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Relationship between dental caries and nutritional status among five-year-old school children in Uasin-Gishu County, Kenya

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Abstract

Dental caries is a major public health problem affecting 60-90% children globally and associated with diet and nutrition. Objective: To establish the relationship between dental caries and nutritional status of 5-year-old school children in urban and rural areas of Uasin-Gishu County. Study group: A cross sectional survey was used to select 382 five-year-old children and their parents/caregivers from urban and rural schools in Uasin-Gishu County, Kenya. Methods: Dental caries status was assessed based on WHO criteria for oral health surveys. Anthropometric measurements were used to assess the nutritional status of the children and analyzed using ENA for SMART computer programmes. Pearson's correlation was used to determine the relationship between nutritional status and dft. A p value of < 0.05 was considered significant. Results: The prevalence of dental caries among the children was 39.3% (dft = 1.55). Overweight was higher urban area compared to the rural at 13.6% and 8.9% respectively, while underweight was higher in rural areas at 10.7%. In both rural and urban sample (n = 384), underweight ($r = 0.67$; $p = 0.047$), overweight ($r = 0.83$; $p = 0.012$), obesity ($r = 0.53$; $p = 0.031$) and wasting ($r = 0.16$; $p = 0.041$) had a significant relationship with dft ($p < 0.05$). Conclusion: Programs targeting alleviation of malnutrition among children be modified to include dental caries mitigation.

Keywords: Nutritional status, dental caries, height, weight, BMI

Introduction

The effects of lifestyle changes and nutrition transition in developing countries are becoming manifested in dietary habits and resultant nutritional status among school children (1). This has exacerbated the burden of non-communicable diseases particularly in developing countries, Kenya included.

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Among them, dental caries and obesity are the most prone and of great importance (2). The brunt effects of dental caries continue to be meted on young children even though evidence shows that it is preventable (3).

'Nutritional transition' and change in lifestyles is associated with the increase in the prevalence of overweight and obesity in children in developing countries (4). Overweight and obesity in children is associated with prolonged exposure to carbohydrates (5), which is also well documented to be a major causal factor of dental caries (6). Dental caries that is left untreated is increasing among preschool children in Uasin-Gishu, Kenya (7).

Dental caries cause pain, discomfort and irritability thus compromising the ability of the children to eat a variety of foods and function well at school and home (8). Good nutrition is an important part of leading a healthy lifestyle. However, the pain and discomfort lower the ability of children to eat a variety of foods thus exposing them to unhealthy eating habits (7). These unhealthy eating habits may include drinking and eating snacks high in refined sugar that has been implicated in causing obesity as well as dental caries (5).

The prolonged intake of foods and snacks with refined sugar, is associated with dental caries, and has long been associated with overweight and obesity. However, studies carried out in developing countries to determine the relationship between prevalence of dental caries and the nutritional status reveal conflicting results (5). Hence, there is need for such a study in Kenya as literature revealed limited information. The aim of the present study was therefore to investigate the relationship between dental caries and the nutritional status of 5-year-old school children in Uasin-Gishu County, Kenya.

Methods

The cross-sectional research design was adopted in this study. The purpose of this study was to assess the relationship between the prevalence of dental caries with nutritional status of 5-year-old preschool children in rural and urban areas of Uasin-Gishu County. Eldoret Municipality was chosen purposefully because there are limited studies done on prevalence of dental caries and nutritional status of 5-year-old children. Eldoret municipality has thirteen administrative units. One administrative unit was randomly sampled from the urban area. The researcher identified total number of day primary schools with Early Childhood Development classes in the administrative unit. Two primary schools were randomly sampled, and the total number of 5-year-old established from the school registers or birth certificates available in the school records. Two wards from the six administrative units in Uasin-Gishu County were sampled using multistage sampling procedure. One school from each ward was randomly selected. The number of children selected from each area (Urban and rural) was based on the number of 5-year-old children in that area as a proportion of the total number of 5-year-old children enrolled in primary schools multiplied by the sample size. The 5-year-old children whose parents consented for dental caries examination and anthropometric measurements were included in the study and those who were unwell during the study period were excluded. A total of 384 preschool children aged 5-year-old were assessed. A structured questionnaire was used to collect socio-demographic data of the caregiver and the child.

Anthropometric measurements were carried out using standard anthropometric equipment and procedures as described by de Onis et al. (9). Body weight was taken using a SECA weighing scale (Vogel and Halke Hamburg, Model 7141014009, Germany, 2008) to the nearest 0.1kg. The weighing scale was placed on a flat surface and was calibrated on every visit before the measurements were made using 1 kg of sugar as recommended by KNBS & Ministry of Public Health and Sanitation (MoPHS) (2008) (15). The child was asked to remove heavy clothing and shoes and asked to step at the center of the scale facing straight ahead, arms at the side, looking relaxed but still. Three consecutive readings were taken and the average was used for analysis. Height measurements were taken using a portable microtoise to the nearest 0.1 cm. It was stretched to its full length and hooked on a wall using a nail. A child, with shoes removed, stood on a flat cemented surface below the microtoise with the head positioned such that the Frankfurt plane was horizontal; the knees of the child were straight with buttocks, heels, shoulder blades and back of the head touching the wall and arms

hanging loosely at the side of the~~ir~~ body with the palms facing the thighs. Just before the measurements were taken the subject inhaled deeply, held the breath and maintained erect posture. The microtoise was lowered gently until it touched the crown of the head. Three sets of measurements off the red mark on the microtoise were taken at the eye level and recorded. Mid upper arm circumference (MUAC) measurements were taken using a non-stretchable arm circumference tape to the nearest 0.1 cm. It was measured on the posterior aspect of the left arm on the midpoint between the acromion process of the shoulder and the olecranon process of the elbow. This was done by locating the tip of the child's shoulder. The Olecranon process was located by bending the child's elbow to make a right angle. Clothing that may cover the child's arm were removed. The arm was relaxed and hanging down side the body. The child's arm was straightened and the tape wrapped around the arm at midpoint. The researcher made sure the numbers were right side up and the tape ~~is~~ was flat around the skin but firmly around the arm. The measurements were read from the window of the tape without pinching the arm or leaving the tape loose. The measurements were taken three times and the average value calculated and used for the analysis.

The values for height, weight and MUAC measurements of each child were transferred to ENA for SMART computer programme (http://www.nutrisurvey.de/ena/ena.html) for z-score calculations. The z-score height-for-age (HAZ), weight-for-age (WAZ), and MUAC were assessed.

Two research assistants were recruited to assist in nutritional assessment of the children. They were conveniently selected from University of Eldoret Food Science and Nutrition third year students. These students had basic knowledge on anthropometric assessment. The research assistants were trained for three days on the objectives of the research and the data collection procedures. During the training, the research assistants were taken through taking of MUAC, height and weight of the children using the actual measurement tools which were used in this study. For calibration, Inter and intra examiners agreement were calculated using Kappa coefficients ($k \geq 0.75$).

Three fifth year dentistry students from Moi University, School of Dentistry were conveniently recruited to assist in assessing the prevalence of dental caries status among the sampled children. The students had basic knowledge to assess dental caries in children. The students were familiarized with the study requirements and the tools to be used in the study. A pediatric dentist calibrated the students to assist in dental caries assessment for consistency using two children attending dental clinic in Moi Teaching and Referral Hospital (MTRH). Kappa Coefficient was used to assess the inter-examiner reliability and agreement where the results of the First, Second and Third assessor had Kappa coefficient of 0.8, 0.9 and 0.7 respectively.

Dental caries examination was carried out in the school compound where subjects were examined in a seated position on a school chair and the examiners sat in front of them. Cotton wool was used for drying the teeth, and natural daylight was used for proper visibility. A CPI ball-ended probe and a lighted mouth mirror were used as examination tools to score caries according to standard procedures described by World Health Organization (14). The relationship between dental caries prevalence of the children and their nutritional status was then investigated.

Data analysis

Data was cleaned and entered in Statistical Package for Social Sciences (SPSS) computer software version 21 (2012) for analysis. Descriptive statistics and Pearson's correlation coefficient was used to test the association between dft and nutritional status. A p-value of < 0.05 was considered statistically significant.

Prior to the study, reliability of the research instruments to check for feasibility and validity was ensured by pre-testing of the research instruments on 40 children of similar age to those in the main study. These children were selected from a school in a peri-urban area that did not participate in the study.

Results

The socio-demographic characteristics of parents/caregivers indicated that one hundred and sixty-eight (168) (43.9%) had attained college/university edu-

cation. Those who did not complete secondary education were 80 (20.9%) and 44 (11.5%) had completed primary school. With regard to occupation, 125 were civil servants representing (32.8%), self-employed 104 (27.1 %) and casual labourers 74 (19.3%). Furthermore, those who practiced farming of crops such as maize, wheat, beans, and vegetables for food and sold the surplus were 63 accounting for 16.6% of the parents/caregivers. Additionally, 123 (32.2%) of the households had a monthly income of Ksh.21, 000-50,000, another 75 (19.6%) earned Ksh.11, 000-20,000 while 66 (17.2%) earned Ksh.6000-10,000 (see Table 1).

Table 1. Socio-demographic characteristics of parents/caregivers in urban and rural areas of Uasin-Gishu County, Kenya

Variable	Description	n	Percentage (%)
Level of education	Did not attain primary	12	3.1
	Attained primary	44	11.5
	Incomplete secondary	80	20.9
	Complete secondary	71	18.6
	University& college	168	43.9
	None	7	1.80
Occupation	Farmer	63	16.6
	Civil servant	125	32.8
	Casual laborer	74	19.3
	Self-employed	104	27.1
	Other	16	4.2
Household income	<Ksh. 5000	23	6.0
	Ksh. 6,000-10,000	66	17.2
	Ksh. 11,000-20,000	75	19.6
	Ksh. 21,000-50,000	123	32.2

Characteristics of the children

Out of the 384 children who participated in this study, more than half (59.6%) were from urban areas with 50.3% being male and 49.7 % females. The average age of the children was 4 years and 6 months (see Table 2).

Prevalence of dental caries in children in rural and urban areas of Uasin-Gishu County

From a total sample of 382 children, those with dental caries were 150 (39.3%) with a mean dft of 1.55 ± 1.34 while 232 children (60.7 %) had no dental caries (see Figure 1).

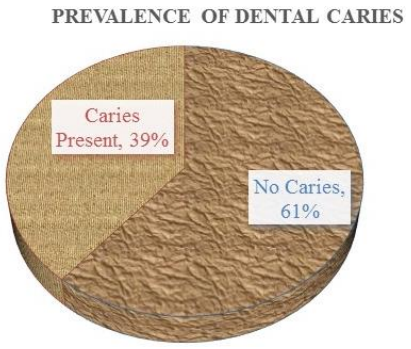

Figure 1. Prevalence of dental caries in 5 year old children.

Table 2. Characteristics of the children in both urban and rural areas of Uasin-Gishu County

Variable	Description	Sample	Percentage (%)	P-Value
Location	Urban	228	59.6	0.028*
	Rural	154	40.4	
Gender	Male	192	50.3	0.421
	Female	190	49.7	
Average years		384	Mean age = 4 years, 6 months	

*Significant at p < 0.05l.

Nutritional status of children according to location

Overweight was higher in children in urban area compared to the rural area at 13.6% and 9%. Wasting cases were higher in rural areas at 10.7%, stunting at 14.6% and underweight at 6.8%. Weight-for-age (Underweight) was significantly different between urban and rural children at p = 0.03 (see Table 3).

Table 3. Nutritional status of the children according to location

Nutrition Index	Indicator	Overall prevalence (Rural and Urban) [%]	Rural area prevalence [%]	Urban area prevalence [%]	p-value
Weight for Height (WHZ)	Wasting	8.6	10.7	8.6	P = 0.02*
	Overweight	12.0	9.0	13.6	p = 0.15
Height for Age (HAZ)	Stunting	9.1	14.6	8.5	p = 0.13
Weight for Age (WAZ)	Underweight	6.7	6.8	5.6	p = 0.03*

*Significant at p < 0.05.

Relationship of nutritional status and dft of children in Uasin-Gishu County

There was a significant positive correlation between prevalence of dental caries and underweight (r = 0.67, p = 0.047), overweight (r = 0.83, p = 0.012), Obesity (r = 0.53, p = 0.031) and wasting (r = 0.16, p = 0.041) (see Table 4).

Table 4. Relationship between nutritional status and dft of 5-year-old school children in Uasin-Gishu County

Nutritional status	Mean dft	Pearson Coefficient (r)	p-value
Underweight (WAZ < -2 z score)	1.58	0.67	0.047*
Normal/ healthy weight	1.24	0	1.31
Overweight (WHZ >2 z score)	1.77	0.83	0.012*
Obesity (WHZ >3 z score)	1.83	0.53	0.031*
Stunting (HAZ < -2 z score)	1.48	0.13	0.732
Wasting (MUAC < 11.5 cm)	1.52	0.16	0.041*

*Correlation significant at P < 0.05.

Discussion

There was a high prevalence of overweight among the urban children than the rural children. This can be attributed to difference in the socio-economic characteristics. For example, the parents/ guardians of children in urban areas earned more income than those in the rural areas (see Table 1). This could be a show of purchasing power of their families to afford fast foods and refined foods such as cakes, ice-cream, and commercially prepared drinks, among others. Studies have shown that consumption of refined foods in developing countries as a show of economic prosperity (10). Also, the presence of convenience shops in schools and adjacent to the school environment, especially in urban areas were observed. This phenomenon makes it easier for children in urban areas to access to refined sugar snacks and drinks than their rural counterparts, thus the high rates of overweight reported in urban areas than rural areas. The mode of transport might also explain the high levels overweight in urban population than in rural areas, where it was observed that children in urban areas use motor vehicles to commute to school while those in rural areas walk to and from school.

Prevalence of underweight was higher in rural areas than in urban areas (see Table 3). This might be caused by majority of children in rural areas walking for longer distances to school compared to those who use school/public transport to school in urban area.

Therefore the energy needs of the children in rural schools are higher and may not be adequately provided to cater for the growth needs and hence the increase in underweight.

The prevalence of underweight among the rural population in the present study was (6.8%), which is lower than the national value of 11% reported in the Kenya Demographic Health Survey (11). Similarly, Ronoh et al. (12) reported an underweight rate of 10.8% among preschool children in Western Kenya, which was associated with decreased food and nutrient intake or illness that lead to loss of body mass thus causing a reduction in body weight. The present study clearly showed that wasting was significantly higher (P = 0.02) among children in the rural area. This implies that there will be a vicious cycle of wasting and dental caries thus compromising the quality of life of the children. Underweight and wasting among these children suggests that undernutrition could begin at an early age. Stunting was higher in the rural area (14.6%) than in the urban (8.5%). This might have been caused by prolonged poor quality diet that is low in low in essential nutrients such as zinc and protein. A study by Were et al. (13) linked stunting in children to underlying factors such as deepening household food insecurity, frequent infections, low maternal education attainment and poverty.

Prevalence of dental caries in the present study was 39.3% with a mean dft of 1.55 ± 1.34. According to the WHO criteria on classification of dft score, a mean dft of 1.55 is considered low prevalence (14). This is lower than the results of the first Kenya National Oral Health Survey among 5-year-old children which was 1.87 (15). However, it is still high from the public health perspective, and dental caries is a progressive condition which, if not stopped, will reach alarming rates (6).

The link between dental health and general wellbeing of the public has been explored in current research as an effective way of highlighting the public health impact of dental care and its role in the health policy direction (5, 16). Although many studies have investigated the relationship between the nutritional status and dental caries in preschool children throughout the world, conflicting results have been reported (1, 5, 13).

From the findings of this study, there was a significant positive relationship between underweight (r = 0.67; p = 0.047), overweight (r = 0.83; p = 0.012), obesity (r = 0.53; p = 0.031) and wasting (r = 0.16; p = 0.041) with the prevalence of dental caries. This can be explained by the fact that the causes of BMI increase such as consumption of refined and high sugar diet has also been seen to exacerbate the development and progression of dental caries. Also, intake of refined and high sugar foods and snacks affect the consumption of nutrient rich foods in children, thus preventing them from meeting their daily requirements for important nutrients (17). These findings are supported by Vanishree et al. (1) in a study among preschool children in India where they found a significant positive correlation between dental caries experience and children's WAZ and BMI-for-Age (BAZ). A study on the association of dental caries with nutrition among preschool children in India also reported a positive relationship between dental caries and BMI (18).

Results from the present study showed that there was a positive relationship between dft score and underweight. This implies that the more undernourished the children were, the higher the dft score. This can be attributed to the fact that pain experienced during eating as a result of dental caries can reduce the amount and variety of food consumed by the children, which could result in underweight in the long run. Evidence has shown that underweight children have poor growth and development patterns due to deprivation of essential nutrients owed to lack of variety in the diet (19). Poor nutrition increases susceptibility to dental caries due to altered saliva composition and impaired secretion (20), and that a relationship between malnutrition, enamel hypoplasia, dental caries, and tooth exfoliation exists (21). A study among 3–6-year-old children in Iran found that the relationship between underweight and dental caries was because children who are underweight are more susceptible to infectious diseases due to the compromised immune system (22). Elsewhere, a study among preschool children in Taiwan showed that a higher dental caries score is associated with lower BMI because lower BMI can be caused by other factors such as frequency of consumption of sweets which may not necessarily lead to gain in weight (8).

On the contrary, other studies have reported no statistically significant relationship between the prevalence of dental caries and BMI. A study among 5 to 8-year-old children in the Netherlands concluded that being caries-active is not a predictor for being overweight or vice-versa (23). The probable reason for lack of association between BMI and prevalence of dental caries was that caries score counts the presence of caries in all the teeth during the whole lifespan. On the other hand, BMI in preschool children change rapidly at this stage and thus obesity or being overweight is apparent in a short period of time. In addition, Yen and Hu (8) observed that obesity and overweight can be due to an increased intake of dietary fats and not high sugar snacks and foods which is implicated to cause dental caries. In Chile, a study conducted showed no significant relationship between normal weight, overweight and obesity in relation to their dental caries ($p = 0.837$) (24).

Studies have shown that underweight and dental caries exacerbate each other (16, 25, 26). The pain and oral infection that results from dental caries leads to difficulties in chewing food and thus results in low consumption that cause underweight. On the other hand, underweight children have low immunity and susceptible to infection and have poor oral hygiene (26, 27).

The relationship between a child's growth and the prevalence of dental caries is complex and varies depending on factors, such as age, gender, race, including other social factors that surround a child's life (8). The prevalence of dental caries could also be associated with factors such as prolonged consumption of cariogenic foods (28), low parental education, poverty/lower socioeconomic and higher socioeconomic status level (25), not eating breakfast and eating fewer than five servings of fruit and vegetables daily (29). Furthermore, other studies have reported that attending public school, school absenteeism (30) and high consumption of soft drinks and low health attitude is positively associated with dental caries (31). Consequently, the high prevalence of dental caries in preschool children which continue to be a serious health problem need to be examined further to fully understand the relationship between nutritional status and other associated factors and the prevalence of dental caries in children. Unquestionably, dental caries and nutritional status of children are not determined by one risk factor, but rather a host of causes arising from dietary, health behaviors, social and environmental factors.

Limitations

The limitation of this study is that it used a cross-sectional design that limits the ability of the researcher to identify causality, longitudinal study design would be needed to reveal cause and effect relationship and thus generalizability should be done with caution.

Conclusion

Finally, there was a significant positive relationship between dental caries and prevalence of underweight, wasting, overweight and obesity. Prevalence of overweight was higher among the urban children as compared to the rural population, whereas, underweight was higher in rural areas than urban areas. From this study, it is recommended that that programs targeting alleviation of malnutrition among children be modified to include dental caries mitigation in both rural and urban areas. In addition, longitudinal study design is needed to determine if there is a cause-and-effect relationship between prevalence of dental caries and nutritional status. Further, because this study only looked at the relationship between dental caries and nutritional status in 5-year-old children, future research should focus on establishing the relationship between nutritional status and dental caries in children above 5 years in Kenya.

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