formative index in terms of a sum score of four items considering the usual intake of children's sugared snacks and drinks (i.e. sugar in milk/tea, soft drinks, sweets and cakes/biscuits) [28]. These items were assessed on scales ranging from (1) 'not every day' to (5) 'more than three times a day', and (1) 'daily' to (5) 'never'. The sugar frequency index was dichotomised as 'low' and 'high' around the median for use in cross-tabulation analyses. The intake of cough syrup for longer periods and dental attendance were assessed by one question each, and recorded as (1) 'yes' and (0) 'no'. In addition, information was obtained with respect to the child's previous breast-feeding habits, the use of a dummy/pacifier and oral hygiene habits.

Clinical examinations

The clinical examinations were carried out by one dentist (S.N.K.), facilitated by the pre-school teachers, whereas a trained assistant recorded the observations. Initially, visible plaque on anterior maxillary teeth was recorded as present or absent. Caries experience in the primary dentition was assessed under field conditions using natural light. The child was seated on a chair facing away from the examiner and reclining to rest her or his head on a cushion placed on the examiner's lap. Cotton rolls were used to clean the teeth and to control saliva. Dental probes and plane mouth mirrors were employed as aids for the clinical examination. Caries was recorded in terms of dmft, using the World Health Organization recommendations for oral health surveys [29]. Lesions were recorded as present when a carious cavity was apparent on visual inspection. The dmft score for each child was calculated, and teeth lost as a result of trauma or exfoliation were excluded from the calculation. A tooth was considered missing if there was a history of extraction because of pain and/or the presence of a cavity prior to extraction. Calibration exercises were carried out at the Institute for Paediatric Dentistry, Faculty of Dentistry, University of Bergen, Bergen, Norway,

prior to onset of data collection according to the guidelines published by British Association of the Study of Community Dentistry [30].

Statistical analysis

Data was entered using the EPIINFO-6 computer program and transferred to the SPSS Version 11·5 program for analyses. Univariate analyses were performed by use of chi-square statistics, a one-way analysis of variance (ANOVA) (with multiple comparisons) and logistic regression analyses. Internal consistency and test–retest reliability were assessed using Cronbach's alpha and Cohen's kappa, respectively. Multivariate analyses were performed using logistic regression analyses and a general linear models (GLM) ANOVA.

Test–retest reliability

Approximately 10% ($n = 56$) of the participating parents/caregivers were re-interviewed after 4 weeks to test the consistency of their responses to the questionnaire. Their respective children were re-examined to test for intra-examiner reliability. The agreement for the clinical examination was found to be good (Cohen's kappa = 0·84). There was no evidence of systematic error in the recording of dental caries, as tested by the Wilcoxon signed-ranks test ($P = 0·163$). Cohen's kappa for the socio-economic characteristics had values ranging from 0·66 regarding parents' education to 0·85 regarding household assets. The sugar frequency sum score on both occasions correlated moderately [intra-class correlation = 0·49; 95% confidence interval (CI) = 0·11–0·70].

Results

Table 1 shows the frequency distribution of the participants by socio-demographic and behavioural variables. A total of 77% and 26% of the responding parents had had a higher education in central Kampala and Nakawa, respectively ($P < 0·001$). The corresponding figures for fathers were 87% and 43% ($P < 0·001$). Almost half of the children (43%) had visible plaque on anterior maxillary teeth. A minority (29%) of the caregivers confirmed that their child had ever visited a dentist, and children from central Kampala had attended more frequently than their counterparts from Nakawa (37% *vs*. 21%, $P < 0·001$). A total of 53% and 49% of children from central Kampala and Nakawa, respectively, scored above the median on the sugar frequency score, and this confirmed the children's intake of

Table 1. Frequency distribution of the study participants according to socio-economic and behavioural variables in central Kampala and Nakawa ($n = 589$) (the number of cases in different categories does not add up to 304 and 285 because of missing cases).

Variable	central Kampala ($n = 304$)		Nakawa ($n = 285$)		Total ($n = 589$)	
	Number	Percentage	Number	Percentage	Number	Percentage
Age of child (years):						
3	43	14	24	8	67	11
4	126	42	13	40	239	41
5	134	44	146	52	280	48
Gender of child:						
male	162	53	139	49	301	51
female	141	47	145	51	286	49
Mother's level of education:						
low	70	23	205	74	275	48
high	231	77	71	26*	302	52
Father's level of education:						
low	38	13	154	57	192	34
high	260	87	114	43*	374	66
Oral health behaviour‡:						
plaque score	130	43	119	43	249	43
ever had a dental visit	112	37	59	21*	171	29
sugar snacking	158	53	138	49	296	51
cough syrup for long period	158	52	122	43†	280	48

*$P < 0·001$.

†$P < 0·05$.

‡Percentage of those who confirmed dental attendance, and treatment with medicinal syrup, high sugar snack intake and the presence of plaque on their maxillary anterior teeth.

Table 2. Caries experience and mean decayed teeth (dt), missing teeth (mt), filled teeth (ft) and dmft among 3–5-year-old Ugandan nursery school children (*n* = 586).

Age (years)	Number	dmft > 0 (%)	dt	mt	ft	dmft (± SD)
3	67	45	1·4	0·3	0·06	1·7 ± 2·5
4	239	59	1·9	0·5	0·07	2·4 ± 3·2
5	280	65	2·1	0·8	0·13	3·1 ± 3·8*

*P < 0·05 (between 3- and 5-year-old children).

sugared cough syrups for long periods. Use of cough syrup for longer periods was reported more frequently for children from central Kampala than for those from Nakawa (52% *vs.* 43%, *P* < 0·05).

Boys and girls were equally distributed in each age group (*P* > 0·05) (not shown in Table 1). The caregivers responding on behalf of the child were the mother (64%), the father (26%) or another, i.e. a grandparent, a sibling or a relative (10%). The mean age of the responding caregivers was 32·5 years (SD = 7·8 years, range 16–74 = years). The caregiver's age did not vary systematically with the children's dmft and the sugar frequency scores. A total of 38% and 60% (*P* < 0·001) of the respondents were below 31 years of age in central Kampala and Nakawa. Moreover, a substantial proportion of the children had been both breast- and bottle-fed as babies (65%). Only 14% had ever used a dummy or pacifier, 12% of whom had the pacifier dipped in sugar. Almost all the children had their teeth brushed at least daily (98%) and used a toothpaste bought in shops (99%), which was fluoridated in most cases.

Table 2 summarizes the dental caries experience for the sample of children investigated. A total of 45%, 59% and 65% of the children aged 3, 4 and 5 years, respectively, had at least one tooth with evidence of caries. The decayed teeth (dt) was the major component of the dmft score. Only a few children (4·4%) had a dmft > 10.

Figure 1 illustrates the distribution of caries according to tooth type in 3–5-year-olds attending schools in urban central Kampala and peri-urban Nakawa. The caries rates were highest among children in Nakawa for almost each tooth type, although the tooth-specific pattern of caries was similar in both groups. Overall dental caries experience was higher in the maxillary than in the mandibular teeth. Maxillary central incisors were most frequently affected by caries followed by mandibular molars. A total of 25% and 33% of 3-, 4- and 5-year-olds,
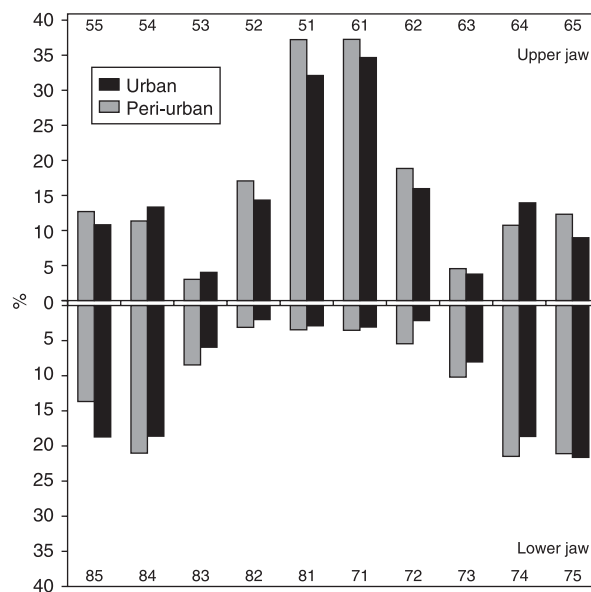

Fig. 1. Frequency distribution of caries experience according to tooth type in the upper and lower jaw of children in central Kampala (urban area) and Nakawa (peri-urban area).

respectively, had a dmft > 0 in the maxillary central incisors. Mandibular molars were affected among 19%, 29% and 35%, respectively. Less than 5% of the anterior mandibular teeth were affected by caries at all ages.

Table 3 summarizes caries experience for the total sample of children according to gender in central Kampala and Nakawa, with mean dmft scores of 2·6 (SD = 3·52) and 2·7 (SD = 3·38), respectively (*P* > 0·05). The corresponding figures for children with a dmft > 0 and a dt > 0 were 56% *versus* 64% (*P* < 0·05) and 55% *versus* 62% (*P* < 0·05). In central Kampala, the caries experience among boys and girls was similar, whereas the caries experience of boys was higher than that of girls in Nakawa (*P* < 0·05).

Table 4 shows the unadjusted and adjusted odds ratios (ORs) for having a dmft > 0. The adjusted ORs for having dental caries were statistically significant for children attending school in Nakawa (OR = 1·6), having mothers with a lower level of education (OR = 1·5), reporting long periods of cough syrup consumption (OR = 1·5), confirming dental attendance (OR = 3·7) and having visible plaque recorded on maxillary incisors (OR = 2·7). After controlling for all variables in the logistic regression analysis, one statistically significant interaction in terms of nursery school locality by cough syrup consumption was identified in addition to that

Table 3. Mean dmft scores (± SD) and percentage of subjects with dmft, decayed teeth (dt) and missing teeth (mt) > 0 in children aged 3–5 years by gender and place of school (central Kampala and Nakawa).

	Number	Mean dmft (± SD)	dmft > 0 (%)	dt > 0 (%)	mt > 0 (%)
Urban (central Kampala)					
Boys	162	2·5 ± 3·6	54	53	15
Girls	141	2·7 ± 3·5	59	57	18
Total	303	2·6 ± 3·5	56	55	17
Peri-urban (Nakawa)					
Boys	139	2·8 ± 3·4	70	67	22
Girls	145	2·7 ± 3·4	59*	57	22
Total	284	2·7 ± 3·4	64†	62	22

*Significant differences between peri-urban boys and girls ($P < 0.05$).
†Significant differences between urban and peri-urban children ($P < 0.05$).

Table 4. Frequency distribution, odds ratio and 95% confidence interval (CI) of children with a dmft > 0 by socio-demographic and behavioural variables.

		Odds ratio	
Variable	dmft > 0% (*n*)	Unadjusted (95% CI)	Adjusted (95% CI)
Region:			
urban	56 (171)	1.0	1.0
peri-urban	64 (182)	1·5 (1·1–1·2)	1·6 (1·0–2·5)
Age:			
3	45 (30)	1.0	1.0
4	59 (141)	1·6 (0·9–2·7)	1·3 (0·7–2·3)
5	65 (181)	2·0 (1·2–3·3)	1·6 (0·9–2·8)
Mother's level of education:			
high	56 (168)	1.0	1.0
low	65 (178)	1·5 (1·1–2·0)	1·5 (1·0–2·1)
Cough syrups:			
no	55 (169)	1.0	1.0
yes	65 (183)	1·6 (1·1–2·1)	1·5 (1·0–2·1)
Dental attendance:			
no	53 (219)	1.0	1.0
yes	78 (134)	1·8 (2·1–3·9)	3·7 (2·4–6·1)
Plaque on anterior teeth:			
no	52 (171)	1.0	1.0
yes	71 (177)	2·7 (1·9–3·9)	2·7 (1·8–3·9)

previously described between gender and the location of the school (see Table 3). Separate analyses for central Kampala and Nakawa revealed that the OR for having dental caries if taking cough syrups was significant in central Kampala (OR = 2·1; 95% CI = 1·4–3·2), but not in Nakawa.

Figure 2 shows the distribution of the intake of sugared tea/milk and soft drinks at least daily, and the intake of sweets and cakes daily among 3–5-year-olds in central Kampala and Nakawa. Almost all children reportedly took milk or tea with sugar on a daily basis in Nakawa and central Kampala (97% *vs.* 93%). The corresponding figures with respect to soft drinks, sweets and cakes were 16% *versus* 19%, 8% *versus* 8% and 20% *versus* 15%,
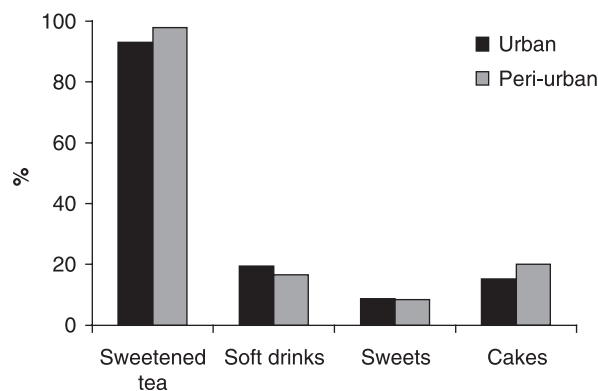

Fig. 2. Frequency distribution of the reported daily intake of sugared snacks and drinks among children in central Kampala (urban area) and Nakawa (peri-urban area).

Table 5. Mean sugar frequency score (theoretical range: the lower the score on the sugar frequency score, the less frequent the sugar intake) by social and behavioural factors, and 95% confidence interval (CI) (adjusted for gender, age of the child, cough syrup consumption and dental attendance).

		Sugar score	
Variable	Number	Unadjusted mean (± SD)	Adjusted mean (95% CI)
Region:			
urban	293	10·6 ± 2·4	10·9 (10·6–11·3)
peri-urban	269	10·6 ± 2·2	10·6 (10·2–10·9)
Mother's level of education:			
high	295	10·4 ± 2·2	10·4 (10·1–10·8)
low	267	10·8 ± 2·5	11·0 (10·7–11·4)*
Plaque on anterior teeth:			
no	323	10·5 ± 2·3	10·6 (10·2–10·9)
yes	239	10·8 ± 2·3	10·9 (10·6–11·3)*

*Significant differences between the sugar scores of children whose mothers have high and low levels of education ($P < 0.05$).

respectively. The overall mean sugar frequency sugar score (mean = 10·6, SD = 2·3, range = 5–17) did not vary systematically with age, gender or the locality of the nursery school, nor with cough syrup consumption or dental attendance. Possible confounding effects of social and behavioural variables were controlled using a GLM ANOVA. The results reveal statistically significantly higher mean sugar frequency scores among children who had mothers with a lower level of education (11·0 *vs.* 10·4) and among those with positive plaque scores (10·9 *vs.* 10·6), as compared to their counterparts in the opposite groups (Table 5).

Discussion

Information about caries experience among Ugandan children is scarce and the Kampala region has been surveyed to a very limited extent [15]. This is the first to consider dental caries in the primary dentition of Ugandan pre-school children at or below the age of 5 years, thereby providing information about age groups not considered by the national oral health surveys. The results indicate neglect of the oral health of the children investigated, providing evidence that the percentages of 3-, 4- and 5-year-olds with any caries experience were 45%, 59% and 65%, respectively. These findings highlight an early onset of caries in the primary dentition of pre-school children from Kampala. Decayed teeth (58%) were the main component of the dmft scores, reflecting a high rate of unmet treatment need.

The caries prevalence in the study group as a whole, amounting to 56% in central Kampala and 64% in Nakawa, is higher than the rate of 35%

observed among 6-year-olds in the national oral health survey of 1987 and in previous Ugandan surveys [15]. Nevertheless, the rate observed in this study is in line with what has been reported from South Africa in similar age groups [31]. It is also in accordance with the caries rates observed among slightly older (5–7-year-old) Ugandan children [16], and corresponds fairly well with the caries experience of similar age groups observed in neighbouring Tanzania and Kenya [16,22,32]. Great care should be exercised, however, when comparing the present findings with those of previous studies from Uganda and other sub-Saharan African countries. The age groups considered are not identical and the diagnostic criteria for ECC have varied among studies. This appears to imply that it is difficult to get a clear picture of the caries situation among pre-school children across time and different regions of sub-Saharan Africa. Importantly, the caries lesions were not evenly distributed by tooth type, being most frequently present in upper maxillary incisors and lower first molars in all age groups, a pattern commonly reported in surveys of the primary dentition [33–35]. The caries distribution might be attributed to infant feeding practices, such as using a baby bottle filled with sweetened beverages or prolonged breast-feeding on demand [36]. Unfortunately, the present data were not detailed enough to provide conclusive evidence on this issue.

The proportion of 3–5-year-old children attending nursery schools in central Kampala and Nakawa was unknown at the time of the study. According to national statistics, however, 63% of children of school-going age (6–14 years) attend schools [26,37]. This figure might presumably extend to the population

of children at and below the age of 5 years attending nursery schools in the region. Although central Kampala and Nakawa represent typical urban and peri-urban Ugandan communities, the participants of the present study are not representative of the general population of 3–5-year-olds resident in this area. This appears to imply that the results might not reflect the situation of same-age children who are not attending nursery schools. Nevertheless, the realities of life in Uganda, as in other sub-Sahara African countries, are that general population studies are almost impossible to conduct and even national oral health surveys have been limited to school-going children [15,31].

The evidence suggests that a complex interaction of socio-demographic, behavioural and microbiological factors is responsible for the occurrence and development of dental caries generally and ECC in particular [23]. Assessing socio-economic status in terms of international classifications of occupational status is not easily applied in Africa, although modifications have been proposed [20,20,32,35,37,41]. The higher caries prevalence observed among children from deprived schools in Nakawa and among those who have mothers with a lower level of education is consistent with findings from industrialized as well as non-industrialized countries [20,20,32,34]. This result differs, however, from other studies in sub-Saharan Africa, where caries has been documented as being significantly worse among children from a higher socio-economic background [17,17,29,31,37,40]. Less-affluent people probably experience financial, social and material disadvantages that compromise their ability to care for themselves and to live in a healthy environment, thereby leading to a reduced resistance to oral and other diseases.

Many studies have found a significant association between the frequency of sugar intake and dental caries [38,39,41,42], but no such relationship was identified by the present study. Nevertheless, sugar consumption was significantly higher among those children who had mothers with a lower level of education, as compared to children of their more highly educated counterparts. Previous studies have suggested that mothers in deprived areas are more likely to give their children sweets after nursery school, to use sweets as comforters, spend more money on sweets and allow continued sweet consumption during the day [40,43]. Since sugar is widely available and relatively cheap in Uganda, a higher rate of consumption in groups with a lower socio-economic

status might be expected. The evidence suggests that caregivers of 0–23-month-old infants add sugar to complementary foods and drinks more frequently than oils and milk, for instance [28,41]. In this study, about half of the caregivers in central Kampala and Nakawa confirmed that their children's consumption was above the median on the sugar frequency score.

Medicinal syrups have long been hypothesized to be a source of hidden fermentable sugars such as glucose, and therefore, have the potential to independently increase the risk of having caries if taken for long periods and/or frequently. The results in this study reveal a significantly higher caries risk among children reported to have consumed medicinal syrups for a longer time. This finding is in agreement with that of other studies [43,44,44,45]. Parents should be informed of the pronounced caries-promoting potential of these medications, and the declaration of fermentable sugars in products such as syrups, lozenges and teething jellies should be enforced by Ugandan food and drug legislation. The substitution of non-fermentable sweetening agents for sucrose could be another way to reduce the caries risk posed by medicinal syrups.

Almost all the caregivers (98%) confirmed that their children practised daily brushing of their teeth using fluoridated toothpaste (bought in shops). In spite of the optimal oral hygiene behaviour of the children that might counteract the deleterious effects of sugary diets [45,46], as reported by their caregivers, almost half of the children examined scored positively with respect to visible plaque on the maxillary anterior teeth. A positive plaque score as a proxy of oral hygiene behaviour varied systematically with dental caries in the multivariate analyses after adjusting for confounding factors. It appears that children who might be at high risk for developing caries because of a high-sugar diet are likely to have a poor oral hygiene. The present findings do indicate that response inaccuracy caused by recall bias and social desirability might be a methodological problem confronting the identification of relationships between reported oral habits and dental caries in this study. The results were, however, consistent with expectations. Although all measures of oral hygiene and sugar consumption have been applied previously in the context of developing countries, validation of the sugar frequency intake questionnaire is an objective in further studies.

In accordance with patterns of dental visits among pre-school children in most countries [46,47,47,48], a large proportion of the children investigated had

never visited a dentist. Evidence from South African studies suggests that the lack of a perceived treatment need, anxiety and fear, and financial considerations are the main barriers to dental treatment [48,49]. Notably, the children who had ever visited a dentist were those who were most likely to have dental caries. Similar relationships have been reported elsewhere [39,42,46,47] and might reflect a greater need for treatment rather than being related to any financial considerations on the part of the responding caregivers.

In conclusion, the caries experience of 3–5-year-olds attending nursery schools in Kampala was high and most of the decayed teeth remained untreated. Moreover, their oral hygiene situation was poor. The caries experience was highest among children attending the less-affluent nursery schools in Nakawa and among those children who had had longer periods of cough syrup consumption. The prevalence of both caries and sugar frequency consumption was higher among children who had less-well-educated mothers, indicating that the mother's level of education could be used as a social marker in prospective caries risk group evaluations. The need for treatment of caries was generally substantial and establishing caries-preventive activities for all pre-school children seems warranted. Uganda, however, is a developing country with serious health problems such as HIV, tuberculosis and malnutrition. In view of the relatively scarce resources that are available for dental care, emphasis should be put on prevention and simple treatment.

Résumé. *Objectif.* évaluer les relations socio-démographiques et comportementales de l'expérience carieuse et les patterns de prise de sucre chez des enfants d'âge pré-scolaire.
Méthodes. La recherche de caries (indice caod) a été effectuée chez 589 enfants, âgés de 3 à 5 ans (garçons 51%, taux de réponse 85%), fréquentant les écoles maternelles de Kampala central (zone urbaine) et Nakawa (zone péri-urbaine). La plaque visible sur les faces vestibulaires des incisives maxillaires a été notée comme indicateur des habitudes d'hygiène. Un questionnaire destiné à évaluer les facteurs socio-démographiques et les habitudes de consommations de sucre a été rempli par les personnes s'en occupant lors d'entretiens personnels.
Résultats. Les indices caod moyens étaient de 1,7, 2,4 et 3,1 et 42%, 44% et 42% avaient de la plaque visible chez les 3-, 4- et 5 ans, respectivement. A Nakawa un total de 64%, 62% et 22% avaient un caod > 0, cd > 0 et ad > 0, respectivement. Les taux correspondants à Kampala central étaient de 56%, 55% et 17%. Les analyses multivariées ont révélé que de plus fortes probabilités (1,6, 1,5, 3,7 et 2,7) d'avoir un caod > 0 étaient corrélées respectivement à fréquenter l'école de Nakawa, avoir une mère de faible niveau d'éducation, consommer du sirop pour la toux, aller chez un dentiste et présenter de la plaque. Les scores de fréquence moyenne de sucre ajustée ont variés systématiquement entre les mères de faible et haut niveau d'éducation (scores moyens 11,0 contre 10,4) et pour les enfants avec des scores négatifs et positifs de plaque (scores moyens 10,6 vs 10,9).
Conclusion. l'expérience carieuse a été plus importante parmi les enfants fréquentant les écoles maternelles de Nakawa et ayant des périodes plus longues de consommation de sirop pour la toux, tandis que les enfants des deux divisions étaient également exposés à la consommation de sucre. La fréquence de prise de sucre et l'expérience de caries étaient plus importantes chez les enfants des mères les moins éduquées.

Zusammenfassung. *Ziel.* Bestimmung von sozio-demographischen und verhaltensbezogenen Korrelaten der Karieserfahrung und das Muster der Zuckeraufnahme bei Vorschulkindern.
Methoden. 589 Kinder im Alter von 3 bis 5 Jahre (51% Jungen, die Teilnahmequote betrug 85%), die Kindergärten im Zentrum von Kampala (städtisch) oder Nakawa (Umland) besuchten, wurden klinisch auf Karies untersucht nach dem dmft-Index. Sichtbare Plaque an den Labialflächen von Oberkiefer-Schneidezähnen wurde zur Dokumentation von Mundhygienegewohnheiten herangezogen. In Einzelgesprächen wurde eine Fragebogen-unterstützte Befragung der Sorgeberechtigten zu sozioökonomischen Faktoren sowie Zuckerverwendung durchgeführt.

Ergebnisse. Der mittlere dmft-Wert war 1.7, 2.4 und 3.1, 42%, 44% und 42% hatten sichtbare Plaque an den Oberkiefer-Schneidezähnen bei den 3-, 4- und 5 Jährigen. In Nakawa war der Gebisszustand bei 64%, 62% und 22% naturgesund, die entsprechenden Zahlen für Kampala waren 56%, 55% und 17%. Eine multivariate Analyse ergab, dass der Besuch eines Kindergartens in Nakawa, eine Mutter mit geringem Bildungsgrad, die Angabe der Einnahme von Hustensaft, Zahnarztbesuche und die Anwesenheit von Plaque mit einem erhöhten Risiko behaftet waren, Karies zu entwickeln (OR 1.6, 1.5, 3.7 und 2.7). Die adjustierten Scorewerte zur Zuckeraufnahme lagen für Mütter mit niedrigerem und höherem Bildungsgrad bei 11.0 bzw. 10.4, für Kinder mit negativem und positivem Plaquescore waren die Werte 10.6 versus 10.9.

Schlussfolgerung. Die Karieserfahrung war am höchsten bei Kindern aus Kindergärten in Nakawa, bei längeren Perioden von Hustensaftverwendung, wobei die Kinder aus beiden Gruppen insgesamt einer gleichen Zuckerexposition ausgesetzt waren. Karieserfahrung und Zuckerfrequenz waren am stärksten bei Kindern von Müttern niedrigeren Bildungsgrades.

Resumen. *Objetivos.* Valorar la correlación socio-demográfica y de comportamiento de prevalencia de caries y los patrones de ingesta de azúcar en niños pre-escolares.

Métodos. 589 niños, 3–5 años de edad (51% niños, porcentaje de respuesta del 85%), asistentes a guarderías en Kampala central (urbano) y Nakawa (peri-urbano), fueron examinados clínicamente de caries usando el índice caod. La placa visible en las superficies vestibulares de los incisivos superiores, se registró como un sustituto del hábito de higiene oral. Se completó por parte de los cuidadores en entrevistas cara a cara, un cuestionario para valorar factores socio-demográficos y los hábitos sobre toma de azúcar.

Resultados. los índices medios de caod fueron 1,7, 2,4 y 3,1 y 42%, 44% y 42% tenían placa visible entre 3-, 4-, y 5 años, respectivamente. En Nakawa un total de 64%, 62% y 22% tenían caod > 0, cd > 0 y at > 0, respectivamente. Los porcentajes correspondientes en Kampala central fueron 56%, 55% y 17%. El análisis multivariante reveló que la asistencia a la escuela en Nakawa, tener una madre de menor educación, comunicar la ingesta de jarabe para el resfriado, visitar a un dentista y la valoración positiva de placa estaban asociados con odds más altas (1,6, 1,5, 3,7 y 2,7) para tener caod > 0. La media ajustada de la frecuencia de los índices de azúcar variaba sistemáticamente entre madres de educación baja y alta (índices de medios 11,0 versus 10,4) y para los niños con índices de placa negativos y positivos (índices medios 10,6 versus 10,9).

Conclusión. La prevalencia de caries fue más alta entre niños asistentes a las guarderías de Nakawa y que tenían períodos más largos de consumo de jarabe para el resfriado, mientras que los niños de las dos divisiones estaban igualmente expuestos al consumo general de azúcar. Tanto la prevalencia de caries y la frecuencia del consumo de azúcar fueron más altas en niños de madres con menos educación.

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