Use of DI-S and CPITN as predictors in dental caries studies in the primary dentition

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Keywords: Dental caries; predictors; oral hygiene; gingivitis

SUMMARY

The DI-S (simplified oral debris index), CPITN (Community Periodontal Index of Treatment Needs) and dmfs (dental caries experience in the primary dentition were recorded in 395 5-year-old black children living in rural and urban areas of Southern Africa. The DI-S and CPITN were grouped, independently and together, to examine their use as simple field methods of predicting dental caries. For each grouping the sensitivity, specificity and positive and negative predictor values were calculated. A CPITN grouping of 0 or of two or more sextants with bleeding, provided the most convenient specificity, sensitivity and predictor values. It is recommended that this simple method should now be used in prospective studies of caries activity.

OPSOMMING

Die DI-S (vereenvoudigde mondoorblyfsels indeks), CPITN (gemeenskaps periodontale indeks van behandelingsbehoef/es) en dmfs (tandheelkundige kariës ondervinding in die primêre gebit) is aangeteken vir 395 vyf-jarige swart kinders, woonagtig in die landelike en stedelike gebiede van suider Afrika. Die DI-S en CPITN is gesamentlik en afsonderlik gegroepeer om te bepaal of hierdie indekse gebruik kan word as eenvoudige veldmetodes om tandheelkundige kariës te voorspel. Sensitiwiteit, spesitiwiteit, negatiewe en positiewe voorspellings- waardes is bereken. 'n CPTIN groepering van 0 of van twee of meer sekstante met bloeding, het die gerieflikste spesitiwiteit, sensitiwiteit en voorspellingswaardes verskaf. Hierdie eenvoudige metode is aanbevelingswaardig, en behoort nou gebruik te word in prospektiewe studies van kariësaktiwiteit (bedrywigheid).

INTRODUCTION

Dental caries prevalence is falling in western industrialised countries, but is likely to increase in developing areas such as Africa (Glass, 1982). If this expected increase occurs it will require considerable money and manpower to treat and to prevent the disease. Identification of people at high risk of caries could enable a concentration of resources of those who need them most.

Prediction of high risk children has been reviewed by Sullivan (1989). She has shown that many predictors have been used in various age groups with limited success. What is needed for Africa and other developing countries is a simple method that can be used in field studies. Since plaque accumulation is associated with the development of dental caries (Newbrun, 1983), a simple technique is to examine the cleanliness of the teeth. This possibility has been recently supported in a surveillance study of nursery school children in South Africa (Cooke, Williams and Cleaton-Jones, 1989). In that study nursery schools were visited every two years, from 1981, for 5 visits, so that some 5 000 children aged 3 to 5 years were examined. When the children were subdivided into high and low debris groups using the Simplified Debris Index (DI-S) (Greene and Vermillion, 1964), those in the high debris group (DI-S >1,0) consistently had twice as much caries as those in the low group (DI-S <0,2).

The DI-S is a simple, rapid measure of debris based on six index teeth. A drawback is that the index shows an amount of debris on teeth at a specific moment in time, which may not be indicative of the usual cleanliness of those teeth. Another measure which is likely to indirectly show oral cleanliness over a longer period is the gingival state. Inflammation results from plaque accumulation and many indices have been developed to measure this. The Community Periodontal Index of Treatment Needs (CPITN) was introduced in 1982 (Ainamo *et al*, 1982) and is now endorsed by the World Health Organisation (1984). If used as an index of periodontal health in conjunction with the current caries indices, increased comparisons may be made of dental health of communities, particularly with regard to longitudinal studies (World Health Organisation, 1987). Although initially introduced for adults (Cutress, 1986), the index has been found to be useful among teenagers (Ainamo, Parviainen and Murtomaa, 1984). The index is simple to use and might be a useful predictor of caries risk in the primary dentition.

The objective of this study was to compare the DI-S and CPITN as possible predictor models of dental caries in the primary dentition of rural and urban African children.

MATERIALS AND METHODS

The data used in this study were collected in two field studies in Namibia and KwaZulu during April 1988. Prior to the study

Article received: 6:3:91
approved for publication: 10:9:91
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the protocol was approved by the University of the Witwatersrand Committee for Research on Human Subjects (Clearance 1/1/86).

The population sample consisted of 395 black children, aged 5 years on their last birthday, who were present at school or kindergarten on the day of examination. The KwaZulu communities studied were rural Nqutu and urban KwaMashu (Durban) and those in Namibia were rural Grootfontein and urban Katatura (Windhoek). All had similar fluoride levels of <0,15ppm in the drinking water.

The children were examined in natural light in the supine position on folding chairs using plane mirrors, curved disposable probes and the CPITN probe recommended by Emslie (1980). Dental caries was diagnosed clinically without radiographs according to WHO (1987) criteria, the DI-S was recorded as described by Greene and Vermillion (1964) using the index primary teeth described in earlier studies (Cleaton-Jones *et al*, 1984). Calibration for dental caries diagnosis was undertaken using extracted teeth mounted in plaster of paris (Cleaton-Jones *et al*, 1989) and kappa values for the examiners were established at levels all greater than 0,80. Re-examination of some 10 per cent of the children in the field showed that the diagnostic reproducibility was maintained. Calibration for the DI-S was by discussion between the examiners before and during the study.

The CPITN was modified for the primary dentition through the substitution of the following index primary teeth for the recommended permanent teeth - the second primary molars in the posterior sextants (55; 65; 75; 85) and a central primary incisor (51; 71) in the anterior sextants. Substitute teeth were selected for missing teeth using the following rules based on criteria recommended for the permanent dentition (Ainamo *et al*, 1982):

(a) if in a posterior sextant, one of the two index teeth was absent, then the examination was based on the remaining index tooth.
(b) if in the anterior maxillary sextant 51 was absent then 61 was substituted; if both 51 and 61 were absent the worst score from the remaining incisors was recorded. Similarly in the mandible, 81 was substituted if 71 was missing and so on.
(c) if all teeth in a sextant were missing or only one functional tooth remained in an anterior sextant, the sextant was not recorded.

For purposes of calibration the examiners practised using the CPITN probe on the gingival sulcus of their own teeth and on their fingernails, pressed gently but sufficient to produce blanching and not pain. This is equivalent to 20 grams pressure or less (Cutress, 1986). A good practical field method to check intra- and inter-examiner variation with the CPITN index has not yet been defined. In trial runs bleeding points from an initial examination could still be seen in a recall examination, thereby introducing bias. To overcome this problem during the study, frequent joint examinations to maintain diagnostic consistency were undertaken.

The data were analysed in the University of the Witwatersrand's mainframe computer using SAS (1985). Determination of predictive levels of DI-S and CPITN was based on the work of Sullivan and Schröder (1989). In this no predetermined 'predictive borders' (Sullivan 1989) were used. All possible borders were tested, for the individual variables, and together in a stepwise manner. The sensitivity, specificity, and positive and predictive values (Barker and Rose 1976) for the various variable borders were determined.

RESULTS

The children examined consisted of 189 rural and 206 urban dwellers. No statistically significant differences in DI-S, CPITN or dmfs were found between the boys and girls using the chi-square (DI-S, CPITN) and median (dmfs) tests, so the results have not been subdivided by gender. The DI-S results are summarised in Table I, CPITN in Table II, and dmfs in Table III. From these three measurements it can be seen that about one third of the children had no debris on their teeth; gingival bleeding was the main periodontal problem identified with the CPITN, and the caries prevalence was low.

When we tested consecutive scale values of DI-S and CPITN in a stepwise manner this resulted in the definition of two combinations of DI-S, ten combinations of CPITN (the number of sextants per mouth in which bleeding was noted), as well as three combinations of DI-S and CPITN together. For dental caries two groups were defined, caries-free (dmfs=0) and caries present (dmfs >1). Table IV lists standard epidemiological measures of sensitivity, specificity, positive predictive value and negative predictive value for variable groupings with the highest values.

Table I: *DI-S - per cent of children with debris and mean scores.*

Group	n	Per cent children		DI-S	
		DI-S = 0	DI-S >0	mean	sd
rural	189	28	161	1,0	0,6
urban	206	40	166	0,8	0,6

Table II: *CPITN - per cent of children and mean number of sextants per child (H=healthy, B=bleeding, C=calculus; X=sextant excluded from examination, no pockets were seen so P1 and P2 are not listed).*

Group	n	Per cent children			mean number sextants/child			
		H	B	C	H	B	C	X
rural	189	40	56	4	3,0	2,3	0,2	0,5
urban	206	73	24	3	4,4	1,3	0,2	0,3

Table III: *Dental caries results.*

Group	n	% caries-free	dmfs			
			mean	sd	min	max
rural	189	37	5,6	7,3	0	35
urban	206	31	6,9	8,3	0	47

When DI-S alone was used it had high sensitivity and a moderate specificity with good predictive values. The results were fairly similar in rural and urban groups. For CPITN only, the sensitivity was higher in rural children compared to urban children with the opposite trend seen for specificity. Predictive values were less different.

Combination of DI-S and CPITN improved the sensitivity and predictive values in the rural group and maintained the sensitivity and predictive values in the urban group.

Table IV: *Characteristics of the predictive groupings (%).*

Grouping	Sensitivity		Specificity		Predictive values Positive		Negative	
	rural	urban	rural	urban	rural	urban	rural	urban
DI-S/only								
≤0,2; ≥0,2	92	85	26	30	68	73	64	48
≤0,2; ≥1,0	89	79	36	41	73	74	64	48
CPITN only								
0,≥1	84	62	36	63	69	79	57	42
0,≥2	82	56	40	68	69	79	57	42
0,≥3	79	50	45	76	70	81	57	42
0,≥4	76	43	50	82	79	82	57	42
0,≥5	67	31	69	91	78	86	57	42
≤1, ≥2	71	50	47	70	69	79	49	39
≤1, ≥3	68	43	52	78	70	81	49	39
≤1, ≥4	63	36	57	39	70	84	49	39
≤2, ≥3	61	39	56	80	70	81	46	37
≤2, ≥4	56	32	61	86	70	84	46	37
DI-S/CPITN								
≤0,2/0; >0,2/≥1	64	84	22	43	64	80	70	50
≤0,2/0; >0,2/≥2	93	81	24	46	70	78	70	50
≤0,2/0; >0,2/≥3	92	77	26	55	63	81	70	50

DISCUSSION

Barker and Rose (1976) have explained that in disease screening a high sensitivity is important, when false negative errors are serious to such an extent that someone might be denied treatment for cancer, for example. High specificity is necessary when false positive errors are undesirable in terms of anxiety and discomfort to subjects or because they lead to further expensive investigations. Raising the specificity of a test will make it less sensitive so the balance between the two is a matter for judgement. For dental caries specificity is more important than sensitivity, since the consequence of a false negative result is unlikely to be serious.

In conditions where prevalences are low, such as dental caries in this study, the positive and negative predictive values of the test must also be considered. For dental caries positive predictor values are more important than negative.

Examination of Table IV shows that the predictor with the best combination of sensitivity, specificity and predictor values is CPITN alone, using the number of sextants with bleeding present. Of the possible combinations those children with no sextants showing bleeding or with 2 or more sextants showing bleeding seems most useful.

In comparison with the single variable gingival state of Sullivan and Schröder's study (1989), particularly in their 5-6 year old period, the CPITN grouping turned out to have high specificity and predictive values.

It clearly is difficult to predict dental caries, and a single variable is less effective than a combination of gingival state and microbiology (Sullivan and Schröder, 1989). Nevertheless, in a third world developing population the CPITN could be a useful measure of high risk children. Longitudinal studies with pre-school children are needed to confirm this.

The present study has been undertaken on cross-sectional data, associating current oral hygiene and gingival state with a disease (caries) developed in the past. What is now needed is classification of children into high and low risk groups using CPITN combined with prospective followup examinations. We hope that clinicians will undertake such studies.

ACKNOWLEDGEMENTS

We are most grateful to Ms Elizabeth Mundie for her expert word processing; to the authorities of the schools taking part in the study; to Mr A de Klerk of the Namibian Education Services and Drs A Khan and A Tuleram of Kwa Zulu Dental Services.

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