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Original Article

Applying Bayesian Model to Predict Socio-demographic and Occlusal Determinants of Early Childhood Caries (ECC)

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Abstract

Objective: To use the Bayesian statistical Model approach to predict the most important socio-demographic and occlusal factors pertinent to high prevalence of ECC. **Material and Methods:** A questionnaire and an oral examination was conducted on children who attended a pediatric dental clinic in Nairobi during the period of study. The parents provided information on socio-demographic and oral habits of the children. The oral examination for presence of dental caries was recorded for each child. Descriptive statistics were obtained for dental caries, oral hygiene, using plaque score, and malocclusion. The results of the questionnaire and presence of dental caries were analyzed and the results subjected to Bayesian statistical analysis to determine any predictive factors for ECC. **Results:** 55% of the children had plaque accumulating on more than one third but less than two thirds of tooth surfaces. The highest plaque scores were reported among children whose fathers (48.2%) and mothers (42.0%) had completed secondary, and whose fathers were in non-formal employment 73.2%. The overall prevalence of dental caries in the study group was 95.5% with a mean dmft of 8.53 (+ 5.52 SD), with the male children having higher dmft 8.65 (SD+5.54) than the female children 8.37 (SD+ 5.50). The prevalence of malocclusion among children in the study was 55%. The majority had mesial step, 51.5% (n=140) and flush terminal plane 28.3% (n=77). **Conclusion:** The Bayesian Model, with a correct assumption, can be used to determine the important factors involved in high prevalence of ECC.

Keywords: Dental Caries; Child; Bayes Theorem.

Introduction

Early childhood caries (ECC) has become the most prevalent disease in children from developing countries, and it is associated with speech malfunctions, difficulties in eating, swallowing, and sleeping disturbances [1].

Past Kenyan studies on ECC, have reported very high prevalence rates of up to 89.4% [2] and 93.6% [3], with the lowest prevalence being 59.5% [4] among 3-5 year-old children. Ghana, on the other hand, has reported a much lower prevalence of ECC of 47% for children aged 2 to 5 years [5]. Environmental, socio-economic, familial, dietary, nutritional and dental factors have often been associated with the disease [6,7].

The Bayesian statistical model approach can be used to capture relevant properties of data, and with prior assumption, can calculate probabilities of the condition's occurrence through factor analysis. This study attempts to determine the probability of certain specific factors involved in the causality of ECC in a cohort of young children attending a public Pediatric dental clinic in Nairobi, Kenya.

Material and Methods

Study Area

The study was conducted at Lady Northey Paediatric Dental Clinic, Nairobi, Kenya, which is located close to the Central Business Area of Nairobi City. The clinic offers free preventive and limited curative dental services to children.

Study Population

All the children aged 3-6 years in full primary dentition and their caregivers, who attended Lady Northey dental clinic during the months of September to November 2014, were eligible for inclusion into the study. Ethical clearance was sought and obtained from the Kenyatta National Hospital and the University of Nairobi Ethics Research Committee and an approval obtained from the Nairobi City County Authority, which runs the Centre. All the caregivers provided a written informed consent, allowing their children to participate in the study. Any disruptive child or a child whose parent had not given informed consent was excluded from the study.

Data Collection

Purposive sampling method was used to select the participants in the study. A trained and calibrated research assistant, using a semi-structured questionnaire, conducted a face-to-face interview with the parent/caregiver of the child, to gather data on the socio-demographic characteristics, oral hygiene practices and dietary practices of the children.

The Principal Investigator (PI), working under natural daylight, performed an oral examination of the children, who either sat on a bench or on the parents' lap, depending on their

ages. Clean disposable gloves, mask, sterile dental mirror, dental explorer and WHO probe were employed during the examination.

The WHO criteria for field studies were used to collect the data on dental caries and plaque score [8]. The malocclusion was assessed with the child biting on his/her back teeth with the jaws in centric relation and data gathered using the guidelines of Foster and Hamilton [9]. An experienced Pediatric dentist had initially calibrated the examiner on 23 children, and a calculated inter-examiner consistency of Cohen Kappa was obtained for dental caries (K=1.00), oral hygiene (dental plaque) (K=0.85) and malocclusion (K=0.80). The examiner also carried out intra-examiner calibration on 27 participants by re-examining every 10th child and obtained a calculated Cohen's Kappa score of 1.00, 0.80 and 0.85 for dental caries, oral hygiene and malocclusion, respectively.

Data Analysis

The data obtained was entered into the computer, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics were obtained for dental caries, oral hygiene, using plaque score, and malocclusion. The results were subjected to Bayesian Model, with the assumption that the occurrence of caries has a relationship to certain factors relating to socio-demography, habits and dental occlusion.

Results

Socio-demographic Characteristics

A total of 272 children and their parents/caregivers participated in the study, with a male to Female ratio of the children being 1:1. Out of the parents who brought the children to the clinic, 48.2% fathers and 41.9% mothers had also completed secondary school education. A total of 73.2% (n=199) of the fathers were in non-formal employment and 20.2% (n=55) were in formal employment. The rest of the demographic features of the participants is shown in Table 1.

Table 1. Socio-demographic characteristics of the study participants.

Variables	Gender		
	Male N (%)	Female N (%)	**Total** N (%)
Age (years)			
3	26 (61.9)	16 (38.1)	42 (100.0)
4	37 (50.0)	37 (50.0)	74 (100.0)
5	66 (45.8)	78 (54.2)	144 (100.0)
6	8 (66.7)	4 (33.3)	12 (100.0)
Total	137 (50.4)	135(49.6)	272 (100)
Highest Level of education by Father			
No formal schooling/Primary school	34 (65.4)	18 (34.6)	52 (100.0)
Secondary school	61 (46.6)	70 (53.4)	131 (100.0)
College or University	33 (44.0)	42 (56.0)	75 (100.0)
No father	6 (66.7)	3 (33.3)	9 (100.0)

Not known	3 (60.0)	2 (40.0)	5 (100.0)
Total	137 (50.4)	135(49.6)	272 (100)
Highest Level of education by Mother			
Primary school	45 (50.6)	44 (49.4)	89 (100.0)
Secondary school	58 (50.9)	56 (49.1)	114 (100.0)
College/University	34 (49.3)	35 (50.7)	69 (100.0)
Total	137 (50.4)	135(49.6)	272 (100)
Employment Status of father			
Unemployed	11 (64.7)	6 (35.3)	17 (100.0)
Non-Formal employment	99 (49.7)	100(50.3)	199 (100.0)
Formal employment	27 (49.1)	28 (50.9)	55 (100.0)
Total	137 (50.4)	135(49.6)	272 (100)

Oral Hygiene

The oral hygiene was measured in terms of plaque accumulation on tooth surfaces. The findings were that 55% (n=149) of the children had plaque accumulating on more than one third but less than two thirds of tooth surfaces. The highest plaque scores was reported among children whose fathers (48.2%, n=131) and mothers (42.0%, n=114) had completed secondary, and whose fathers were in non-formal employment 73.2% (n=199). The frequency of the children brushing their teeth was as shown in Table 2. Approximately 2.9% of the children had never brushed their teeth. Of the children who declared brushing their own teeth, 58.5% (n=159) did it without any form of assistance, 5.9% (n=16) had their teeth brushed by the caregiver and 32.7% (n=89) were assisted by their caregiver (Table 3). The dmft of all the children who brushed or not brushed was recorded, and high dmft scores were associated with children who had never brushed their teeth (and those whose teeth were brushed by the caregiver).

Table 2. Frequency distribution of tooth brushing of children participating in the study.

Brushing Frequency	**Gender** Male N (%)	Female N (%)	**Total** N (%)
Never	6 (4.4)	2 (1.5)	8 (2.9)
Occasionally	14 (10.2)	5 (3.7)	19 (7.0)
Once a day	101 (73.7)	109 (80.7)	210 (77.2)
Two or more time a day	16 (11.7)	19 (14.1)	35 (12.9)
Total	137(100.0)	135 (100.0)	272 (100.0)

Table 3. Distribution of dental caries experience among children, according to the person who brushes their teeth.

Who brushes child's teeth	**Age** 3 yrs	4 yrs	5 yrs	6 yrs	**Total**
1. Child					
Mean dmft	7.36	9.18	8.04	7.25	8.22
SD	5.94	5.77	5.26	5.73	5.45
N	14	39	98	8	159

2. Caregiver					
Mean dmft	11.71	14.33	9.17	0.00	11.25
SD	5.02	0.58	6.71	0.00	5.37
N	7	3	6	0.00	16
3. Child assisted by caregiver					
Mean dmft	8.67	7.40	9.38	3.67	8.33
SD	4.81	5.77	5.39	2.31	5.41
N	18	31	37	3	89
4. None					
Mean dmft	10.00	20.00	12.67	3.00	11.38
SD	6.56	0.00	6.66	0.00	6.87
N	3	1	3	1	8
Total					
Mean dmft	8.83	8.81	8.52	6.00	8.53
SD	5.37	5.91	5.39	5.03	5.52
N	39	73	141	11	264

Results for the consumption of cariogenic foods among the participating children is shown in Table 4.

Table 4. Frequency distribution of cariogenic food and drinks consumption among children participating in the study.

	Frequently	**Occasionally**	**Never**	**Total**
Food/Drink	N (%)	N (%)	N (%)	N (%)
Fresh juice	32 (11.8)	177 (65.0)	63 (23.2)	272 (100)
Biscuits, Cakes	88 (32.4)	149 (54.8)	35 (12.8)	272 (100)
Soft drinks	20 (7.3)	208 (76.5)	44 (16.2)	272 (100)
Jam/Honey	101 (37.2)	81 (29.8)	90 (33.0)	272 (100)
Chewing gum	79 (29.0)	135 (49.7)	58 (21.3)	272 (100)
Sweets/Chocolates	82 (30.2)	128 (47.1)	62 (22.7)	272 (100)
Tea with sugar	255 (93.7)	5 (1.8)	12 (4.5)	272 (100)

Dental Caries

The overall prevalence of dental caries in the study group was 95.5% with a mean dmft of 8.53 (SD±5.52), with the male children having higher dmft 8.65 (SD±5.54) than the female children 8.37 (SD±5.50). Higher dmft scores appeared to be associated with children whose fathers had no formal schooling (15.0 (0.00), mothers with less than primary education (11.0 (9.2) and fathers with unknown employment status (12.0 (0.0), as shown in Table 5.

Table 5. Association of dental caries experience of the studied population with the age of the child and the caregivers' socio-demographic characteristics.

	Dt	**mt**	**ft**	**Dmft**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Overall	8.51 ± 5.52	0.02 ± 0.12	0.00 ± 0.06	8.53 ± 5.52
Gender				
Male	8.65 ± 5.54	0.02 ± 1.15	0.00 ± 0.00	8.67 ± 5.56
Female	8.37 ± 5.50	0.01 ± 0.08	0.01 ± 0.08	8.38 ± 5.49

Age (years)				
3	8.83 ± 5.37	0.00 ± 0.00	0.02 ± 0.15	9.2 ± 5.46
4	8.81 ± 5.59	0.00 ± 0.00	0.03 ± 0.16	8.9 ± 5.73
5	8.50 ± 5.38	0.01 ± 1.20	0.02 ± 0.14	9.1 ± 5.59
6	5.83 ± 4.86	0.17 ± 0.39	0.00 ± 0.00	6.4 ± 5.35
College/University	7.95 ± 5.58	0.03 ± 1.64	0.00 ± 0.00	7.97 ± 5.60
Secondary school completed	8.64 ± 5.15	0.01 ± 0.09	0.01 ± 0.09	8.66 ± 5.15
Primary school completed	8.34 ± 6.01	0.02 ± 0.15	0.00 ± 0.00	8.36 ± 6.03
Less than primary school	9.75 ± 7.97	0.00 ± 0.00	0.00 ± 0.00	9.75 ± 7.97
No formal schooling	15.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	15.00 ± 0.00
No father/legal guardian	8.78 ± 5.33	0.00 ± 0.00	0.00 ± 0.00	8.78 ± 5.33
Not known	12.40 ± 7.44	0.00 ± 0.00	0.00 ± 0.00	12.40 ± 7.44
College/University	8.1 ± 4.96	0.58 ± 1.09	0.03 ± 0.17	8.7 ± 5.2
Secondary school completed	8.1 ± 5.39	0.43 ± 0.89	0.01 ± 0.94	8.5 ± 5.7
Primary school completed	9.2 ± 5.46	0.42 ± 0.80	0.03 ± 0.19	9.6 ± 5.6
Less than primary school	8.7 ± 8.62	2.33 ± 3.22	0.00 ± 0.00	11.0 ± 9.2
Formal employment	7.26 ± 5.29	0.00 ± 0.00	0.00 ± 0.00	7.26 ± 5.29
Non Formal employment	8.74 ± 5.56	0.02 ± 0.14	0.01 ± 0.07	8.76 ± 5.56
Unemployed	9.65 ± 5.48	0.00 ± 0.00	0.00 ± 0.00	9.65 ± 5.47
Unknown	12.00 ± 0.00	0.0 ± 0.00	0.00 ± 0.00	12.00 ± 0.00

The Bayesian statistical model was used to subject the socio-demographic factors and habits of the participants in the study in relation to the occurrence of dental caries in the study's population. The calculated dmft data was fitted using the binomial model. The results were then subjected to Poisson model analysis. The results for this model is shown in Table 6.

Table 6. The summary of the Bayesian fitted model.

Coefficients	Estimate	Std. Error	z value	Pr(>|z|)
Age	-0.05204	0.02798	-1.860	0.062897
Gender1	2.85673	0.42233	6.764	1.34e-11
Gender2	2.77693	0.42623	6.515	7.26e-11
HighestEducFather2	-0.43815	0.34285	-1.278	0.201264
HighestEducFather3	-0.95875	0.28837	-3.325	0.000885
HighestEducFather4	-0.74831	0.28870	-2.592	0.009542
HighestEducFather5	-0.89838	0.29110	-3.086	0.002027
HighestEducFather6	-0.74631	0.31578	-2.363	0.018107
HighestEducFather7	-0.21066	0.31548	-0.668	0.504294
HighestEducMother3	0.15249	0.23609	0.646	0.518336
HighestEducMother4	-0.08414	0.24018	-0.350	0.726111
HighestEducMother5	0.12243	0.24549	0.499	0.617975
FeedingHabitJuice2	0.02795	0.07499	0.373	0.709402
FeedingHabitJuice3	-0.15606	0.07448	-2.095	0.036146
FeedingHabitJuice4	0.02806	0.07536	0.372	0.709631
FeedingHabitJuice5	-0.07630	0.09063	0.842	0.399885
FeedingHabitJuice6	0.33470	0.16504	2.028	0.042565
FeedingHabitBiscuits2	0.13233	0.08643	1.531	0.125765
FeedingHabitBiscuits3	-0.06408	0.09358	-0.685	0.493533
FeedingHabitBiscuits4	0.01500	0.09330	0.161	0.872272
FeedingHabitBiscuits5	-0.10468	0.08402	-1.246	0.212803
FeedingHabitBiscuits6	0.00758	0.13400	0.057	0.954890
FeedingHabitSoda2	0.01840	0.07393	0.249	0.803505
FeedingHabitSoda3	0.18102	0.07919	2.286	0.022254
FeedingHabitSoda4	-0.16056	0.07729	-2.077	0.037773
FeedingHabitSoda5	-0.00785	0.10991	-0.071	0.943062
FeedingHabitSoda6	0.07132	0.38418	0.186	0.852718

FeedingHabitJam2	0.30601	0.07294	4.195	2.72e-05
FeedingHabitJam3	0.26711	0.08990	2.971	0.002966
FeedingHabitJam4	-0.06107	0.09146	-0.668	0.504256
FeedingHabitJam5	0.19743	0.06158	3.206	0.001346
FeedingHabitJam6	-0.06867	0.12432	-0.552	0.580696
FeedingHabitGum2	0.01753	0.08389	0.209	0.834468
FeedingHabitGum3	0.07015	0.07462	0.940	0.347141
FeedingHabitGum4	-0.33977	0.08232	-4.127	3.67e-05
FeedingHabitGum5	-0.32729	0.10009	-3.270	0.001076
FeedingHabitGum6	-0.06980	0.11368	-0.614	0.539189
FeedingHabitSweets2	0.14485	0.08306	1.744	0.081175
FeedingHabitSweets3	-0.02366	0.07558	-0.313	0.754246
FeedingHabitSweets4	0.03281	0.09061	0.362	0.717285
FeedingHabitSweets5	0.19243	0.09745	1.975	0.048299
FeedingHabitSweets6	0.05239	0.11421	0.459	0.646443
FeedingHabitTeasugar3	0.56525	0.32122	1.760	0.078465
FeedingHabitTeasugar4	0.68446	0.21097	3.244	0.001177
FeedingHabitTeasugar5	0.13502	0.15199	0.888	0.374336
FeedingHabitTeasugar6	0.39831	0.13806	2.885	0.003913
Brushing2	0.04208	0.25830	0.163	0.870595
Brushing3	-0.52343	0.24146	-2.168	0.030176
Brushing4	-0.15968	0.16442	-0.971	0.331470
Brushing5	-0.16183	0.12347	-1.311	0.189942
Brushing6	-0.31919	0.13936	-2.290	0.022001

In this model, age appear not to be a significant factor other than the dmft of the participants appear to decrease with increasing age. Further, the gender of the child was seen to be a significant factor in predicting the dmft of the child, with the male children being more prone to increased dmft when related to the female children, even though the difference was not statistically significant. The education level factor of the father was a significant factor that negatively correlated to dmft, with children whose fathers had completed primary level having the lowest dmft, followed by those fathers who had attained university education. The education level of the mother appeared not to contribute much to the child's dmft values.

Most dietary habits were not significant in predicting the levels of dmft of the children in the study. A total of 255 (93%) of the children who participated in the study consumed a lot of tea containing sugar, and 208 (76.5%) children used soft drinks regularly. Nonetheless, feeding of jam and taking tea in sugar without taking note on oral hygiene had the potential of increasing the expected dmft cases, and yeti chewing of gum was seen to actually reduce the number of dmft values.

At the oral hygiene level, it was observed that brushing at least once per week for children between the study ages appeared to reduce the expected number of dmft cases. Brushing at least twice daily was observed to be very significant in achieving this.

Dental Malocclusion

The prevalence of malocclusion among the children in the study was 55%. The majority had mesial step (51.5%, n=140) and flush terminal plane (28.3%, n=77). Majority of the children (66.5%, n=181) had a Class I and minority had Class III canine relationship (11.4%, n=31). The antero-posterior incisor relationship showed that most of the children (75%, n=204) had normal overjet of

0-2 mm. The overjet of 12.2% (n=33) children could not be determined due to missing anterior teeth or presence of retained roots. Two thirds of the children had normal overbite (61%, n=166) according to age. The overbite of 13.6% (n=37) of the children could not be determined due to missing anterior teeth or presence of retained roots. Only 2.9% (n=8) children had posterior cross bite. One hundred and fifty two children (55.9%) had primate spaces in at least one of the jaws. The presence of primate spaces could not be determined in 0.7% (n=2) of the children due to the premature loss of teeth positioned anterior or posterior to the deciduous canines. A complete detail of the findings of the study is shown in Table 7.

Table 7. Occlusal relationship among 3-6 years-old children who participated in the study.

Characteristics	Age				
	3 years N (%)	4 years N (%)	5 years N (%)	6 years N (%)	**Total** N (%)
Overall	42 (15.4)	74 (27.2)	144 (52.9)	12 (4.4)	272 (100.0)
Molar relationship					
1. Flush terminal	11 (26.2)	15 (20.3)	47 (32.6)	4 (33.3)	77 (28.3)
2. Mesial step	26 (62.0)	48 (64.9)	62 (43.1)	4 (33.3)	140 (51.5)
3. Distal step	3 (7.0)	8 (10.8)	13 (9.0)	1 (8.4)	25 (9.2)
4. Undeterminable	2 (4.8)	3 (4.0)	22 (15.3)	3 (25.0)	30 (11.0)
Canine relationship					
1. Class I	28 (66.6)	51 (68.9)	97 (67.4)	5 (41.7)	181 (66.5)
2. Class II	6 (14.3)	14 (18.9)	34 (23.6)	5 (41.7)	59 (21.7)
3. Class III	8 (19.1)	9 (12.2)	12 (8.3)	2 (16.6)	31 (11.4)
4. Undeterminable	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.4)
Overjet					
1. Normal	29 (69.0)	54 (73.0)	113 (78.5)	8 (66.7)	204 (75.0)
2. Increased	5 (11.9)	7 (9.5)	15 (10.4)	3 (25.0)	30 (11.0)
3. Reverse	1 (2.4)	2 (2.7)	1 (0.7)	1 (8.3)	5 (1.8)
4. Undeterminable	7 (16.7)	11 (14.8)	15 (10.4)	0 (0.0)	33 (12.2)
Overbite					
1. Normal	24 (57.1)	42 (56.8)	94 (65.3)	6 (50.0)	166 (61.0)
2. Increased	5 (11.9)	8 (10.8)	13 (9.0)	5 (41.7)	31 (11.4)
3. Edge to edge*	5 (11.9)	7 (9.5)	13 (9.0)	0 (0.0)	25 (9.2)
4. Anterior open bite	2 (4.8)	2 (2.7)	4 (2.8)	0 (0.0)	8 (3.0)
5. Anterior cross-bite	1 (2.4)	2 (2.7)	1 (0.7)	1 (0.7)	5 (1.8)
6. Undeterminable	5 (11.9)	13 (17.5)	19 (13.2)	0 (0.0)	37 (13.6)
Posterior Cross-bite					
1. Present	1 (2.4)	3 (4.1)	2 (1.4)	2(16.7)	8 (2.9)
2. Absent	41 (97.6)	71 (95.9)	142 (98.6)	10 (83.3)	264 (97.1)
Primate spaces					
1. Present	24 (57.1)	48(64.9)	70 (48.6)	10 (83.3)	152 (55.9)
2. Absent	18 (42.9)	26 (35.1)	72(50.0)	2 (16.7)	118 (43.4)
3. Undeterminable	0 (0.0)	0(0.0)	2 (1.4)	0 (0.0)	2 (0.7)

The occlusal characteristic findings were subjected to the Bayesian Model statistical test to determine whether they have any influence on the occurrence of caries in the studied population. With zero (0) indicating absence of malocclusion and one (1) indicating the presence of malocclusion, the data was appropriately coded and subjected to the Bayesian model in the form of a binomial

model with a logit link. This dependent variable was then fitted against dmft. The results were as given in Table 8.

Table 8. The Bayersian model on malocclusion of the children who participated in the study.

Coefficients	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.05987	0.25481	-4.159	3.19e-05
dmft	0.14830	0.02631	5.637	1.73e-08

From the fitted model above, it was found that the there is a 74.27% chance of malocclusion when there is presence of dmft translating to an odds ratio of 2.89, implying that for every one child without malocclusion, there are three children out there with malocclusion.

Discussion

The current study was based on the diagnosis of dental caries through a clinical examination, without the use of X-ray. Consequently, the possibility of under-reporting caries cannot be ruled out. The dependence on parents/caregivers in the determination of the study participant's oral health practices might have influenced the validity of the parents/caregivers answers in the present study. There was also the possibility that socially desired and undesired habits and practices could have been over or underestimated by the parents/caregivers in the current study.

The prevalence of caries in the current study population was high (95.5%), just like what had been reported previously in two previous Kenyan studies (89.4% and 93.6%) [2,3]. However, some past Kenyan studies on ECC have reported lower dental caries prevalence rates of 45% [10], 63.5% [11] and 59.5% [4]. In Uganda, the prevalence of ECC has been reported as 64% among 3 to 5 years old [12], and in Asia, some authors [13] reported a dental caries prevalence rate of 40% among 3-5 year old children. The high prevalence appeared to relate to dental caries-related issues and age of the child. The age distribution of 3 to 6 years old could explain why the older children whose teeth had been exposed for a longer period to the oral environment had a higher probability of developing dental caries. The difference in caries experience between males and females could have been a result of the meticulous nature of girls in their personal hygiene and thus better tooth brushing as compared to the boys [4].

Regarding dietary habits, this model did indicate that dietary factors were important indicators for high ECC, and in this study the high rate of sugar intake, probably a result of its easy availability to the children, appeared to result in high numbers of ECC [14].

Poor oral hygiene was the whole mark of this study population, a similar situation as noted in a previous study [2]. Many of the children had plaque deposit, with its severity increasing with increasing age of the child. Further, children whose fathers were in non-formal employment, and those whose parents had completed secondary education appeared to have very high plaque scores. The Bayesian Model did bring out this outcome for the present study. This could have been due to the parents spending more time to look after their daily needs like food supply and other issues, giving low attention to the oral health of the child. Even though the majority of the children (97%)

reported to be brushing their own teeth using toothbrush and toothpaste, the effectiveness of the brushing might have been poor, as has also been reported in previous study [15], and also given that majority of the children in the study (58.5%) did not receive any assistance in brushing from their caregivers. Children below the age of six years old have poor manual dexterity and require the caregiver's assistance during tooth brushing due to their physical and cognitive immaturity [4]. Probably, the caregivers' ignorance contributed to this results, and hence the high prevalence of dental caries in the study population, as the highest dmft scores were clearly evident in the Bayesian Model, for the participants whose had never brushed their teeth and also those whose parents had the least or no formal education and those whose father's were unemployed. This was probably due to the fact that inadequate knowledge by these parents on oral health, unaffordability of oral health care could be factors contributing to this high ECC in these children [7].

The prevalence of malocclusion in this study was 55%, just like those found in other Kenyan studies, with values of 60.9% [9] and 51% [16]. Malocclusion, though common in children, may be unnoticed during the early years of life, but can predispose a child to unfavorable sequel, requiring complex orthodontic treatment in the permanent dentition [17]. It is important to determine this factor earlier in life and undertake interceptive measures. Difficult as this factor is in making diagnoses in the deciduous dentition, different concepts have been used to define malocclusion in young children [18]. The Foster and Hamilton criteria [9] were used in this study as it defines the occlusal characteristics in the anterior-posterior, vertical and transverse dimensions. In the current study, malocclusion was reported when either distal step terminal plane, canine class II or III, increased overjet, anterior open bite, increased overbite, or presence of cross-bites.

In the current study, the Bayesian Model applied showed that the mesial step was the most prevalent terminal plane relationship (51.5%), as has been reported in other studies where the values were 70.1% [17,19]. The current study did not show any differences of the anterior-posterior molar relationship across the ages and this was similar to the Kenyan population [17]. The prevalence of primate spaces (55.9%) was lower than other previous Kenyan studies, which reported prevalence rates of 85% (16) and 80.3% [17]. This may indicate a greater possibility of crowding in the subsequent dentition. The prevalence of posterior cross-bite in the present study was 2.9%, this was similar to a Kenyan study which reported a prevalence of 2.5%. Other Kenyan [16] and Nigerian [20] studies have reported similar findings. The results of subjecting the malocclusion findings to Bayesian model indicated that it was still a factor in terms of occurrence of caries in the participants. This could be suggestive of the need for early diagnosis of malocclusion and early intervention in those affected.

Conclusion

Bayesian approach model as applied to the present study, has demonstrated that the model can correctly discriminate and pick out specific factors that were relevant to ECC in the 3 to 5 years old children who participated in the study.

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