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Nutritional Status and Dental Caries Experience among 36-59-Months-Old in Kiambu Kenya

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Abstract:
Background: Nutritional status has a major role in the growth and development of children. Dental caries is one of the commonest chronic diseases that children suffer from globally.
Objective: The aim of this study was to examine the relationship between nutritional status and dental caries experience among children aged 36-59 months in Kiambu County.
Materials and methods: The study was descriptive and cross sectional; conducted for a period of six months and involved 380 children aged 36-59 months in Kiambu County in Kenya. Multistage stratified sampling was used to select the schools from the administrative units called Wards. Semi-structured, self-administered questionnaires was used to gather socio-demographic data. Nutritional status was assessed using World Health Organisation (WHO) guidelines. Oral hygiene status was assessed using the plaque index of Silness and Loe (1964). Dental caries was determined using the WHO criteria of 2013.
Results: The ages of the children ranged between 36-59 months with a mean age of 48.36 months (SD 7.06). The response rate was 295 (77.6%). One hundred and forty-two (48.1%) children were males while 153 (51.9%) were females. The prevalence of dental caries was 62.7% (n=185). The mean dmft for the group was 3.19 (SD 3.96). Anthropometric assessment revealed low prevalence of stunting (n=6), underweight (n=4) and wasting (n=3). There was no significant relationship between all nutritional parameters and dental caries experience.
Conclusion: There is no relationship between nutritional status and dental caries experience among children aged 36-59 months.

Keywords: *Nutritional status, dental caries, pre-school children.*

1. Introduction

According to World Health Organization (WHO) definition of 1948, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Improvement of oral health is one of the ways of ensuring a healthy population especially healthy children because dental caries and gingivitis are some of the commonest chronic diseases that children suffer from globally. Nutritional status of children has a major role in their growth and development. Children under the age of five years are vulnerable to disease and malnourishment. Studies on nutritional status of children and its effects on the oral cavity have generated variable results. Some studies have failed to relate different nutritional parameters to the prevalence of dental caries in children while others have yielded results that suggest a relationship between nutritional status and prevalence of this oral condition (1-4).

The current study was motivated by the gap in knowledge and variable results in the relationship between nutritional status and prevalence of dental caries. The study sought to establish whether there is a relationship between certain nutritional parameters and dental caries in children aged between 36-59 months. The nutritional status of the children was determined using the WHO protocols of weight for age and height for age (5) while dental caries was assessed using WHO criteria of 2013 (6). Oral hygiene was assessed using the plaque index of Silness and Loe (1964). Socio-demographic data was obtained by means of a semi structured self-administered questionnaire. Relevant statistical tests were performed to determine the relationship between variables.

2. Materials and Methods

2.1. Study Area and Design

The study involved nursery school children aged 36-59 months within Thika Sub County, Kiambu County, Kenya. This was a descriptive cross sectional study.

2.2. Sampling Method and Sample Size

Sampling was based on multistage stratified sampling of the nursery schools where the sub county was divided into four administrative units referred to as wards. Then, the preschools in each ward were stratified into private and public schools as per the list provided by the sub County early child development (ECD) officer. From each stratum, one preschool was randomly selected for the study. In total eight preschools were selected from which the children for the study were recruited. Proportionate sampling was then conducted to ensure fair distribution of the children among the schools.

To determine the sample, size a prevalence of 59.9% for dental caries among children aged 3-5 years in Kiambu, Kenya was used (7). Using the formula $n= (Z_{1-\alpha})^2 [P (1-p)]/(d)^2$; where n is the required sample size; $Z_{1-\alpha}$ is, the critical value associated with the level of significance, p is the estimate of proportion and d is the margin of error, P=0.599; therefore, $n= 1.96^2 \times 0.599(1-0.599)/0.05 \times 0.05=344$. To the calculated sample size was added 10% to cater for attrition. Hence, the final sample size for this study was 380 children aged 36-59 months. The study participants were then randomly selected from the school register by taking every n^{th} child until the desired number was reached.

2.3. Instruments for Data Collection

Semi-structured self-administered questionnaires together with an explanatory letter and a consent form were initially sent to the parents/ guardians of the study children through their children to obtain socio-demographic data. However, the response was low and the principal investigator decided to approach the parents directly after making arrangements with the school administration. This gave a better response as more forms were returned by the parents.

2.4. Intraoral Examination

Intra oral examination was done by the principal investigator under natural light using a sterile mouth mirror and a dental probe with participants seated on an ordinary chair next to a window. Data sheets were used to score for dental caries and plaque index. Dental plaque was recorded first before examining for dental caries which required the tooth to be wiped with gauze before examination.

2.5. Oral Hygiene Status

Oral hygiene status was assessed using the plaque index of Silness and Loe (1964). According to Silness and Loe, a tooth is divided into four surfaces; lingual, buccal/ labial, mesial and distal. Each tooth surface was examined for presence of plaque accumulation. The scoring was as follows; zero- no plaque detected, one -a film of plaque adhering to the free gingival margin and adjacent area of the tooth which can only be seen by applying a probe on to the tooth surface; two- moderate accumulation of soft deposits within the gingival pocket or the tooth and gingival margin which can be seen with the naked eye; three- abundance of soft matter within the gingival pocket and/or the tooth and gingival margin using 55, 52, 64, 72, 75, and 84 as the index teeth and the sum of scores from the 4 areas of a tooth were added up. The mean plaque score was obtained by having the total scores from all the teeth examined divided by the number of teeth examined. Scores of 0, 0.1-0.9, 1.0-1.9, 2.0-3.0 was indicative of excellent, good, fair and poor oral hygiene respectively.

2.6. Dental Caries

Dental caries was determined using the WHO criteria of 2013 (6). Each tooth was scored as sound, decayed, filled or missing (dmft). Prior to caries diagnosis, each tooth was dried with a piece of sterile gauze.

2.7. Nutritional Status

Nutritional status was assessed by taking the weight for age and height for age indices. The height of the children was measured with a standard height board to the nearest 0.5cm while the individual was standing erect and bare foot. The weight was measured using a Salter scale to the nearest 0.1kg. Two readings were taken for height and weight and the average calculated. The age was taken in complete months from school records or as reported by the care giver. WHO methodology of measuring children was used (5)

2.8. Ethical Considerations

Ethical approval was obtained from the Ethics and Research committee of the University of Nairobi and Kenyatta National Hospital, Kenya. Permission to conduct the study was obtained from all the government administrative bodies. Informed consent was obtained from the parents/caregivers and children's assent obtained. Confidentiality was maintained and information obtained was only used for the purpose of the study and for the benefit of the community.

3. Results

3.1. Caregiver Socio Demographic Characteristics

Total of 300 caregivers consented for the study and filled in the questionnaires. The questionnaires sought to find out the caregivers' level of education and employment status as these were considered confounding variables. Slightly less than half of the caregivers had attained college/ university education (n= 129, 43.0%). Only two caregivers (n= 2, 0.7%) had no form of formal schooling. The rest of the caregivers attained education levels of between less than primary school to high school completion. The caregivers who had less than primary education, primary education, secondary school education and high school education accounted for 3.3% (n=10), 12.7% (n=38), 27.7% (n=83) and 12.0% (n=36) respectively. Caregivers who were in self-employment accounted for 48.8% (n=144) about half of these being entrepreneurs (n=65, 47.4%). About a quarter of caregivers (27.7%, n=83) were in formal employment. A total of seventy-three caregivers were unemployed (n=73, 24.3%).

3.2. Children's Socio-Demographic Characteristics

Out of the targeted three hundred and eighty children, a total of two hundred and ninety-five had properly filled questionnaires and were included in the study and examined, giving a response rate of 77.6%. One hundred and forty-two children were males which comprised 48.1% of the total while the remaining one hundred and fifty-three (51.9%) were females. The ages of the study participants ranged between 36-59 months with a mean age of 48.36± 7.06 month.

3.3. Children's Dietary Habits

The study found that majority of the children consumed tea with sugar on a daily basis (n=230, 75.2%). Slightly less than half of the children (n=125, 40.6%) consumed fresh fruits every day. Other sweetened foods/ snacks such as biscuits, cakes, sugared gum, sweets/ candy and milk with sugar were consumed at variable frequencies with consumption of milk with sugar having the highest number of children (n=40, 13.5%) consuming it daily followed by biscuits/ cake at 8.3% (n=25) daily consumers. Sixty-four children (22.1%) breast fed for a period of between 4 months to 1 year while 22.8% (n=66) breast fed for 1 to 1.5 years' duration. One hundred and eighty-eight children (40.7%) breast fed for a period of 1.5 to 2 years. Only 12.4% (n=36) of the children breastfed for more than 2 years. Six children (2.1%) were reported to have never breastfed. Most of the study participants (n=261, 85.9%) breastfed at will during the night. One hundred and twenty-five children (42.4%) were reported to have bottle fed while 170 (57.6%) did not use the bottle. Most children (n=75, 79.8%) who used the bottle for feeding had milk as the main content in the bottle. Only nine children (3%) were reported to have slept with the bottle in the mouth.

3.4. Nutritional Status of the Study Participants

There was low prevalence of malnutrition as only four children were underweight (n=4), all of them being girls. The underweight children had WAZ scores of -2 which translates into moderate malnutrition. The rest of the study population had normal weight for age Z (WAZ) scores. Total of six children had low height for age (n=6). The rest of the study participants had normal height for age as depicted by their HAZ scores. There was low prevalence of wasting among the study participants. Total of three children had low weight for height (n=3). The rest of the children had normal weight for age as depicted by their WHZ scores.

3.5. Dental Caries Experience among the Children

Prevalence of dental caries was 62.7%. Among the children affected by dental caries 54.1% were females while 45.9% were males. The decay (d) component of the dmft accounted for 62.5% of the children. A total of 5.4% of the children had missing teeth while only 1.6% had filled teeth. More females (62.7%) had decayed teeth than males (56.8%). Children aged between 36-47 months had higher prevalence of dental caries at 71.7% compared to children aged 48-59 months who had dental caries prevalence of 61.2%. Age and gender had no significant relation with the dental caries experience (dmft) among the children. The mean dmft for the group was 3.19 (SD 3.96) with a range from 0 to 18. Table 1 shows the results of a Pearson's chi square test that was done to check the relationships between gender, age and dental caries experience among the children.

Characteristic	Category	No caries	Caries affected	χ^2	df	*p-value at 95%CI*
		n (%)	n (%)			
Age	36-47 months.	28 (28.3)	71 (71.7)	3.058	1	0.080
	48-59 months.	66 (38.8)	104 (61.2)			
Gender	Male	57 (40.1)	85 (59.9)	0.953	1	0.329
	Female	53 (34.6)	100 (65.4)			

Table 1: Pearson's chi square for caries experience by age and gender in children aged 36-59 months, n=295

3.6. Nutritional Status and Its Relationship to Dental Caries

A comparison in dental caries experience among stunted and normal height children was done. Stunted children had a mean dmft of 3.67 while normal height children had dmft mean of 3.18. Stunted children had a slightly higher dmft index. The comparison between the two groups revealed that nutritional status in relation to height for age had no significant effect on dental caries experience (F=0.089, Sig. 0.766). Dental caries experience (dmft) of children with low BMI for age was lower than that of children with normal BMI for age. The mean dmft's were 2.00 and 3.20 respectively. However, BMI for age had no significant relation to dental caries experience as deduced from the ANOVA tables (F=0.273, Sig. 0.602). Children who had low weight for age were found with higher dmft than children of normal weight for age. The dmft's of the two groups were 4.50 and 3.17 respectively. However, weight for age had no significant relationship with dental caries experience among the children (F=0.443, Sig. 0.506). Children who had low weight for height had a mean dmft of 2.00 while the ones who had normal weight for height had a mean dmft of 3.20. The relationship between weight for height and dmft was not significant (F=0.273, Sig. 0.602). Therefore, the hypothesis that there is no relationship between nutritional status and dental caries experience among children aged 36-59 months is accepted.

4. Discussion

The response rate was 77.6% which reduces the power of this study. The results therefore are to be interpreted with caution that the desired sample size was not achieved. The targeted number of 380 children could not be achieved due to lack of cooperation from parents. Many children returned poorly filled forms which were lacking in parental consent. The behaviour of the parents could be attributed to ignorance and suspicion towards research activities. Prevalence of dental caries among the study participants was 62.7% and the mean dmft was 3.19. This is comparable to prevalence reported by Njoroge et al (7) and Ngatia et al (8). Njoroge et al reported prevalence of early childhood caries to be 59.9% while Ngatia and colleagues reported prevalence of ECC at 63.3%. Similarities in diets and oral health behaviour among these children could partly explain the similarities in ECC prevalence among them. Maternal oral health behaviour and child weaning habits could also be attributed to these similarities in dental caries prevalence.

According to this study, more females were affected by dental caries compared to males. This finding is in agreement with the report by Kenya National Oral Health Survey (KNOHS) of 2015 (9). According to the report, female children had higher dmft/DMFT mean index than male children. In this study, girls were more affected by dental caries and this could be due to snacking habits of girls, who tend to consume more refined sugars. However, this finding is in contrast to what Njoroge and colleagues (7) reported that there was gender bias in dental caries prevalence with boys being more affected than girls. The dmft in this study was 3.19. The decay (d) component accounted for 62.7% while the missing and filled components accounted for 5.4% and 1.6% respectively. The Kenya National Oral Health Survey (KNOHS) (9) also reported that tooth decay was the major contributor to dmft/DMFT among the study participants. Wasunna et al (10) reported that the decay component was high in their study on nutritional status of children aged 3-5 years with and without severe early childhood caries, possibly due to lack of accessibility to preventive and curative dental services among the population. Poorly equipped government facilities and lack of technical knowhow among the available oral health care providers was blamed for the high frequency of missing teeth due to extraction and low frequency of filled teeth. This study agrees with these hypotheses as some of the causes of high frequency of decayed teeth and low frequency of filled teeth. High prevalence of decayed teeth is also a reflection of unmet treatment needs among preschool children in this County and the country at large.

Children aged 36-47 months had more decayed teeth than their older counterparts. This is in contrast with what Gupta et al (11) reported in India that caries prevalence increases with age of the preschool children. However, the Kenya national oral health survey (9) also reported that the younger children aged 5 years had the highest dmft compared to 12 and 15 year olds. Disease burden due to dental caries is heavier among the younger children. In this study, it is hypothesized that manual dexterity and thus effectiveness of tooth cleaning increases with age of a child. Older children are also likely to have had their teeth extracted due to pulpal involvement thus a lower decay prevalence with an increase in missing teeth prevalence. The trend in dental caries occurrence could be changing with young children being more affected than the older ones. Female gender could also be a risk factor dental caries.

The frequency of tooth cleaning had a significant relationship with dental caries experience among participants in this study (x^2 =12.194, df=5, **p=0.032**). Likewise, there was a significant relationship between use of toothpaste during teeth clean and dental caries occurrence (x^2 =5.994, df=1, **p=0.015**). These findings emphasize the role of mechanical and chemical plaque removal in dental caries prevention. The most frequently used dentifrice among the study participants contained fluoride. The role of fluoride ion in plaque metabolism is therefore emphasized by this finding. Fluoride ion has been reported to have an inhibitory effect on plaque bacteria metabolism. Breast feeding at night had a significant relationship with dental caries experience (x^2 =6.646, df= 2, **p=0.036**). This finding is in tandem with reports by other authors (12, 13). The swallowing reflex is less active at night. This leads to reduced oral clearance of the carbohydrates consumed at bed time. Because the pathophysiology of dental caries is dependent on time, more cavities tend to occur when high carbohydrate is consumed during the night. This partly explains the significant relationship between at-will breast feeding during the night and dental caries occurrence. There was no significant relationship between nutritional status and dental caries occurrence among the participants in this study. However, stunted children had higher dmft than children of normal height for age. Stunting is an indicator of chronic malnutrition mostly as a result of food insecurity within the family. These stunted children could be coming from families with food insecurity and probably poor nutritional choices which can lead to increased dmft. Chronic malnutrition can also lead to hypoplasia of the teeth and this can predispose teeth to dental caries. Underweight children also had higher dmft than children of normal weight. This could be due to poor dietary habits of these children who could be consuming a lot of refined sugars with little nutritional value but more cariogenic potential. The hypothesis that nutritional status had no relationship with dental caries experience was therefore accepted as there was no statistical significance from ANOVA tables.

5. Conclusion

The following conclusions were drawn from this study:

1. The prevalence of dental caries was 62.7% with dmft of 3.19 (+/- 3.96)
2. There was a statistically significant difference in dental caries occurrence among the children in relation to their tooth cleaning frequency.
3. There was a statistically significant difference in dental caries occurrence among the children in relation to their use of toothpaste.
4. At-will breastfeeding during the night had a statistically significant relationship with dental caries occurrence among the children.
5. There was no relationship between nutritional status and dental caries experience among the children.

6. Study Challenges

The parental response was poor as the response rate was less than 50%, however parents were approached directly by the principal investigator. The second approach had a higher response rate than the first method. This resulted in a delay of the second stage for clinical examination. Children were recruited only if the parents filled in the questionnaire were included in the study.

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