

## **ABSTRACT**

**Introduction:** High sugar intake is a well-known risk factor for a plethora of diseases among adults and children. Even though different health authorities have played much attention on sugar intake of people, hitherto, according to the published literature in Sri Lanka, there are no available data on sugar intake patterns among adults or children or factors that predispose those patterns. Among children, dental caries and obesity are the main adverse health effects resulted by high sugar intake. In Sri Lankan context early childhood dental caries (ECC) is a significant public health problem with high prevalence and persisting for many decades, and obesity is an emerging health problem still with a low prevalence.

**Objective:** To assess the patterns of sugar intake; identify the factors associated with it; its association with dental caries status and general nutritional status and to identifying safe patterns of sugar intake among 04 to 05-year-old preschool children in the Colombo District.

**Methods:** This study was conducted as two components.

### **Component I**

Development of the food frequency questionnaire: A cross-sectional descriptive study was carried out among 518 preschool children in the Colombo district. They were selected from all the 13 district secretariat divisions in the Colombo district. Three interviewer-administered 24 hour dietary recalls were collected from each participant.

To obtain more comprehensive data on children's diet, these dietary recalls were taken on two weekdays and one weekend day. By using these findings, all the sugar containing food and beverage items consumed by the children were extracted. To identify the sugar-containing foods reputed recipe books, recipes from local food manufacturers and food label were searched. All these identified sugar containing food items were included in the food list of the FFQ. Thus, the list of foods included in the FFQ can be considered as a well representative and comprehensive list to assess the sugar intake of preschool children in the Colombo district.

The validation of the FFQ was established by conducting a cross-sectional study among a sample of 108 preschool children who are 04 to 05 years of age, in the Colombo District, which is the same population the FFQ is going to apply. In the present study, the 24-hour dietary recall was

used as the reference method. The FFQ was applied twice to the same population in six weeks interval to assess the reliability.

## **Component II**

A descriptive cross sectional study was conducted to identify the patterns of sugar intake among preschool children then a cross sectional analytical study was done to identify the factors associated with sugar intake patterns and identify the association between sugar intake and possible consequences like dental caries and overweight or obesity. Then a safe sugar intake pattern for preschool children was identified that will not increase the risk of dental caries or obesity. This study was conducted in 86 preschools among 813 preschool children and their parents. These 86 clusters were selected from all the 13 district secretariat divisions in the Colombo District utilizing probability proportionate to size sampling technique. From each district secretariat division, the required numbers of preschools were selected by simple random sampling technique. Using the registered preschool list of the district secretariat division random preschools were selected using computer-generated random numbers. Data collection was done in two days. Mainly the primary caregiver of the child was invited for the data collection. On the first day questionnaire 1, questionnaire 2 and the newly developed food frequency questionnaire (FFQ) used to collect data. A three day dietary record was given to fill at home. On the second day weight and height of the children were measured. Intra oral examination was carried out.

**Results:** A 75 item quantitative food frequency questionnaire (FFQ) was developed to assess the patterns of sugar intake among preschool children. The median (IQ Range) sugar intake levels from FFQ1 was 64.46 (39.9 – 111.52) grams/ day, and the corresponding value for 24h recalls 56.95 (29.38 – 102.77) grams per day, and FFQ2 was 61.78 (41.33 – 97.82) grams/ day. Outcome was assessed by the Wilcoxon sign rank test, and no difference in mean sugar intake from FFQ1 and three 24h recalls, and FFQ2 and three 24h recalls. Spearman correlation between FFQ1 and three 24h recalls were 0.98 and FFQ2, and three 24h recalls were 0.78. Bland and Altman plots for sugar intake from FFQ1 and three 24h recalls, and FFQ2 and three 24h recalls showed acceptable agreement throughout the range of intake. When compare sugar intake from FFQ1 and FFQ2 (same FFQ applied twice to the same population after two weeks). These two applications showed Spearman correlation of 0.68 and intraclass correlation coefficient of 0.55. Bland and

Altman plots also showed a acceptable agreement throughout the range of intake between two applications of FFQ. Therefore, can be concluded this newly developed FFQ as a valid and reliable instrument to assess sugar intake patterns among preschool children in the Colombo district.

The median amount of free sugar intake among preschool children in the Colombo district was 57.9 g/ day with an interquartile range of 33.2 - 95.8 g/ day. The median frequency of sugar consumption was four times/ day with an interquartile range of 2.7 – 6.1 times/ day. When consider this sugar intake as a percentage of total energy requirement of the child (this was used to simulate the total energy intake) the median was 21.1% with an interquartile range of 12.5% - 35.9%.

Comparing this sugar intake of preschool children with WHO guideline on sugar intake for adults and children which suggested limiting the free sugar intake less than 10% of total energy intake, the sugar consumption of the current population of preschool children was almost twice the recommended level.

Multivariable analysis elicited multiple statistically significant associations with sugar intake patterns of preschool children when controlled for other factors included in the model. Maternal education level and dental clinic attendance were emerged as statistically significant negative associations with the amount of sugar intake. Ethnicity being other than Sinhala, presence of school going siblings, eating while coming back from preschool and eating while watching television had statistically significant association with higher intake levels of sugar.

The prevalence of dental caries among the 04 – 05-year-old preschool children in the Colombo District was 42.9%. The median decayed missing and filled teeth (dmft) value was four teeth with an interquartile range of 02 – 08 teeth.

Multivariable analysis identified only two statistically significant associations with the level of dental caries (Measured by dmft score) when controlled for the other factors included in the model. Those were sugar intake as a percentage of total energy requirement ( $\beta = 0.47$ ,  $p < 0.001$ ), and Frequency of sugar intake ( $\beta = 2.16$ ,  $p < 0.001$ ). This indicates that the sugar intake is the single most predominant determinant of the development of dental caries. When compare the sugar intake patterns among children with dental caries and children without dental caries all nine sugary food group intake was significantly high among children with dental caries.

Prevalence of overweight was 1.3%, and obesity was 0.8% among the 04 – 05-year-old preschool children in the Colombo District. Children were classified into three groups as underweight, normal weight and overweight according to the WHO criteria weight for height of children under five years of age and according to BMI of children above Five years of age to compare their sugar intake patterns. There was no significant difference in amount of sugar intakes among three weight categories, and there was a significant difference in sugar intake as a percentage of total energy requirements. The underweight children had a highest sugar intake as a percentage of total energy requirement, and overweight/ obese children had the lowest sugar intake as a percentage of total energy requirement. Though high sugar intake was generally considered as associated with overweight and obesity, the present findings suggests children who were taking high percentage of their total energy requirement from sugar have a more possibility of becoming underweight.

The safe maximum amount of sugar intake that can be recommended for a 04 - 05-yearold child that will not increase the risk of dental caries or the risk of being overweight or underweight was 4% of total energy requirement which is approximately 12 g/ day. When this was converted to teaspoons, it is about 3 flat teaspoons/ day. The safe maximum frequency of sugar intake that can be recommended for optimum dental health is only once a day.

**Conclusion and recommendations:** Free sugar intake is the single most important risk factor for the development of dental caries. Primarily the amount and then the frequency of sugar intake are the most important determinant of the dental caries status of preschool children. This effect of high sugar intake on development of dental caries cannot be mitigate by other factors like brushing teeth twice or use of fluoride particularly in toothpaste.

High intake of free sugar as a percentage of total energy requirements has more propensity to affect the normal growth of the child and they can become underweight.

Relevant authorities should pay attention on this massive problem of excess sugar intake of preschool children and appropriate measures should be taken to address this.

**Keywords:** *sugar intake, preschool children, dental caries, nutritional status, overweight, food frequency questionnaire*