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**ORIGINAL ARTICLE**

# Feeding practice among 6–36 months old in Tanzania and Uganda: Reliability and relationship with early childhood caries, ECC

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**Abstract**

***Objective.*** To assess the reproducibility of caregivers' responses to dietary recall from birth and 24-h dietary recall with respect to infants' intake of sugared snacks and to assess whether those assessment methods provide comparable results for groups of infants. Re-test reliability and clinical covariates of time to first exposure of sugared snacks and time to termination of breastfeeding were also examined. It was hypothesized that time to first exposure/termination would vary according to socio-demographic profile and ECC. ***Method.*** Interviews and clinical oral examinations were carried out in Kampala and Manyara, including 1221 and 816 child–caregiver pairs. Reproducibility was assessed using Cohen's kappa and Intra Class Correlation Coefficient, ICC. Adjusted Cox regression was used to model time to first exposure of sugared snacks and time to termination of breastfeeding. ***Results.*** Cohen's kappa for intake of sugar items ranged from 0.40–1.0, with no differences observed between average intakes at test–re-test. Mean sugar score based on 24-h recall increased significantly by increasing quartiles of the sugar score based on recall from birth. Cox regression revealed that the odds ratio, OR, for early exposure to various sugared snacks and the ORs for early termination of breastfeeding were significantly smaller in infants with than without ECC. ***Conclusion.*** Fair-to-good reproducibility was established. Infant's sugar consumption emerge as early as 6 months of age. Survival of any breastfeeding and non-exposure to sugared snacks was most prolonged among infants with ECC. This has implications for interventions needed to improve feeding habits of infants and toddlers.

**Key Words:** *caries, infants, eating habits*

## Introduction

Early childhood caries, ECC, describes any form of caries in children from birth through 71 months of age [1–4]. In developing countries, the ECC prevalence has been reported to be as high as 70% for disadvantaged groups [3]. When left untreated, ECC impacts on children's quality-of-life to an extent similar to other systemic diseases [5,6]. Programs to promote the development of healthy dietary habits starting before or soon after tooth eruption are important to optimize the chances of infants and toddlers to stay free of dental caries.

Comprehensive reviews have confirmed that highly fermentable carbohydrates, such as sugared snacks and drinks, are the most important dietary factor in the development of ECC [7]. In low income countries such as Tanzania and Uganda, globalization has been linked to changes from a traditional- to a western-style diet [8]. Evidence suggests that commercialized sugar products have become easily available and highly preferred, particularly among affluent people in urban areas [9]. Urbanization, development of the food industry and advertisements in terms of unhealthy dietary messages through radio and/or television have influenced caregivers to feed their children with sweets, to add sugar to complementary foods and drinks, to use sweets as rewards and to spend more money on sweets [10,11]. According to the 'Feeding infants and toddlers study', a majority of toddlers above 8 months consume sugared snacks and drinks on a daily basis [12]. It is important to understand feeding practices through the transition stage of infant nutrition, when intake of sugared snacks or

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'extra foods' is emerging and when parents have less control over the child's access to foods and drinks. Whereas numerous studies have considered parental infant feeding in general, the consumption of extra foods during the infant and toddler period has not been thoroughly investigated [13].

Evidence suggests that teeth are susceptible to ECC shortly after tooth eruption and prior to final maturation [2]. This is the time when most children are being breastfed. The World Health Organization (WHO) has recommended exclusive breastfeeding from birth to 6 months, followed by on-demand breastfeeding and complementary feeding until 24 months or even longer [14]. Despite the high prevalence of breastfeeding in sub-Saharan Africa, only a small percentage of infants below 6 months are exclusively breastfed and prolonged breastfeeding is most frequent in low income populations [15]. Breastfeeding above 24 months and at night beyond tooth eruption has been identified as a risk factor for ECC [16,17]. Nevertheless, systematic reviews do not suggest a consistent association between breastfeeding and ECC and research examining this relationship has been equivocal [18]. Early screening of infants' dietary habits and appropriate counseling is important from a caries prevention point of view. However, the onset of sugar consumption and age at termination of breastfeeding as possible important parameters related to infants' and toddlers' oral health have seldom been investigated.

Assessment of dietary habits in younger children is a challenging issue posing methodological problems related to the accuracy of measurements [19]. Until children reach a cognitive developmental stage when they can remember and report their own food intakes, the responsibility of dietary reporting falls on the primary caregivers, particularly the mothers. Memory, time lapse and time spent with the infant during the periods being recalled may affect the accuracy of reported dietary information [13]. Thus, reports on infants' dietary habits rely on parental recall of events that occurred months or even years previously and caution has been recommended in accepting the accuracy of such retrospective information [20–22]. Whereas results obtained from studies using retrospective dietary recall is important, the quality of such data emanating from sub Saharan African countries has yet to be addressed. Data on the accuracy and relative validity of dietary practices during infancy allow improved interpretation of epidemiological findings.

### *Purpose*

This study assessed consumption of sugar containing foods and drinks among 6–36 months old infants in Kampala and Manyara, using dietary recall interviews with primary caretakers. The aim was to assess the reproducibility of caregivers' responses to dietary recall from birth and 24-h dietary recall and to assess whether those two established methods of dietary assessment provide comparable results for groups of infants and toddlers. Moreover, the re-test reliability and socio-demographic and clinical covariates of time to first exposure of sugared snacks and drinks and time to termination of breastfeeding were examined. It was hypothesized that time to first exposure of sugared foods and drinks and time to termination of breastfeeding would vary according to infants' socio-demographic profile and ECC experience.

## Method

### *Manyara site*

Recruitment of children and caretakers took place at Haydom Lutheran Hospital (HLH) and in its 20 mobile outreach community service sites in Mbulu, Hanang and Babati districts of Manyara region, northern Tanzania, from August 2010 to January 2011. Manyara region covers an area of 50,836 $km^2$ and has a population of 1,037,605, of whom 18% are children below 5 years of age. The region is populated with a predominately poor rural population with a literacy rate of 73% [23]. It is administratively divided into five districts, three of which, Mbulu (4452 $km^2$, total population 237,280), Hanang (3899 $km^2$, total population 204,640) and Babati (7169 $km^2$, total population 302,253), constituted the study areas [24]. The districts have drinking water with fluoride content ~ 3.0 mg F/L [25]. In collaboration with the government authorities through District Health Management Teams (DHMT) and other Voluntary Agencies, HLH has taken responsibility for an extensive outreach program covering Reproductive and Child Health (RCH) services [26]. The RCH includes one post with daily activities at the hospital in addition to 20 community posts, visited once a month by car on a rotating basis. According to the 2002 population and housing census in Tanzania, the RCH outreach program covered six out of 54 villages in Hanang, three out of 81 villages in Babati and 12 out of 70 villages in Mbulu, serving, respectively, 4790, 1538 and 7910 children below 5 years of age. During the project period, 21 RCH posts were visited 3–5 times on a rotating basis, recruiting 10–14 caretaker–child pairs per visit. All caregiver–child pairs who were resident in the catchment areas and who satisfied the inclusion criteria of being a mother or primary caregiver of children aged 6–36 months attending for immunization and/or growth monitoring were invited to participate in the study. Mothers were the primary target respondents, but in the case of mothers' absence, the primary caregiver was recruited. Out of 1250 caregiver–child pairs approached, 1221 agreed to participate (total response rate 97.7%, range 94–99%). A sample size ($n$ = 1221) of this magnitude is sufficient to the

pre-calculated sample size of 810 caregiver–child pairs, assuming a prevalence of ECC of 50%, a margin error of 5%, confidence level of 95% and an assumed design effect of 2. Another 5% was added to the sample size to account for non-responses and children to be excluded for being the second eligible child of the same mother or caregiver.

*Kampala site*

A cross-sectional RCH-based study was conducted in Kampala district, Uganda, from June to October in 2007. Kampala covers an area of 197 $km^2$ and has a population of 1.2 million, of whom 18% are under 5 years. Kampala has an overall literacy rate of 75% [23]. It is administratively divided into five divisions, two of which, Nakawa (42.5 $km^2$, total population in 2008 = 300,000) and Makindye (40.6 $km^2$, total population in 2008 = 380,000), constituted the study areas. The districts have drinking water with fluoride content of 0.3 mg F/L [27]. One non-governmental (Kibuli) and one governmental (Naguru) RCH care facility were purposely selected in Makindye and Nakawa, respectively. Both facilities have large catchment areas and include community outreach clinics for the provision of child immunization. The inclusion criteria were caregivers with children aged 6–36 months attending the Kibuli and Naguru clinics for immunization and/or growth monitoring. All caregiver–child pairs who attended the clinics during the study period and who satisfied the inclusion criteria were eligible for participation. Out of 831 caregivers approached, 816 agreed to participate (response rate 98%). This satisfied a pre-calculated sample size assuming a prevalence of ECC of 30%, a standard error of 3% and a confidence interval of 95%. Another 5% was added to the sample size to account for children who had to be excluded from analysis for being the second eligible child of the same mother/caregiver. For a more detailed description of the sampling procedure, see Wandera et al. [28].

*Ethical clearance*

In Tanzania, permission was granted by the Medical Research Coordinating Committee of the Ministry of Health and Social Welfare and the Ethical Research Committee in Norway (REK VEST). In Uganda, permission was given by The Ethical Committee of Uganda National Council of Science and Technology, Research and Publication Committee at Makerere University. Informed written consent was obtained from participating caregivers in both recruitment sites. When the caregivers could not read and write verbal consents were obtained.

*Clinical oral examination*

Clinical examinations were carried out by trained and calibrated dentists (one at each site), whereas trained assistants recorded the observations. Calibration exercises were carried out according to the guidelines published by the British Association of the study of Community Dentistry (BASCD) [29]. Children were examined in knee-to-knee position using a dental mirror and natural light. Teeth were cleaned and dried by sterile gauze and inspected for ECC using disposable dental mirrors. ECC was assessed on fully and partially erupted teeth according to the WHO criteria and recorded in terms of decayed, filled and missed teeth [30]. No radiographs were taken and decay was recorded at the level of cavitation. In the present analysis, decayed teeth (dt) was dichotomized as (0) absent (dt = 0) and (1) present (dt ≥1). Intra-examiner agreement for dental caries was found to be acceptable and in the range 0.8–1.0 [31].

*Interview*

The interview schedules were constructed in English and translated into Luganda and Kiswahili, the main languages in Uganda and Tanzania. Kiswahili is spoken proficiently by almost 95% of Tanzanians. Single words of the Kiswahili interview were translated into Iraque, Datoga, Nyaturu and Nyisanzu languages, when deemed necessary during the interview. The interview schedule was translated in several steps; from English into local languages by bi-lingual Kiswahili/English and Luganda/English professionals and then back-translated to English by independent translators. The interview schedule was piloted to evaluate the quality of the translations in terms of comprehensibility, readability and relevance to assess face validity and was performed with caretakers before their children underwent a full mouth oral clinical examination. After 3 weeks, a re-test was undertaken among 24 and 81 randomly selected caretakers in Kampala and Manyara, respectively, to assess the extent of measurement consistency across the two interview administrations.

*Measurements*

Sugared foods and drinks were assessed in terms of sugar items known to be commonly preferred and consumed among infants in Tanzania and Uganda. The 24-h recalls reflected feeding practices from the previous morning to the morning of the interview and was assessed by asking 'from when you woke up yesterday till you woke up this morning did you give any of the following items to (Name of child): tea with milk and sugar, black tea with sugar, fruit juice, sugared soda, biscuits/cakes/ice-cream, and sweets/toffees/chocolate?' Responses were given as (1) No and (2) Yes. The same items were asked for in a dietary recall since birth in terms of 'Have you ever given any of the following items to (Name of child):'. Responses were given as (1) No and (2) Yes.

Table I. Frequency distribution of study participants in the total study group and in the group for whom breastfeeding was terminated at study entry according to socio-demographic and clinical variables in Kampala and Manyara.

| Variables | Categories | Kampala total sample, % (*n*) | Kampala stopped breast feeding, % (*n*) | Manyara total sample, % (*n*) | Manyara stopped breast feeding, % (*n*) |
|---|---|---|---|---|---|
| Sex of child | Boys | 50.7 (414) | 48.8 (160) | 50.5 (616) | 46.7 (227) |
| | Girls | 49.3 (402) | 51.2 (168) | 49.5 (605) | 53.3 (259) |
| Age of child (months) | 6–12 | 45.5 (371) | 12.8 (42) | 29.6 (362) | 2.7 (12) |
| | 13–24 | 29.7 (242) | 32.9 (108) | 50.9 (621) | 55.9 (246) |
| | 25–36 | 24.9 (203) | 54.3 (178) | 19.5 (238) | 41.4 (182) |
| Mother's education | Lower | 40.5 (324) | 43.6 (142) | 28.2 (344) | 26.5 (129) |
| | Higher | 59.5 (476) | 56.4 (184) | 71.8 (877) | 73.5 (357) |
| Mother's age | ≤24 years | 54.3 (443) | 49.4 (162) | 33.8 (403) | 34.5 (166) |
| | >25 years | 45.7 (373) | 50.5 (166) | 66.2 (789) | 65.5 (315) |
| ECC | dt = 0 | 82.4 (636) | 67.1 (220) | 96.3 (1176) | 92.6 (450) |
| | dt >0 | 17.6 (136) | 32.9 (108) | 3.7 (45) | 7.4 (36) |

The respondents were asked if any of the sugar items had been given to the child and, if so, at what age it was given for the first time. Sum scores based on 24-h recall and recall since birth were constructed by adding the six single items as initially scored. The higher the mean sum scores the higher intake of sugared snacks and drinks.

Termination of breast feeding was assessed by the questions 'Have you ever breastfeed (Name of child)'. Responses were given as (0) No and (1) Yes. If yes; 'for how long did you breastfeed (Name of child)?' Information about first time exposure to sugared snacks and termination of breastfeeding was recorded in months, with less than 4 weeks counted as 0 months and only completed months being used for analysis. Socio-demographics in terms of mother's and fathers education were assessed; 'What is the highest level of school you/father of the child have attended?' Responses were given as (0) No formal education, (1) Did not complete primary school, (2) Completed primary school, (3) Secondary, (4) Completed Secondary, (5) College/University. A dummy variable was constructed, 0 = lower education and 1 = at least primary education.

### *Statistical analyses*

Predictive Analytics Software (PASW) version 18.0 was used for data analysis. Spearman's correlation, Wilcoxon matched pair signed-rank test and Mc Nemar's test were used for paired ordinal and dichotomous variables. Reproducibility was assessed using Cohen's kappa and Intra Class Correlation coefficient (ICC) and 95% Confidence interval (CI). Cox proportional hazards analysis was used to evaluate associations of ECC at the study entry with time to first exposure of sugared snacks and drinks and with time to termination of breastfeeding whilst adjusting for socio-demographic factors. Time to first exposure of sugared snacks and drinks was analyzed using the total study group, whereas analyses of time to cessation of breastfeeding involved only mothers who had stopped breastfeeding at the study entry [32].

## Results

Table I gives the percentage distribution of infants' socio–demographics–and clinical variables for the total study groups and the groups of infants for whom breastfeeding had terminated at the study entry in Kampala and Manyara. Totals of 328 and 486 caregivers had stopped breastfeeding in Kampala and Manyara, respectively. At each study site, children for whom breastfeeding was terminated were older and had higher caries prevalence than their counterparts in the total study group. As shown, totals of 816 (94.6% mothers, mean age = 24.7 years, SD = 4.7) and 1221 (98.6% mothers, mean age = 28.3 years, SD = 6.5) caregiver/child pairs participated in Kampala and Manyara, respectively. Totals of 59.5% and 71.8% of mothers reported at least primary education in Kampala and Manyara, respectively. The ECC prevalence (dt >0) amounted to 17.6% in Kampala and 3.7% in Manyara. Corresponding rates for current breastfeeding were 57% and 60% and corresponding rates for ever breastfeeding 98.4% and 99.9%. Totals of 98.8% and 100% of mothers in Kampala and Manyara had started breastfeeding within the third day after delivery (not in Table I).

### *Re-test reliability of infants' feeding practices*

Cohen's Kappa values for recall since birth ranged from 0.39 (chocolate/sweets) to 1.00 (fruit juice, sugared soda) in Kampala and from 0.61 (biscuits, cakes) to 0.92 (fruit juice) in Manyara (Tables II and III). Kappa values based on 24-h recalls ranged from 0.41 (biscuits/cakes) to 0.86 (chocolate/sweet) in Kampala and from 0.68 (fruit juice) to 0.84 (chocolate/sweets) in Manyara (not in Tables II and III). Wilcoxon matched pairs signed-rank test showed no

Table II. Crude agreement and Cohen's kappa for ever intake of sugared foods and drinks at time 1 and time 2, in Kampala and Manyara. Values for time 1 and 2 are % (*n*) reporting ever use.

| Recall from birth | Time 1, % (*n*) | Time 2, % (*n*) | Crude agreement, % | Cohen's Kappa |
|---|---|---|---|---|
| *Kampala* (*n* = 24) | | | | |
| Tea with milk and sugar | 91.7 (22) | 95.8 (23) | 95.8 | 0.647 |
| Black tea with sugar | 83.3 (20) | 79.2 (19) | 95.8 | 0.864 |
| Fruit juice | 95.8 (23) | 95.8 (23) | 100.0 | 1.000 |
| Soda | 79.2 (19) | 79.2 (19) | 100.0 | 1.000 |
| Biscuits/cakes | 83.3 (20) | 87.5 (21) | 87.5 | 0.500 |
| Chocolate/sweets | 70.8 (17) | 70.8 (17) | 75 | 0.395 |
| *Manyara (n = 81)* | | | | |
| Tea with milk and sugar | 43.2 (35) | 45.7 (37) | 92.6 | 0.850 |
| Black tea with sugar | 72.8 (59) | 74.1 (60) | 88.9 | 0.715 |
| Fruit juice | 44.4 (36) | 45.7 (37) | 96.3 | 0.925 |
| Soda | 54.3 (44) | 55.6 (45) | 86.4 | 0.726 |
| Biscuits/cakes | 76.5 (62) | 71.6 (58) | 85.2 | 0.616 |
| Chocolate/sweets | 70.4 (57) | 66.7 (54) | 86.4 | 0.686 |

statistically significant difference between time 1 and 2 with respect to mean sugar scores based on recall since birth and 24-h recall (not in Tables II and III). Except for biscuits and cakes, where the introduction time was reported later in the second than in the first interview (6.8 months vs 7.02 months, $p = 0.002$), no statistically significant differences between time 1 and time 2 scores occurred with respect to time to first exposure of sugared snacks and drinks and time to breastfeeding termination at either study site. The ICC ranged from 0.59 (95% CI = 0.26–0.87) (chocolate sweets) to 0.97 (95% CI = 0.93– 0.98) for tea with milk and sugar in Kampala and from 0.90 (95% CI = 0.81–0.94) for sugared soda to 0.98 (95% CI = 0.98–0.99) for biscuits/cakes in Manyara (Table IV). For time at breastfeeding termination the ICC were 0.9 (95% CI = 0.9–1.0) and 1.0 (95% CI = 0.9–1.0) in Kampala and Manyara, respectively.

### *Relative validity of dietary habits*

Mc Nemar's test with single sugar items revealed statistically significant differences between recall since birth (ever use) and 24-h recall, with caregivers consistently reporting higher frequencies using the former assessment method. According to recall since birth, the frequency rates ranged from 69.7% (chocolate sweets) to 93.4% (fruit juice) in Kampala and from 38.7% (fruit juice) to 72.6% (biscuits) in Manyara. According to 24-h recall, the frequency rates ranged from 13.9% (soda) to 49.7% (black tea with sugar) in Kampala and from 5.4% (soda) to 16.8% (chocolate sweets) in Manyara. Wilcoxon matched pairs signed-rank test revealed statistically significant differences between the mean sugar scores based on recall since birth and 24-h recall in both Kampala and in Manyara. Spearman's correlation coefficients amounted to 0.35 ($p < 0.001$) (Table V). To assess the ability of the sugar score based on recall since birth to rank individuals into broad categories of sugar consumption, this sugar score was divided into quartiles. A GLM ANOVA adjusted for child's age and gender revealed a statistically significant increase in the mean sugar score based on 24-h recall by increasing quartiles of the sugar score based on recall since birth. The adjusted mean values were 6.2 (95% CI = 6.1–6.3), 6.4 (95% CI = 6.3–6.5), 6.7 (95% CI = 6.5–6.7) and 7.1 (95% CI = 7.0–7.2) in quartiles 1, 2, 3 and 4 in Manyara and 7.2 (95% CI = 7.0–7.4), 8.0 (95% CI = 7.8–8.1) and 8.3 (95% CI = 8.2–8.4) in, respectively, the 1st, 2nd and 3rd quartile in Kampala (not in Table V).

### *Covariates of time to first exposure of sugared snacks and drinks and time to breastfeeding cessation*

In Kampala the mean age at first exposure to sugared snacks and drinks varied from 5.9 months (SD = 4.3, range = 1–30 months) for tea with milk and sugar to 9.7 months (SD = 4.7, range = 2–36 months) for

Table III. Crude agreement and Cohen's kappa for sugared foods and drinks intake at time 1 and time 2. Values for time 1 and 2 are % (*n*) reporting 24-h recall.

| 24-h recall | Time 1, % (*n*) | Time 2, % (*n*) | Crude agreement, % | Cohen's Kappa |
|---|---|---|---|---|
| *Kampala* (*n* = 24) | | | | |
| Tea with milk and sugar | 41.7 (10) | 50.0 (12) | 83.3 | 0.667 |
| Black tea with sugar | 50.0 (12) | 54.2 (13) | 91.6 | 0.750 |
| Fruit juice | 50.0 (12) | 50.0 (12) | 91.6 | 0.833 |
| Soda | 8.3 (2) | 16.7 (4) | 91.6 | 0.625 |
| Biscuits/cakes | 20.8 (5) | 37.5 (9) | 75.0 | 0.415 |
| Chocolate/sweets | 16.7 (4) | 20.8 (5) | 95.8 | 0.864 |
| *Manyara* (*n* = 81) | | | | |
| Tea with milk and sugar | 7.4 (6) | 11.1 (9) | 96.2 | 0.780 |
| Black tea with sugar | 14.8 (12) | 17.3 (14) | 92.5 | 0.725 |
| Fruit juice | 7.4 (6) | 9.9 (8) | 95.0 | 0.688 |
| Soda | 4.9 (4) | 7.4 (6) | 97.5 | 0.787 |
| Biscuits/cakes | 7.4 (6) | 12.3 (10) | 95.0 | 0.724 |
| Chocolate/sweets | 18.5 (15) | 21.0 (17) | 95.0 | 0.844 |

Table IV. Reproducibility of time to first exposure of sugared items and time to breastfeeding cessation.

| | Time 1, Median ($25^{th}$, $75^{th}$) [Mean, SD] | Time 2, Median ($25^{th}$, $75^{th}$) [Mean, SD] | Wilcoxon signed rank test ($p$) | ICC (95% CI) |
|---|---|---|---|---|
| Time to first exposure | | | | |
| *Kampala* ($n$ = 24) | | | | |
| Tea with milk and sugar | 5.5 (3.0, 7.25) [6.82, 7.00] | 6.0 (4.0, 6.0) [6.48, 5.97] | 0.888 | 0.97 (0.93, 0.98) |
| Black tea with sugar | 6.0 (5.25, 9.25) [6.75, 3.17] | 6.0 (5.0, 9.0) [6.84, 3.65] | 0.916 | 0.93 (0.82, 0.97) |
| Fruit juice | 6.0 (5.0, 7.0) [6.26, 2.37] | 6.0 (4.0, 8.0) [7.08, 5.00] | 0.458 | 0.72 (0.35, 0.88) |
| Soda | 7.0 (6.0, 10.0) [7.94, 3.15] | 7.0 (6.0, 12.0) [8.52, 4.18] | 0.865 | 0.80 (0.48, 0.92) |
| Biscuits/cakes | 8.5 (6.0, 12.0) [8.65, 2.71] | 8.0 (6.0, 12.0) [8.57, 3.26] | 0.932 | 0.63 (0.62, 0.86) |
| Chocolate/sweets | 9.0 (6.5, 12.0) [9.29, 3.60] | 9.0 (6.5, 12.0) [10.0, 3.67] | 0.799 | 0.59 (0.26, 0.87) |
| *Manyara* ($n$ = 81) | | | | |
| Tea with milk and sugar | 6.0 (5.0, 8.0) [6.98, 3.52] | 8.0 (6.0, 10.0) [8.29, 3.85] | 0.254 | 0.93 (0.87, 0.96) |
| Black tea with sugar | 6.0 (5.0, 8.0) [7.19, 3.37] | 6.5 (6.0, 10.75) [7.80, 3.00] | 0.096 | 0.94 (0.90, 0.96) |
| Fruit juice | 7.0 (6.0, 10.0) [8.22, 4.15] | 8.0 (6.0, 12.0) [8.78, 4.19] | 0.589 | 0.95 (0.90, 0.99) |
| Soda | 8.0 (6.0, 12.0) [8.49, 3.66] | 8.0 (6.0, 10.5) [8.69, 3.34] | 0.090 | 0.90 (0.81, 0.94) |
| Biscuits/cakes | 6.0 (6.0, 8.0) [6.84, 2.75] | 6.0 (6.0, 8.0) [7.02, 3.16 ] | 0.002 | 0.98 (0.98, 0.99) |
| Chocolate/sweets | 6.0 (6.0, 8.0) [6.83, 2.64] | 6.0 (6.0, 8.0) [7.03, 2.14] | 0.680 | 0.94 (0.90, 0.96) |
| Time to breastfeeding cessation | | | | |
| Kampala | 18.0 (12.5, 21.0) [16.56, 5.52] | 18.0 (13.0, 21.0) [16.67, 5.45] | 0.317 | 0.99 (0.99–1.0) |
| Manyara | 16.5 (12.0, 19.25) [16.3, 5.05] | 16.5 (12.0, 19.0) [16.2, 5.02] | 0.157 | 1.0 (0.99–1.0) |

sweets/chocolates In Manyara, the figures varied from 6.8 months (SD = 2.6, range = 2–24 months) for sweets/chocolates and biscuits/cakes to 8.4 months (SD = 3.6, range = 2–27 months) for sugared soda. Mean age at termination of breastfeeding in Kampala and Manyara was 14.6 months (SD = 7.3, range = 1–36 months) and 17.1 months (SD = 5.6, range = 1–32 months), respectively (Table VI). Time to first

Table V. Relative validity—percentage ($n$) of intake of sugared foods and drinks based on recall since birth and 24-h recall, chi-square (Mc Nemar's test) for the comparison of single sugar items and Wilcoxon signed rank test based on comparison on simple sum sugar scores.

| | Recall from birth | 24-h recall | Chi-square | Mc Nemar's test ($p$) |
|---|---|---|---|---|
| *Kampala* ($n$ = 772) | | | | |
| Tea with milk and sugar | 84.6 (653) | 47.7 (368) | 128.15 | 0.000 |
| Black tea with sugar | 83.5 (645) | 49.7 (384) | 150.439 | 0.000 |
| Fruit juice | 93.4 (721) | 40.9 (316) | 37.842 | 0.000 |
| Soda | 83.0 (641) | 13.9 (107) | 25.386 | 0.000 |
| Biscuits/cakes | 84.6 (653) | 25.3 (195) | 47.546 | 0.000 |
| Chocolate/sweets | 69.7 (538) | 16.5 (127) | 66.114 | 0.000 |
| *Manyara* ($n$ = 1221) | | | | |
| Tea with milk and sugar | 41.9 (512) | 7.2 (88) | 106.882 | 0.000 |
| Black tea with sugar | 65.8 (804) | 14.4 (176) | 86.427 | 0.000 |
| Fruit juice | 38.7 (473) | 5.9 (72) | 64.115 | 0.000 |
| Soda | 44.6 (545) | 5.4 (66) | 32.931 | 0.000 |
| Biscuits/cakes | 72.6 (886) | 11.1 (136) | 28.778 | 0.000 |
| Chocolate/sweets | 66.3 (809) | 16.8 (205) | 40.237 | 0.000 |

| | [Mean, SD] | [Mean, SD] | Wilcoxon signed rank test ($p$) | Spearman's rho |
|---|---|---|---|---|
| Simple sum (SC) sugar score in Kampala | 11.0 (1.4) | 8.0 (1.2) | 0.000 | 0.354* |
| Simple sum (SC) sugar score in Manyara | 9.2 (1.6) | 6.6 (1.0) | 0.000 | 0.355* |

* $p < 0.05$.

Table VI. Time to first exposure of sugared snacks and drinks and to termination of breastfeeding.

| | Mean age in months (SD) [range] | |
|---|---|---|
| Food item | Kampala | Manyara |
| Tea with milk and sugar | 5.9 (4.3) [1–30] | 6.9 (3.5) [1–30] |
| Black tea with sugar | 6.7 (3.9) [1–36] | 7.1 (3.3) [1–24] |
| Fruit juice | 6.8 (3.8) [1–36] | 8.2 (4.1) [1–27] |
| Sugared soda drinks | 8.2 (4.2) [2–36] | 8.4 (3.6) [2–27] |
| Biscuits and cakes | 9.0 (4.5) [1–36] | 6.8 (2.7) [2–26] |
| Sweets/chocolates | 9.7 (4.7) [2–36] | 6.8 (2.6) [2–24] |
| Breastfeeding | 14.6 (7.3) [1–36] | 17.1 (5.6) [1–32] |

exposure of sugared snacks and drinks and time to breastfeeding cessation were positively and statistically significantly associated ($p < 0.001$) with Spearman's correlations ranging from 0.18 (Ugandan tea) to 0.21 (chocolate/sweets) in Kampala. In Manyara, time to breastfeeding cessation was significantly associated with time to first exposure of fruit juice (0.22, $p < 0.001$) and chocolate/sweets (0.16, $p < 0.001$) (not in Table VI).

In Kampala, adjusted ORs and 95% CI for early exposure to sugared tea with milk, black tea with sugar and cakes were, respectively, 0.7 (95% CI = 0.5–0.8), 0.6 (95% CI = 0.5–0.8) and 0.8 (95% CI = 0.6–0.9) times smaller in children with than without ECC experience (Table VII). In Manyara, adjusted ORs and 95% CI for early exposure to fruit juice was 0.5 (95% CI = 0.3–0.8) times less among children with than without ECC (Table VI). In Manyara and Kampala, the ORs for early termination of breastfeeding were 0.6 (95% CI = 0.4–0.9) and 0.5 (95% CI = 0.4–0.7) times less among children with than without any ECC experience. In Manyara, OR for early breastfeeding termination were 0.6 (95% CI = 0.5–0.8) times less for older than for younger mothers, whereas in Kampala the OR was 1.3 (95% CI = 1.1–1.7) times greater for mothers having at least primary education compared with those having less education (Table VIII).

## Discussion

Across study sites and dietary measurement methods, the re-test reliability for sugared snacks and drinks ranged from fair-to-very good according to Landis and Koch [31]. Consistent with what has been reported previously, there was a tendency to refer the first time exposure of sugared snacks and drinks to a later month in the second than in the first interview [20]. This telescope effect is a well-known condition of memory that has been recognized in previous studies of infant feeding [20]. The tendency in Manyara to refer the cessation of breastfeeding to an earlier month in the second than in the first interview might be attributed partly to local attitudes towards infant feeding. Previous studies suggest that maternal recall of breastfeeding duration is good, whereas reported correlation coefficients of first and second assessments vary between 0.49–0.95 [33,34]. In the present study, the short time interval that elapsed between the assessments makes confusion of dietary changes with lack of consistency in a caregiver's report less probable. On the other hand, caregivers might have remembered the answer they gave the first time and, thus, might have repeated it. However, this is probably unlikely since the questions on breastfeeding and sugar consumption were only a few in a long schedule mostly devoted to topics other than infants' feeding habits. The consistency of duration of any breastfeeding was good at each study site, even with these samples of poor women having a relatively long duration of breastfeeding, characteristics that previously have been related to poor recall [35].

One major contribution of this study is the comparison of infants' intake of sugared snacks and drinks using since birth recall as a complement to the 24-h recall. The latter assessment method has been advocated for estimation of usual food intake in large scale surveys in developing countries [36]. Sugar intake based on the two assessment methods differed, however, with the highest consumption estimated from recall since birth across all sugar items at both study sites. Previous studies have shown discrepancies

Table VII. Cox regression analysis on dental caries associated with first time exposure to sugared drinks and sugared foods, Kampala ($n = 772$) and Manyara ($n = 1221$). Adjusted OR 95% CI.

| | OR (95% CI) | | | | | |
|---|---|---|---|---|---|---|
| | Milk Tea | Black tea | Fruit juice | Soda | Biscuits/cakes | Sweets |
| Kampala, $n = 772$ | | | | | | |
| dt = 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| dt >0 | 0.7 (0.5–0.8) | 0.6 (0.5–0.7) | 0.7 (0.6–1.1) | 0.9 (0.7.1.2) | 0.8 (0.6–0.9) | 0.8 (0.6–1.1) |
| Manyara, $n = 1221$ | | | | | | |
| dt = 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| dt >0 | 0.7 (0.4–1.0) | 0.7 (0.5–1.0) | 0.5 (0.3–0.8) | 0.9 (0.5–1.5) | 1.1 (0.7–1.5) | 0.9 (0.5–1.2) |

Adjusted for child sex, mother's education, mother's age and teeth presented.

Table VIII. Cox regression analysis on experience with ECC associated with termination of breastfeeding. In Kampala ($n = 330$) and Manyara ($n = 486$). Adjusted ORs for number of teeth erupted.

| | Adjusted OR (95% CI) | |
|---|---|---|
| | Kampala | Manyara |
| Mother's education | | |
| Lower | 1 | 1 |
| At least primary | 1.3 (1.1–1.7) | 0.9 (0.7–1.2) |
| Caretaker's age | | |
| < 24 years | 1 | 1 |
| 25 years and above | 0.8 (0.6–1.0) | 0.6 (0.5–0.8) |
| dt = 0 | 1 | 1 |
| dt >0 | 0.5 (0.4–0.7) | 0.6 (0.4–0.9) |

when comparing 24-h recall with alternative dietary assessment methods, suggesting that, whereas the 24-h recall estimates might be too low, dietary histories gives too high group mean values [15,37]. Using retrospective cross-sectional methods to describe infants' feeding patterns generates methodological challenges. It is questionable whether such studies might provide a feasible alternative to prospective continuous dietary assessments during infancy. Bland et al. [38] compared 48-h recall and 6-months recall with prospective assessments and found both recall methods to be equally poor. Andersen et al. [39] examined 2-year old Norwegian toddlers and found sugared snacks to be over-estimated in food frequency questionnaires as compared with a 7-days prospective food record. The difficulty with retrospective studies is that the investigator has to rely on participants' memory [2–5]. These problems with retrospective data quality are generally considered to be worse for data pertaining to events in the past than for events taking place shortly before the interview. Nevertheless, a striking limitation of a single 24-h recall is the probability of substantial misclassification of usual feeding patterns when the studied nutrition varies between different days of the week. Another caveat is that caregivers might have difficulties in estimating intake of children's sugar consumption as it is performed also outside home. In addition, the youngest children up to 12 months are fed by caregivers, whereas older children commonly feed themselves [39]. A possible bias that might have affected both recall methods utilized is social desirability because commercialized sugar products have increasingly gained social importance in developing countries. The social desirability bias with over-reporting of anticipated preferred and under-reporting of less preferred consumption patterns is a particular problem in face-to-face interviews [40]. Finally, as the time periods covered by recall since birth and 24-h recall were not identical, some disagreement between methods should be expected. Thus, sugar snacks not reported on the 24-h recall could still have been given to the child at any time since birth. This type of error is the result of daily variation and is a form of sampling variation. Continuous monitoring or repeated prospective interviews during infancy might be necessary if valid and reliable sugar consumption data are desired. The mean sugar scores based on ever use and 24-h recall did differ statistically significantly at both study sites. However, an exact agreement at group level is not necessarily critical to the ability of the score to rank or classify individuals into broader groups of sugar consumption [40]. According to the present results, the sum sugar score based on recall since birth distinguished between children having high and low sugar intake as assessed by the 24-h recalls. This demonstrates its ability to correctly classify subjects into broader groups of intake of sugared snacks and drinks. Although the Spearman's rank order correlation coefficients were of moderate strengths (0.35 at both sites), validity coefficients in the range of 0.20–0.30 to 0.50–0.70 have been recognized to be satisfactory [41,42].

To our knowledge, this is the first study to consider age at first exposure to sugared snacks and drinks and age at any breastfeeding cessation focusing infants and toddlers in Tanzania and Uganda. High re-test reliability in terms of ICC was observed with respect to both time measures. In contrast, previous studies have reported on poor consistency in caregivers reporting of age at which tooth cleaning began [43]. Unexpectedly, children with caries were less likely than their caries-free counterparts to have experienced early exposure to sugared snacks and drinks at the time of the survey. It is not immediately apparent why this should be so, suggesting that the role of diet in caries development is complicated. In this study, late cessation of any breastfeeding was associated with late first time exposure to sugared snacks. Both might reflect poor socio-economic status and limited access to food items generally as well as poor nutritional status of infants and toddlers. Increased risk of dental caries has been reported among 1–5 year old underweight Brazilian children with poor nutritional status and children with low Body Mass Index (BMI) have been reported to have significantly more caries than their counterparts having normal weight [44]. Although socio-demographic factors were adjusted for in Cox regression analyses, the measure of socio-economic position utilized was limited in covering only a narrow range of social circumstances.

Successful breastfeeding depends on multiple factors related to the mother, the infant and the environments [15]. Identifying factors that might predict early breastfeeding cessation, particularly early exclusive breastfeeding cessation, is essential for the planning and implementation of effective health promotion. Consistent with what has been reported in previous studies, early cessation of breastfeeding was

more common in children having mothers of higher education and less common in children with older mothers and caries experience [2,4,34]. Thus, prolonged survival of any breastfeeding might be attributed to low socio-economic status as well.

In conclusion, the present study showed good reproducibility for infants' consumption of sugared snacks and drinks as well as for age at first exposure to sugared snacks and cessation of any breastfeeding across the study sites. Survival of breastfeeding and non-exposure to sugared snacks was most prolonged among children with ECC. This needs further investigation in prospective cohort studies. The results have implications for oral health interventions to caregivers needed to improve diets of infants and toddlers.

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