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Sugar snack consumption in Ugandan schoolchildren: validity and reliability of a food frequency questionnaire

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Abstract – *Objectives:* This study assessed the reproducibility and relative validity of an eight-item self-administered food frequency questionnaire (FFQ) on intake of sugared snacks in Ugandan schoolchildren. A 5-day precoded food behaviour checklist (FBC) was used as validation criteria. Sociodemographic correlates of a sum frequency sugar score were explored. *Methods:* The study was conducted in Kampala, Uganda, in 2004. Six hundred and fourteen schoolchildren (mean age 12.4 years) completed the FFQ on cakes/biscuits, chocolate, ice sticks, soft drinks, coffee, tea, sugared desserts and sweets/candies at school. They were examined clinically for dental caries. Forty students completed the FFQ twice, 1 week apart and 325 students completed the 5 day FBC at school. *Results:* The mean decayed, missing and filled tooth index score was 0.98 (SD 1.6, range 0–15). Reproducibility scores (Cohen's kappa) for the sugar items ranged from 0.17 (ice sticks) to 0.55 (biscuits). No differences were seen between the average intakes at test and retest. Higher intake was reported in FFQ than in FBC across all sugar items. Crude agreement between students reporting intake at least 3–5 times a week/less than three times a week ranged from 50% to 55% (e.g. biscuits, chocolate) to 87% (tea). Spearman's correlation coefficients ranged from 0.14 (desserts) to 0.27 (sweets). ANOVA revealed significant increase ($P = 0.001$) in the mean FBC sum scores by increasing quartiles of the FFQ sum scores. The average sum FFQ sugar scores were higher in girls than in boys and higher in older than in younger students. *Conclusion:* Fair reproducibility was established for the FFQ sugar items. The FFQ was acceptable in classifying individuals into broad categories of low and high sugar consumption.

Key words: reliability; schoolchildren; sugared snacks; Uganda; validity

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Lifestyle-related diseases, such as cancers and cardiovascular disease, are on the rise all over the world, particularly in developing countries (1, 2). In the case of dental caries there is consensus about the relationship between frequency of intake of nonmilk extrinsic sugars and incidence of tooth decay (3, 4). The Nordic countries have recommended limiting added sugars to a maximum of 10% of children's total energy intake (5). Many developing countries, including Uganda, have experienced increases in the per capita consumption of sugar (6, 7). Evidence suggests that commercialized sugar products have become easily available and are highly preferred and frequently consumed, particularly among the higher socioeconomic status groups and urban residents (6). Eating habits during childhood tend to persist into adulthood (8, 9). The policy of promoting restricted sugar consumption needs information about the patterns of intake of

sugared snacks at an early age and its significant influencing factors.

Assessment of dietary habits is a challenging issue (10). The study of dietary assessment in adults poses methodological problems relating particularly to the accuracy of assessment (10, 11). Dietary studies in children have additional problems because children's cognitive ability to record and remember intake as well as their limited knowledge of food and food preparation must be addressed (11). Self-reported food frequency questionnaire (FFQ), 24-h recalls, food diaries and direct observations have commonly been used to assess eating behaviours in both children and adults (12). The FFQ is appreciated for its ease of administration and relatively low cost. It correlates moderately well with information obtained by 24-h recalls, diaries and direct observations, whereas recalls and records show stronger agreement with other validation standards (12, 13). The validity of the FFQ methods has been investigated in many studies in adults. This method has been assumed to be suitable for collecting data in epidemiological studies from the age of 10 years and upwards when the cognitive process of children are more similar to those of adults (10, 14–16). However, validation studies of questionnaires used in children and adolescents are limited. Few reproducibility and validation studies have been published that have evaluated methods of assessment for gathering self-reported food group intake among children without involving parents (12, 13, 15). No such study has evaluated self-reported intake of sugared snacks and drinks of primary schoolchildren in sub-Saharan Africa.

This study assessed sugar-related eating habits among Ugandan primary schoolchildren using an eight-item FFQ. Its principle purpose was to rank the consumption of individuals into broad categories of intake rather than quantifying individual consumption (17). The FFQ contained selected sugar items known to be commonly preferred and consumed among children and adolescents in East African countries (18–20). A study of its psychometric properties was deemed necessary and advantageous before further use. Thus, this study aimed at assessing the reproducibility and relative validity of the eight-item FFQ on intake of sugared snacks and drinks among 10- to 14-year-old pupils attending primary schools in Kampala, Uganda. In the absence of an absolute gold standard for dietary assessment in free-living populations (10), a 5-day precoded food behaviour checklist (FBC), believed to provide greater accuracy than the questionnaire, was used as validation criterion. The sociodemographic and clinical dental status correlates of children's sugar intake were also examined.

Material and methods

Study population and sampling method

A cross-sectional study was conducted among children attending primary schools in Kampala (0.3 mg fluoride/l), the capital city of Uganda, which covers an area of 197 km^2 and has a population of 1.2 million people (49% male, 18% below the age of 5 years). The study was conducted during January–March 2004 using an FFQ, a clinical examination and a 5-day FBC to collect data. A list of all government primary schools ($n = 13$) within the Kampala central division (area 14.7 km^2) was obtained from the Division Headquarters. Two primary schools with less than 30 children were excluded due to limited size leaving 11 schools constituting the sampling frame of 2589 standard seven pupils. A sample size of 650 children was calculated based on an assumed prevalence of dental caries (DMFT > 0) of 50%, a standard error of 5% and a design effect of 2 (21). Lists of all students in grade 7 were obtained from the school authorities and every third student in each school was randomly selected to participate. This strategy provided a sample that was self-weighting, implying that each participating student had the same probability of being selected in the study. Allowing for refusal to give informed consent and exclusion of a few pupils in the age range 15–18 years, 826 parents was contacted and 701 signed letters were returned. The help of teachers was elicited in reminding the children to return the signed forms and to set an appropriate date for the data collection. Twenty pupils who completed the questionnaire survey refused to be examined clinically and were thus excluded from the study. The final participation rate for the main questionnaire survey and clinical examination was 74% ($n = 614$, mean age 12.4, SD = 0.8) (Table 1).

A test–retest of the whole FFQ was undertaken among 40 participants after 1 week to assess the extent to which the measurements are consistent across administrations (22). Participants were not told that they would complete identical questionnaires twice. For assessing the relative validity of

Table 1. Distribution of study participants according to selection of sample and exclusion criteria

	n (%)
Standard 7 children attending 11 government schools in Kampala central	2589
Size of systematic random sample	826 (100.0)
Children who did not return consent forms	125 (15.1)
Children who refused to be examined	20 (2.4)
Children above 15 years of age excluded from analyses	67 (8.1)
Children for FFQ survey	614 (74.3)
Children selected to participate in 5-day FBC	394 (100.0)
Number of children who completed 5-day FBC	325 (82.5)

FFQ, food frequency questionnaire; FBQ, food behaviour checklist.

the FFQ, a follow-up study was conducted 4 weeks after completion of the main FFQ and clinical examination. A subgroup of participants from the FFQ survey consisting of 394 pupils attending four conveniently selected schools volunteered to keep FBC for five consecutive school days. A total of 325 completed (participation rate 82.5%) the records for the whole period (Table 1).

Ethical considerations

Ethical clearance was obtained from the 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 informed consent was obtained from the parent on behalf of their children.

FFQ survey

The structured questionnaire comprised various sociodemographic and oral health-related variables and sugar frequency questions. The questionnaire was constructed and administered in English, which is the language of instruction in all formal academic institutions in Uganda. Health professionals reviewed the survey instrument for semantic, experiential and conceptual equivalence. Sensitivity to culture and selection of appropriate words were considered. The FFQ was pilot tested and adjusted accordingly before being used in the field. It was administered by the main researcher (SK) and four trained assistants in schools as part of the classroom activity to provide a standard administration with the available adult assistance. Questions were read out loud one at a time while the participants filled in the responses on their own.

Measurements

Sociodemographic characteristics

Age of the child was recorded as age at last birthday and categorized as (0) 10–12 years and (2) 13–14 years. *Gender* was coded as 0 = male, 1 = female. *Father's and mother's highest level of education* was assessed on scales ranging from (1) primary education to (4) university/higher learning institutions. Two dummy variables were constructed yielding the categories (0) lower education (primary and secondary education) and (1) higher education (college or university or higher learning institutions). Household durable assets (e.g. bicycle, television, car, motor cycle) were assessed as (1) available/in working condition, (2) not available/nor in working condition. Aspects of the dwelling were assessed including number of rooms and main source of fuel. A household wealth index (asset) was constructed from seven variables using principle component analysis with factor scores ranked into quintiles from (1) poorest to (5) least poor (23).

Food frequency questionnaire

Sugar frequency intake was assessed using eight items (biscuits, chocolate, ice sticks, soft drinks, tea with sugar, sugared coffee, sweetened desserts and sweets/candy) (4), several times a day (3), once a day (2), 3–5 days a week (1) and <3 days a week. Participants were asked to have their usual intake in mind when completing the questionnaire. No particular time frame was provided. A FFQ sum additive score (FFQ ADD) was constructed from the eight items as initially scored [range from 8 (low) to 32 (high)]. For cross tabulation analyses, each item was dichotomized into (1) at least 3 days a week and (0) <3 days a week.

Clinical examination

The clinical examination ($n = 614$) was carried out by one dentist (SNK) whereas a trained assistant recorded the observations. Caries was assessed using the decayed, missing and filled tooth index (DMFT) as described by the World Health Organisation (24). Lesions were recorded as present when a carious cavity was apparent on visual inspection under field conditions (DMFT = 0 and DMFT > 0). Calibration exercise was carried out at the Institute for Paediatric Dentistry, Faculty of Dentistry, University of Bergen, Norway.

Follow-up study: 5-day FBC

A 5-day FBC was chosen as the reference method as 3–7 days are normally adequate to assess food group intake (16, 25). Only students who completed records for the whole period were included in the analyses. On each day the FBC was completed anonymously in the class setting in the presence of the teacher and a research assistant responding to questions from students to help in completing the checklists. The FBC was constructed to assess adequate documentation of the eight sugar items from the FFQ. The students were asked whether or not they had taken biscuits, chocolate, ice sticks, soda, tea, coffee, sugared desserts and candy the previous day. Answers were given as (1) yes and (0) no. All students were also asked about intake frequency (i.e. number of times an item was taken yesterday ranging from zero and upwards). The FBC is a simplification of the 24 h recall. By focusing on a recent and defined time period (yesterday), the memory task is simplified by prompting specific sugared foods and drinks. An average score for the 5 days (range 0.0–1.00) was computed for each participant with respect to whether or not they had taken a sugar item yesterday. To enable comparison with FFQ sugar scores, each average FBC score was expressed as a proportion of the weekly use of that sugar item. Students in the score range 0.0–0.2 were weighted as '<3 days a week' (coded 0), whereas those having values ≥0.40 were weighted as 'at least 3 days a week' (coded 1). A simple count FFQ sugar score (FFQ SC) and a simple count FBC sugar score (FBC SC) was constructed from the eight dummy variables (0 = '<3 days a week' and 1 = 'at least 3 days a week') yielding ranges of 1–8 and 0–8 respectively. In addition, the frequency of intake of sugared snacks and drinks taken the previous day was recorded and dummy variables were constructed yielding (1) ≥ once yesterday and (0) not taken yesterday.

Statistical analysis

Data was entered using STAR OFFICE and transferred to SPSS version 11.5 for analyses. Univariate analyses were performed by use of chi-square statistics. Spearman's correlation, Wilcoxon signed-rank test and McNemar's test were used for paired ordinal and dichotomous variables. Internal consistency and reproducibility was assessed using Cronbach's alpha and Cohen's kappa respectively. Multiple variable analyses were conducted using GLM ANOVA and GLM repeated measures.

Results

Sample profiles

Table 2 gives the percentage distribution of participants' sociodemographic characteristics by gender for the FFQ survey. A total of 614 students, 45.1% boys, mean age 12.4, SD = 1.0, 59.6% younger (10–12 years) participated in the FFQ and the clinical examination. Most of the younger students were girls. The mean DMFT was 0.98, SD = 1.6, range 0–15. The corresponding scores in 10–12- and 13–14-year-old children were 0.77 (1.3) and 1.3 (2.0) respectively. A total of 59.8%, 61.7% and 1.1% had, respectively, DMFT = 0, DT = 0 and FT > 0. Forty students (50% boys, mean age 12.6, SD = 1.0) completed the FFQ a second time after a period of 1 week. Three hundred and twenty-five students participated in the follow-up FBC study, 42.8% boys, mean age 12.3, SD = 1.0, 62.5% younger (10–12 years). To assess whether the participants of the follow-up ($n = 325$), were representative of the study group as a whole, the follow-up group was compared on relevant characteristics with the pupils who completed the main FFQ study only ($n = 289$). There were no statistically significant differences between the two groups with respect to sociodemographics, DMFT status and frequency of intake of sugared snacks and drinks.

Table 2. Percentage (n) of participants by sociodemographic characteristics ($n = 614$)

	Male	Female	All
Age (years)			
10–12	53.4 (148)	64.7 (218)	59.6 (366)
13–14	46.6 (129)	35.3 (119)**	40.4 (248)
Mother's education			
Low	54.5 (139)	60.7 (181)	57.9 (320)
Higher	45.5 (116)	39.3 (117)	42.1 (233)
Father's education			
Low	37.3 (91)	41.9 (124)	39.8 (215)
High	62.7 (153)	58.1 (172)	60.2 (325)
Wealth index			
Most poor (1)	21.2 (56)	18.6 (61)	19.8 (117)
Very poor	17.0 (45)	21.3 (70)	19.4 (115)
Poor	19.7 (52)	21.6 (71)	20.8 (123)
Little poor	20.5 (54)	19.2 (63)	19.8 (117)
Least poor (5)	21.6 (57)	19.2 (63)	20.3 (120)
DMFT > 0	37.9 (105)	42.1 (142)	40.2 (247)

DMFT, decayed, missing and filled tooth index.
**$P < 0.01$.

Internal consistency and test–retest reliability

Internal consistency reliability (Cronbach's alpha) for the FFQ ADD and SC sugar scores obtained in the main survey ($n = 614$) were 0.70 and 0.69 respectively. The corresponding alpha score for the FBC SC scores among follow-up study participants ($n = 325$) was 0.70. Table 3 shows the mean and median sugar intake estimated from the FFQ at two time periods ($n = 40$). Wilcoxon signed-rank test showed no statistically significant difference at the group level between the intake assessed at time 1 and time 2. The weighted kappa values ranged from 0.16–0.17 (coffee, ice sticks) to 0.55 (biscuits). Intraclass correlation coefficient for the FFQ ADD scores at time 1 and time 2 was 0.55 (95% CI 0.3–0.7). The examiner agreement for the clinical examination was found to be acceptable (Cohen's kappa = 0.75).

Relative validity

With few exceptions, no striking differences were found between boys and girls and younger and older students. Thus, results from the whole sample are presented (Table 4). McNemar test with dummy variables (cut-off point at least 3–5 days a week) revealed statistically significant differences between the two methods with participants consistently reporting a higher intake in the FFQ when compared with the FBC. With respect to the single sugar items, Spearman's correlation coefficients ranged from 0.14 (sugared desserts) to 0.27 (sweets). Results from Wilcoxon signed-rank tests revealed overestimation on the part of the FFQ SC score when compared with the FBC SC score, with mean values of 5.5 (SD = 1.9) and 3.4 (SD = 1.9) respectively ($P < 0.001$) (not shown in Table 4). Spearman's correlation coefficient (ρ) for the FFQ SC and FBC SC scores was 0.30 ($P < 0.001$). The corresponding figures for 10–12- and 13–14-year-old students were 0.25 and 0.40 ($P < 0.001$) respectively. Crude agreement between students confirming intake at least 3 days a week and less than three times a week ranged from 50–55% (biscuits, chocolate, soft drinks, coffee, desserts), to 55–65% (ice cream, sweets) to 87% (tea). The least and most frequently reported sugar items estimated by both methods were intake of chocolate and tea. To assess the ability of the FFQ to rank individuals into broad categories of sugar intake, the FFQ SC scores were divided into quartiles. A GLM ANOVA, adjusting for age and gender revealed a statistically significant increase

Table 3. Reproducibility: intake of sugared snacks per week based on FFQ at time 1 and time 2

	Time 1	Time 2	*P*	Kappa
Biscuits	3.0 (2.0, 3.0), 2.7	3.0 (2.0, 3.0) 2.7	0.964	0.55
Chocolate	3.0 (1.0, 3.0), 2.4	3.0 (2.0, 3.0), 2.6	0.198	0.39
Ice sticks	3.0 (3.0, 3.7), 2.9	3.0 (2.0, 3.0), 2.8	0.112	0.17
Soft drinks	3.0 (1.2, 3.0), 2.4	3.0 (2.0, 3.0), 2.5	0.711	0.40
Coffee	3.0 (1.2, 3.0), 2.6	3.0 (2.0, 3.0), 2.7	0.410	0.16
Tea	3.0 (3.0, 4.0), 3.1	3.0 (3.0, 4.0), 3.1	0.572	0.29
Sugared desserts	3.0 (2.2, 3.7), 2.8	3.0 (3.0, 3.0), 2.8	0.967	0.23
Sweets	3.0 (3.0, 4.0), 3.0	3.0 (3.0, 3.0), 2.9	0.654	0.23
Sugar ADD scores	22.0 (20.2, 24.0), 22.4	23.0 (19.0, 25.0), 22.3	0.723	0.45

Values for time 1 and time 2 are median (25th, 75th percentile), mean. Wilcoxon's signed-rank test and kappa ($n = 40$).

Table 4. Relative validity: mean and (SD) for intake of sugared snacks and drinks, chi-square (McNemar's test) and the Spearman's correlation coefficient (ρ) based on the FFQ and 5-day FBC ($n = 325$)

	FFQ [*f* mean (SD)][a]	FBC [*f* mean (SD)][a]	Chi-square	*P*	ρ
Biscuits	0.6 (0.4)	0.3 (0.3)	41.5	<0.001	0.17**
Chocolate	0.5 (0.4)	0.1 (0.3)	119.9	<0.001	0.21**
Ice sticks	0.7 (0.4)	0.5 (0.4)	59.1	<0.001	0.22**
Soft drinks	0.6 (0.4)	0.4 (0.3)	25.4	<0.001	0.16**
Coffee	0.6 (0.4)	0.3 (0.4)	71.6	<0.001	0.25**
Tea	0.9 (0.2)	0.8 (0.3)	6.5	<0.001	0.14**
Sugared desserts	0.7 (0.4)	0.4 (0.4)	53.7	<0.001	0.24**
Sweets	0.7 (0.4)	0.5 (0.4)	26.2	<0.001	0.27**

[a]The average of the 0,1 variables is the proportion who scored 1 at least 3 days a week.
**$P < 0.001$.

($F = 10.5$, d.f. $= 3$, $P < 0.001$) in the mean FBC SC scores by increasing FFQ quartiles. The adjusted mean values were 2.9 (95% CI 2.5–3.3), 3.1 (95% CI 2.5–3.6), 3.4 (95% CI 3.1–3.8) and 4.6 (95% CI 4.1–5.0) in quartiles 1, 2, 3 and 4 respectively. Bonferroni *post hoc* showed that the mean values of quartile 4 differed statistically significantly from those in quartiles 1, 2 and 3. Correspondingly, for all eight sugar items, mean FBC sugar intake increased across the FFQ categories, at least 3 days a week and <3 days a week. With respect to intake of biscuits, desserts and tea, the increase was statistically significant for the older age group, only.

The proportions of children who reported consumption of sugared snacks and drinks at least once the previous day across five consecutive days are depicted in Table 5. The day-to-day variation was limited but varied across the food items. GLM with frequency daily consumption from FBC as within subject factor (time) and the corresponding FFQ item in terms of (1) at least daily and (2) less than daily as between-subject factors revealed no statistically significant two-way interactions. This confirms the visual evidence of stability in rank as depicted for daily soda consumption in Fig. 1. Thus, the FBC mean daily frequency consumption within the FFQ categories maintained their relative position in rank across the 5 days. One-way ANOVA revealed that reported intake of all sugared items in the FBC showed stability in ranking between day 1 and day 5 with the 'at least daily' and 'less than daily' FFQ categories being statistically significantly different at each follow-up day ($P < 0.005$).

Table 5. Day-to-day variation (%) in intake of sugared snacks and drinks based on the FBC. Percentage of those reporting at least once a day intake ($n = 325$)

Sugar items	Day 1	Day 2	Day 3	Day 4	Day 5
Biscuits	28.7	29.8	26.6	25.7	25.4
Chocolate	12.3	11.1	9.1	10.2	9.4
Ice stick	21.1	39.5	39.8	39.5	36.3
Soda	37.4	29.8	30.7	25.0	24.0
Tea	87.1	81.0	73.7	75.0	77.2
Coffee	29.2	24.3	26.6	25.7	24.6
Desserts	37.4	34.8	29.8	29.8	28.7
Sweets	39.2	36.8	37.4	42.7	36.3

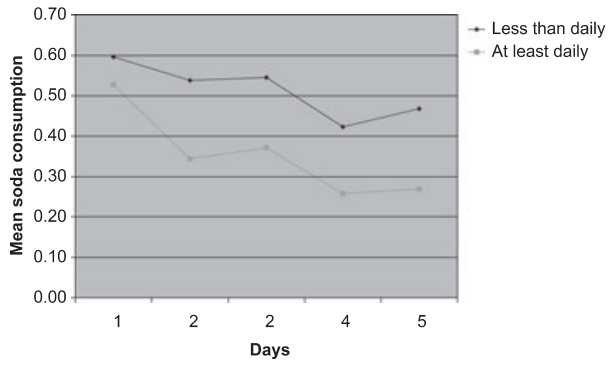

Fig. 1. Mean frequency of daily soda consumption as reported by food behaviour checklist at day 1–day 5 in groups reporting soda consumption at least daily and less than daily by food frequency questionnaire.

Sociodemographic correlates of sugar consumption

The proportions of pupils in the main FFQ study ($n = 614$) who reported intake of sugared snacks and drinks at least 3 days a week ranged from 57% (chocolate) to 93% (sugared tea). Gender differences with a higher proportion of girls than boys reporting that intake were statistically significant for biscuits, chocolate and sweets. A GLM ANOVA with the sum FFQ SC sugar score (mean = 5.8, SD = 2.0, range 0–8) as dependent variable and age, gender, parental education and caries experience as fixed factors revealed statistically significant effects of gender ($F = 6.7$, d.f. $= 1$, $P = 0.010$) and age group ($F = 4.1$, d.f. $= 1$, $P = 0.045$) (Table 6). An interaction effect between age and DMFT status ($F = 3.6$, d.f. $= 1$, $P = 0.058$) approached statistical significance. Stratified analysis revealed a negative and positive relationship between DMFT and the mean FFQ SC scores in the younger (10–12 years) and older (13–14 years) age groups respectively. Subgroup analyses ($n = 325$) with FFQ SC and FBC SC scores as dependent variables and gender, mothers education, age and

Table 6. Adjusted mean FFQ SC scores and 95% confidence interval (95% CI) by sociodemographic and clinical variables ($n = 614$)

	n	Mean (95% CI)
Gender		
Female	290	6.0 (5.7–6.2)
Male	244	5.5 (5.2–5.7)*
Mother's education		
Lower	309	5.7 (5.4–5.9)
Higher	225	5.8 (5.5–6.1)
Age group		
10–12 years	320	5.5 (5.3–5.8)
13–14 years	220	5.9 (5.6–6.2)*
Caries prevalence		
DMFT = 0	319	5.8 (5.5–6.0)
DMFT > 0	215	5.7 (5.4–5.9)

FFQ SC, food frequency questionnaire simple count; DMFT, decayed, missing and filled tooth index.
*$P < 0.05$.

DMFT as independent variables revealed effects similar to those revealed by the main sample analysis ($n = 614$).

Discussion

Fair to moderate reproducibility was established for most FFQ items. According to Landis and Koch (26), kappa values at and below 0.20, in the ranges of 0.21–0.40, 0.41–0.60, 0.61–0.80 and 0.81–1.00, indicate poor, fair, moderate, good and very good agreement respectively. On the group level, no mean differences were observed between the two time periods (Table 2). A short 1-week interval was used in the present study to avoid the possibility of confusing dietary changes and lack of repeatability in these young individuals (22).

It has been suggested that the simplest method for comparing frequency data is to calculate the percentage agreement within a certain number of units (14). Comparing the categories at least 3 days a week/<3 days a week based on the FFQ and FBC method revealed less satisfactory agreement (50–55%) for biscuits, chocolate, soft drink, coffee and dessert, moderate agreement (60%) for sweets and ice cream and good agreement (87%) for tea, only (14). The mean consumption estimated by FFQ and FBC did differ statistically significantly, with the highest consumption identified by the FFQ across all sugar items. Overestimation of children's food intake with FFQ is a common finding in the literature (12–15, 27, 28). Earlier studies of Norwegian (29) and British adolescents (30, 31) as well as Spanish adults (32) observed overestimation for most nutrients by FFQ when compared with weighted dietary records. According to the present data, overreporting was a larger problem with chocolate, biscuits and ice cream than with soft drinks, sugared tea and desserts. Thus, lack of agreement was most extensive with the items least frequently reported, suggesting that main course food items consumed on an everyday basis might be recalled more accurately when compared with secondary food items such as sugared snacks (27). Pupils might also have overreported intake of sugared snacks due to social desirability because commercialized sugar products increasingly gain social importance in nonindustrialized countries (1, 2).

An exact agreement at group level between the results from FFQ and FBC is not necessarily critical to the ability of the FFQ to rank or classify individuals into broader groups (22). Thus, the FFQ distinguished reliably between those having high and low average weekly and average daily intake as assessed by the FBC, demonstrating its ability to correctly classify subjects into broader groups of intake of sugared snacks. Nevertheless, the correlation coefficients obtained ranged from 0.14 to 0.30, suggesting rather poor ability of the FFQ to rank subjects, particularly in relation to the single sugar items. A plausible explanation might be low inter-subject variation and restricted ranges of assessment scales on both the FFQ and FBC instruments (22). Moderate reliability on the part of both assessment methods might have contributed to the small validity coefficients estimated (22). The rank order coefficients observed were similar to those obtained previously by several authors, but lower than those reported by others (13, 16, 27, 31). Many researchers have suggested that validity coefficients in the range 0.30–0.70 could indicate satisfactory agreement between FFQ and dietary records (33), whereas Romieu et al. (34) recommended coefficients in the range 0.20–0.50 to be satisfactory.

The present findings should be interpreted in the light of the assumed accuracy of the reference method applied. If the 5-day FBC was biased towards underestimation of sugar snacking due to forgetfulness, lack of compliance and unstructured eating patterns, then the validity of the FFQ would be underestimated as well. A limitation connected with the FBC is the coverage of five school days only. As there was no school on Saturday and Sunday, checklists were not collected on those days. If the consumption of certain sugar items is strongly connected with certain days of the week, the FBC may not give a true picture of the average weekly intake. Little difference was observed across the 5 days regarding the ability of the FFQ categories to discriminate between high and low average daily consumption (Fig. 1). This suggests that variation in sugar consumption over time was not a major source of variability in the FBC data.

Questions have been raised as to the suitability of FFQ for assessing normal food intake in young individuals (35). Although oral health questionnaires with children in the 6–10-year-old age group have been found to have a high level of concordance between child and caregiver (36), children below the age of 12 have been considered too young to report their own food intake with

acceptable accuracy (14). This suggests that recalls and records work better at that age than do FFQ (12). In this study, the FFQ sum scores were appropriate for the purpose of classifying subjects into broader groups of sugar snacking and the appropriateness tended to improve with increasing age of the participants.

On average, respondents showed a relatively high overall level of sugar intake with the highest intake reported for females and older pupils. This adds to the construct validity of the FFQ. Higher sugar consumption in females has been commonly reported in studies of community populations in sub-Saharan Africa (18, 19). On the other hand, children's sugar frequency intake was not positively correlated with their DMFT status. This has been reported previously (37) and might be attributed to the overall high level of sugar consumption identified. In a previous study of 3–5-year-olds in Uganda, children of parents with low level of education consumed more sugared snacks and drinks and had higher caries prevalence than did their counterparts having parents with longer education (20). Similar results with respect to sugar intake in 4-year-olds have been reported from industrialized countries (38, 39). This association was not observed in the present study, which also corroborate findings reported elsewhere (38, 39). This appears to imply that parental influences are less important among 10- to 14-year-old primary schoolchildren.

In sum, the ability of the FFQ to classify Ugandan schoolchildren into broad categories of low and high sugar snacking was acceptable. The results indicate that the eight-item sugar FFQ is inappropriate for estimating absolute intake but could discriminate between high and low consumers and might be applicable for identifying children at risk and for examining differences between child populations. Despite the practical advantages of the short sugar snacking FFQ in this study, it needs further revision to become a valid tool for the measurement of sugar snacking in 10- to 14-year-old urban schoolchildren.

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