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Findings from a study in a defined urban population in South-western Nigeria using the PUFA index

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Introduction

Dental caries is a preventable infectious disease which affects the dental hard tissues (enamel, dentine and cementum) as a result of bacterial action on sugar substrate over a period of time [1]. It is also described as a dynamic process of demineralization and remineralization resulting from microbial metabolism on the tooth surface which over time results in a net loss of mineral and subsequently but not always leading to cavitation [2,3]. It is one of the commonest oral childhood diseases.

Regardless of the major improvements in the oral health of populations in several countries (including early diagnosis and treatment of dental caries), globally problems still exist, and more so in developing countries [4]. Research on caries in developed world is tailored towards early lesion detection, which is different from what obtains in the developing countries where although the documented prevalence of caries is low, the burden of non-treatment is high. Furthermore, in many developing countries, access to oral health care is limited and decayed teeth are often left untreated [5]. The burden of caries is particularly high among the disadvantaged and the poor in both developing and developed countries [6].

Over the years, disease burden has been measured using indices, (an index being a standard measure of a disease or condition). Caries burden has been measured using indices such as the Decayed, Missing and Filled Teeth index (DMFT) which was developed by Klein and Palmer [7]. This index has been the most widely used index in measuring prevalence of dental caries for over 70 years. It is still the most popular caries index in existence; it however has a few limitations. The mean value of the index is skewed in populations with overall low caries prevalence but with a subpopulation with high individual scores. This subpopulation needs more attention when compared to the general population as they need highly specific intervention. For this subpopulation, the significant caries index [8] is used to determine the magnitude of the disease. It is calculated as the mean dmft of one third of the population with the highest dmft values. Although local and international studies on dental caries abound in the literature, as well as the known sequel of dental caries such as pain, missed school days, inability to eat and inability to sleep [9–11], studies quantifying the

clinical consequences of untreated caries are few and have only recently been carried out using the 'Pulp, Ulcer, Fistulae and Abscess' (PUFA) index [12,13]. This PUFA index was developed in 2009 as a means of quantifying the clinical consequences of untreated caries [12]. This was the first index to address the issue and some validation studies have been conducted [11,13,14]. Before the PUFA index, quantifying the clinical consequences of untreated caries, the severity and complexity of the sequel of untreated caries in Nigeria were just sweeping statements [15]. A validation of this index in the Nigerian population will help put the picture of the burden of untreated caries in proper perspective, allowing for policy formulation for a more holistic management of caries and reaching the underserved communities. The PUFA index is recommended for use in conjunction with the DMFT index.

This study therefore aims to determine caries prevalence using the DMFT index and ascertain the proportion of children experiencing various clinical consequences of untreated dental caries in a defined urban population in South-western Nigeria using the PUFA index.

Methodology

The sample location was Ibadan North Local Government Area (IBNLGA). This Local Government Area has the highest concentration of schools within the city of Ibadan and is home to over two hundred and fifty schools. It is also home to the University of Ibadan (UI) and the University College Hospital (UCH). A cross sectional study was carried out between October 2012 and June 2013. The sample population consisted of 6 year old pupils from randomly selected schools in Ibadan North Local Government Area who had dental caries involving at least one tooth. The study assessed the presence and pattern of oral conditions resulting from untreated caries in this age group.

The minimum sample size was calculated, based on 95% confidence interval and 80% power, assuming a 10% loss to follow up. A list of all registered primary schools in the local government area was obtained from the Oyo State Ministry of Education and the schools were categorized into private and public schools. A sampling frame was used and 30 schools were randomly selected from the two school categories i.e. 15 private primary schools, 15 public primary schools (this was to enable adequate spread of the sample population). The random selection was done via a ballot system by an independent individual. At each selected school, all the six year old pupils in the school participated in the study.

The school principals/ head teachers were approached to allow entry into the school as well as obtain consent to assess the children. Informed consent forms were given out to all children who met the age criteria for the attention of their parents/guardians, these were returned and only those with parental/guardian consent were involved. In some schools, the principal stood locus parentis for the children and gave consent on their behalf. All age appropriate children were screened because of the low prevalence of caries in this environment.

Sociodemographic data of the children were taken prior to the commencement of the oral examination. Each consenting participant was made to clean his/ her teeth with a new

toothbrush and fluoride containing toothpaste; this was to ensure a debris free field for the oral examination. The examination of each child was done privately in a well lit room while sitting comfortably on a chair. The intraoral examination was done under bright natural light with gloved hands and a (Community Periodontal Index of Treatment Needs) CPITN probe. The principal investigator and two trained and pre-calibrated research assistants carried out all the oral examinations. Calibration of examiners was done to minimize the inter-examiner variability. This was done by duplicate examinations of 15 randomly selected participants. The scores of both sets of examinations were compared and reproducibility determined using the kappa statistic which yielded a good level of reproducibility of between 0.7 and 1.

The treatment need index was also calculated using the formula (d/dmf) and reported as a percentage. The clinical consequences of untreated caries according to the PUFA index criteria were recorded and the data entered into the computer and cleaned using the Statistical package of Social sciences (SPSS) software version 19.

Uppercase letters were used for permanent dentition and lowercase letters were used for the primary dentition. The codes and criteria for PUFA/pufa index are as follows.

P/p: pulpal involvement was recorded when the opening of the pulp chamber was visible or when the coronal tooth structures had been destroyed by the carious process and only the roots or root fragments was left. No probing was performed to diagnose pulpal involvement. **U/u:** ulceration due to trauma from sharp pieces of tooth was recorded when sharp edges of a dislocated tooth with pulpal involvement or root fragments have caused traumatic ulceration of the surrounding soft tissues, e.g. tongue or buccal mucosa. **F/f:** Fistula was scored when a pus-releasing sinus tract related to the tooth with pulpal involvement was present. **A/a:** Abscess was scored when a pus containing swelling related to a tooth with pulpal involvement was present.

The PUFA/pufa score per person was calculated by allocating a value of one to any tooth that meets the PUFA diagnostic criteria. The score for each tooth is then added up to give the individual's PUFA score i.e. P + U + F + A. The PUFA score for permanent teeth and pufa for primary teeth were recorded separately. The prevalence of PUFA/pufa was calculated as a percentage of the study population with a PUFA/pufa score of 1 or more. The 'untreated caries, PUFA Ratio' was calculated using the formula [12]

$$\frac{(pufa+PUFA)}{(d+D)} \times 100$$

These findings are part of a larger study into the clinical consequences of untreated caries among school children in Ibadan Ethical approval was obtained from the UI/UCH Ethics Review Committee.

Results

A total of 2149 six year old children were screened for dental caries and a caries prevalence rate of 9.3% was observed. Among those screened, 43.5% were male. Table 1 shows the

characteristics of children with caries. There were more female participants who had caries in the study (56%) and most had fathers of low socioeconomic status. A significant association was observed between the dmft index and school type ($p=0.02$). The class distribution of participants is as shown in Fig 1

The mean dmft/DMFT was 0.21 ± 0.82 and 0.02 ± 0.16 respectively while the mean pufa/PUFA were 0.88 ± 1.2 and 0.05 ± 0.22 respectively. As regards the deciduous dentition, 94% of the participants had at least one carious tooth; 10.5% had more than 4 carious teeth. Also, in the permanent dentition 13.5% of participants had caries of one or more teeth with 0.5% having more than 4 carious teeth.

Overall, 102 (51.0%) participants had carious lesions with progression into the pulpal cavity regardless of the type of dentition. Using the pufa/PUFA index, deciduous and permanent dentition with pulpal involvement were 47.0% and 10.0% respectively. The school type or class of the participant show no statistically significant association with the presence or absence of a pufa component (see Table 2).

Using the Significant Caries Index, 8.0% of participants have the most number of carious lesions with a mean dmft of 6.38 ± 1.0 . Among this subpopulation, 11 (73.3%) have pulpal involvement of their carious teeth as compared to 102 (51.0%) in the general population. All participants with high caries burden were pupils of private schools. The associations between the high caries index subgroup and the general population is as shown in table 3.

There is a positive association between the fathers' socioeconomic status and the level of caries experience. ($p=0.01$).

Discussion

This study reports an overall low prevalence of caries among the participants with majority of the participants being female. The father's socioeconomic status and the school type showed a significant association in the prevalence of caries experienced. It was also observed that participants with the highest caries values were all pupils of private primary schools and the majority of participants had never had a previous visit to the dentist.

This study reports a lower caries prevalence among six year old children when compared to many studies both locally and globally [16–20], though a lower prevalence among similar age group was reported in Saudi Arabia [21]. Various reasons have been postulated for these higher global prevalence and these include but is not limited to poor access to dental care as well as lack of affordable fluoride toothpaste among the investigated population [17]. The reason for the lower prevalence obtained in this study is not well understood as these factors mentioned above are present in this environment [15,22,23].

With respect to gender, we observed that caries prevalence was higher in females and this finding is similar to those from previous studies [24–28]. This observation may be as a result of more female participation in the study as well the perceived notion that females erupt teeth earlier and the teeth thus being exposed longer to cariogenic activity in the oral cavity [29].

In developing countries and among the underserved minority populations within developed countries as well as rural dwelling populations, non-treatment of decayed teeth has been shown to be high [30–36]. Studies in Nigeria have reported that over 70% of carious teeth are untreated [15,18,37–39]. The findings of this research, corroborates this statement as almost all participants (97%) had one or more unrestored carious tooth.

The adverse effects of the non-treatment of caries cuts across the affected children, parents, guardians, teachers and other stakeholders. In the affected children discomfort, pain, missed school days and possibly hospitalisation are real issues while for other stakeholders missed days at work, financial and economic costs are also effects a negative impact. Using the pufa index global studies have reported a high ‘p’ component as supposed to the other ‘a, f and a’ components [13,14]. This is similar to the findings of a pilot study in a suburban population in Nigeria [39]. The investigators of this study also found that in over half of the participants, the carious lesions had progressed into the pulp. The other components of the index were not observed in this population. This may be due to the popular habit of self-medication by a large proportion of the population in this environment [40].

Conclusion

The burden of untreated caries among school children in this environment is high despite the overall low prevalence of caries. It becomes paramount to focus resources on preventive care via school based oral health programmes in order to address caries and its subsequent complications, as well as establish accessible and affordable oral health services in the community.

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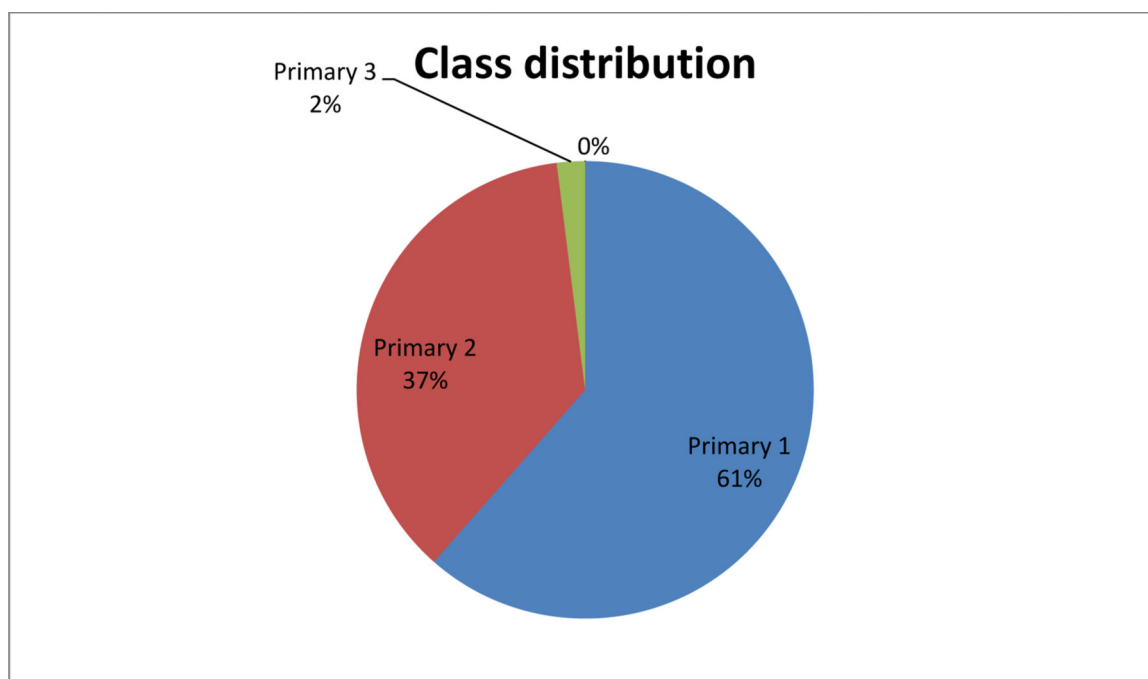


Figure 1.
Class distribution of participants

Table 1

Sociodemographic characteristics of eligible participants

Variables		N=200(%)
Gender	Male	88 (44.0)
	Female	112 (56.0)
School type	Private	129 (64.5)
	Public	71 (35.5)
Previous dental visit	Yes	16 (8.0)
	No	184 (92.0)
Father's SES	High	66 (33.0)
	Low	95 (47.5)
	Unknown	39 (19.5)

Table 2

Pattern of pulpal involvement in both deciduous and permanent dentition

Pulpally involved teeth	Participants (n=200)	
	Deciduous number (%)	Permanent number (%)
None	106 (53.0)	190 (95.0)
≥ 1	94 (47.0)	10 (5.0)
$\chi^2 = 91.68$, df=1; p < 0.001		
1 tooth	49 (24.5)	10 (5.0)
2 teeth	29 (14.5)	0 (0)
3 or 4 teeth	14 (7.0)	0 (0)
>4 teeth	2 (1.0)	0 (0)
Total	94 (47.0)	10 (5.0)

Table 3

Associations between high caries level and Sociodemographic variables

Variables		High Caries level No. N=184 (%)	Yes. N= 16 (%)	Total
Gender	Male	84 (95.5)	4 (4.5)	88 (100)
	Female	100 (82.0)	12 (8.0)	122 (100)
$\chi^2 = 1.78$, Fishers Exact Test p = 0.18				
School type	Private	113 (87.6)	16 (12.4)	129 (100)
	Public	71 (100.0)	0 (0)	71 (100.0)
Past dental visit	Yes	14 (87.5)	2 (12.5)	16 (100.0)
	No	170 (92.4)	14 (7.6)	184 (100.0)
$\chi^2 = 0.045$, Fishers Exact Test p= 0.373				
Fathers SES *	High	57 (86.4)	9 (13.6)	66 (100.0)
	Low	92 (96.8)	3 (3.2)	95 (100.0)
$\chi^2 = 4.77$, Fishers Exact Test p = 0.01				

* Missing data