ORIGINAL RESEARCH

Comparison of def index with Nyvad's new caries diagnostic criteria among three to six years old children in a school at Bangalore city

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ABSTRACT

Background: Dental caries is a multifactorial disease with varying clinical picture and its diagnostic criteria is complicated, when initial lesion is considered. Hence, there is a need for an index which measures cavitated, non-cavitated, and initial lesion in dental caries. So, the purpose of this study was to compare the of def index with Nyvad's new diagnostic criteria.
Materials and Methods: A total of 249 school children in the age group of three to six years were selected for the study from Sajjan Rao School at Bangalore city. Children teeth were cleaned and dried with cotton rolls and chip blower. The dental caries examinations were conducted under standardized conditions using plane mouth mirrors and explorers with the help of artificial illumination. The diagnostic criteria used were deft and d, e, and f component of Nyvad's new caries diagnostic criteria. Mann Whitney 'U' test was used to compare the two indexes at five percent significant level.
Results: The mean value for deft was 2.48 and the mean for d, e, and f component of Nyvad's new caries diagnostic criteria was 3.18 which shows statistically significant difference with *P* value of <0.05.
Conclusion: The result obtained by Nyvad's new caries diagnostic criteria produces values much higher than those with def caries index system. Hence, Nyvad's new caries diagnostic criteria can be used to diagnose dental caries at the initial stages, which in turn will reflect exact prevalence of caries.

Key words: Def index, dental caries, Nyvad's criteria

Dental caries is one among the major public oral health problem. Hence, there is an immediate need to reduce the prevalence of this disease. But, it is a multifactorial disease[1] with varying clinical picture. Its diagnosis is complicated, when initial lesion is considered. Therefore if it can be identified at the initial stages, its prevalence can be substantially reduced.[2]

Dental indices have been widely used tool for identifying and measuring dental diseases. There are a lot of dental indices which are used for measuring dental caries, but there is a need for an index which measures dental caries in the initial stage of the lesion. In most of the epidemiological studies, the standard DMF/def indices have been used to evaluate caries status in a given population. This simple index which can be modified by specific circumstances has been accepted for several years. It has some limitations, such as failing to register the initial manifestation like the white spot lesion[3] thereby under estimating the prevalence and severity of caries lesion.

The other indices used to measure dental caries in deciduous dentition were Caries severity index,[4] Nyvad's criteria,[5] World Health Organization (WHO) and WHO-IL,[6] International Caries Assessment and Detection System (ICDAS),[7,8] ICDAS-II[9] and recently The Caries Assessment Spectrum and Treatment CAST system[10] has been used. Out of all these, only Nyvad's Caries diagnostic criteria only considers both cavitated and non-cavitated as well as active and inactive caries lesion.[5]

Another important issue is the decrease in the prevalence of dental caries among children and adolescents which

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have been reported worldwide over the past 20 years.[11-13] Although there is decrease in prevalence, the initial lesion being undiagnosed does not come into account which creates a greater public health concern in late stages. Hence, a more exact diagnostic criteria need to be employed for the identifying and measuring dental caries. Thus, the traditional measurement of caries at the stage of cavitation, excluding the pre-cavitation stages of caries may no longer sufficient to reflect changes in the incidence of caries in present-day populations exhibiting an overall slow rate caries progression.[14]

Further, the diagnosis of caries at the cavitation level result in a significant under estimation of the actual caries experience in populations.[15-17] So both cavitated and non-cavitated lesions need to be considered when diagnosing dental caries. Also for many years, recording of non-cavitated caries lesions was deliberately avoided due to the belief that it is not possible to achieve a reliable diagnosis of precavitation of caries.[18] However, several studies contradict this statement and it has been demonstrated that inter- and intra-examiner reliability is not necessarily reduced when non-cavitated caries lesions are included in the recording system provided that the examiners are thoroughly trained and calibrated prior to the study.[15]

Nyvad in 1999 has introduced an index with his new caries diagnostic criteria. The new caries diagnostic criteria included the initial manifestation of caries in the pre-cavitated stages. Nyvad's system differentiates between active and inactive caries lesions at both cavitated and non-cavitated levels.[17] So, this caries diagnostic system which takes into consideration of cavitated versus non-cavitated and infected versus affected needs to be validated for our population to be used in routine epidemiological survey.

Hence, the purpose of this study was to compare the def index with Nyvad's new diagnostic criteria.

MATERIALS AND METHODS

Children in the age group of three to six years from Sri Sajjan Rao Vidya Samasthe School, Bangalore, were recruited for this cross-sectional study. The study was conducted in the year 2008 for a period of two months. This school was selected based on convenience that is based on availability of school children with only deciduous dentition on the day of examination. A total of 249 school children were available in the age group of three to six years satisfying the inclusion and exclusion criteria. All the school children selected for the study belonged to the same socio-economic status. As the school which was selected for this was one of the adopted schools for annual school oral health program, their practice and knowledge related to oral health were unique.

Inclusion criteria

- Children in the age group of three to six years
- Fully erupted deciduous dentition.

Exclusion criteria

- Congenital missing tooth
- Students with illness (fever).

The purpose and the nature of the study were explained to the principal of the school and a written informed consent was obtained from their parents and school head master. The study was approved by the institutional ethical committee of V.S. Dental College and Hospital, Bangalore.

The investigation was conducted in two stages; first stage for comparing the two dental caries index and the second stage for comparing the reliability criteria. Stage one examination was done for a period of seven days. After a month, reliability examination was carried out for three days. The comparisons of both indices were done considering def index criteria as gold standard.

Caries diagnostic criteria

The caries diagnostic criteria were developed on the basis of information from the literature[19,20] with clinical caries diagnosis by Grubell[3] in 1944 for def index and by Nyvad in 1999 for Nyvad's criteria.[5]

Active and inactive caries lesions[21] were distinguished on the basis of a combination of visual and tactile criteria. The assessment was carried out at three levels of increasing severity, depending on the depth of penetration of the lesions (intact surface, surface discontinuity in enamel or manifest cavity in dentin). Explorers were used to gently clean the tooth surface from bacterial deposits and to check for loss of tooth structure (cavitation) and surface texture (hard or rough/soft/leathery).[22]

Probing of lesions was deliberately avoided unless plain visual criteria (e.g., opaque versus shiny) were not sufficient to assign a lesion into the active or inactive category. 'Mixed' lesions containing elements of both active and inactive caries were diagnosed as active.[22]

Comparison criteria

Nyvad's new caries diagnostic criteria scores were given decayed (d), extracted (e) and filled (f) by the same author for comparison.[22]

Subject and examination

The investigator and examiners were trained and calibrated by the faculty members of the Department of Preventive and Community Dentistry through discussions and practical exercises with the out patients from the oral medicine department belonging to the age group of three

to six years for a period of two weeks regarding the caries diagnostic criteria by Nyvad and Grubell before the start of the study. Caries examinations were conducted by two examiners. The same examiner assesses the same child for both criteria.

Children teeth were cleaned and dried with cotton rolls and chip blower. The dental caries examinations were conducted under standardized conditions using plane mouth mirrors and explorers with the help of artificial illumination. The time spent for examination of each child was approximately three to five minutes.

Assessment of reliability

The intra-examiner reliability[23,24] of the caries diagnostic criteria was assessed at the tooth surface level using three different diagnostic thresholds after a period of one month. Each examiner was asked to re-examine all the children for reliability assessment. The inter-examiner reliability was assessed at the first examination with the following diagnostic thresholds. The reliability measurements were made to find out the reproducibility of this new method of examination.

The cut-off points were the following:

- Sound versus diseased (diseased including all visible signs of caries);
- Active versus inactive (cavitated and non-cavitated lesions pooled); and
- Cavity level (non-cavitated caries and caries with discontinuity recorded as sound) [Box 1].

Box 1: Overview of the diagnostic thresholds for the cut-off points used for reliability test

Sound vs. diseased	Active vs. inactive	Cavity level
Sound 0=sound;	Active 1=active (intact); 2=active (surface discontinuity); 3=active (cavity); 8=filling with active caries;	No cavity 0=sound; 1=active (intact); 2=active (surface discontinuity); 4=inactive (intact); 5=inactive (surface discontinuity); 7=filling; 9=filling with inactive caries.
Diseased 1=active (intact); 2=active (surface discontinuity); 3=active (cavity); 4=inactive (intact); 5=inactive (surface discontinuity); 6=inactive (cavity); 7=filling; 8=filling with active caries; 9=filling with inactive caries.	Inactive 0=sound; 4=inactive (intact); 5=inactive (surface discontinuity); 6=inactive (cavity); 7=filling; 9=filling with inactive caries.	Cavity 3=active (cavity); 6=inactive (cavity); 8=filling with active caries;

Statistical analysis

The statistical test used was Mann Whitney 'U' test for comparison of means obtained by two indices and Chi-square test was used find significance in age and gender between both the indices. The '*P*' value was assigned at 5% and the power of the test was kept at 80%. The reliability was assessed using percentage agreement and Cohen's Kappa value. The statistics was performed using Statistical Package for the Social Sciences (SPSS) Ver. 15.0.

RESULTS

The distribution of the study subject based on age and gender is shown in the [Figures 1 and 2]. Both age and gender shows almost equal in its distribution with *P* value of 0.958 and 0.746, respectively, which does not show any significant difference.

The deft index showed 58% of the subjects experienced dental caries. The mean deft score was 2.48 for the entire sample and 1.43, 2.33, 2.97, and 3.14 for the age group of three, four, five, and six years, respectively. This shows an increase in the mean deft score as the age increases. When Nyvad's caries diagnostic criteria were used, the caries prevalence was 67%. The mean score for d, e, and f component of Nyvad's caries diagnostic criteria were 1.91, 3.13, 3.91, and 3.76 for the age group of three, four, five, and six years, respectively, which also shows an increasing trend with age and there was significant difference in def component of Nyvad's criteria with def index only for the age group of three years with a *P* value 0.023 [Table 1 and Figure 3].

When overall mean deft score and mean score for d, e, and f component of Nyvad's caries diagnostic criteria was compared and subjected to test of inference, the result showed that a statistically significant difference existing between the two index with the '*P*' value of <0.05 and 0.037 [Table 2].

The percentage matching and Cohen's Kappa value for three different cut-off points shows that there exists a strong agreement between the two observations of each observer made at two different point of time (intra-examiner) and the observations made by two different observers (inter-examiner) with Kappa >0.60. Percentage agreement of caries diagnosis by Nyvad's criteria varied from 83% to 88%.

The intra-examiner reliability was 84.5% (0.68), 83% (0.63), and 85% (0.66) for different cut-off points like sound versus diseased, active versus inactive, and cavity present versus cavity not present, respectively. The inter-examiner reliability was 86% (0.69), 84% (0.67), and 88% (0.70) for different cut-off points like sound versus diseased, active versus inactive, and cavity present versus cavity not present, respectively. The inter-examiner reliability was found to be 86% (0.69).

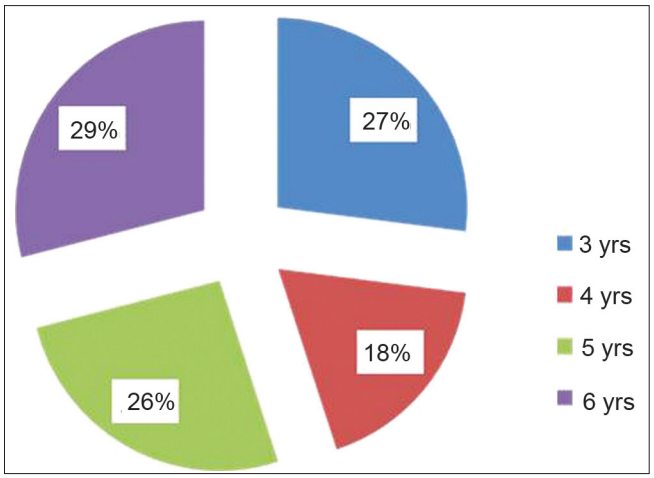

Figure 1: Distribution of study subjects by age

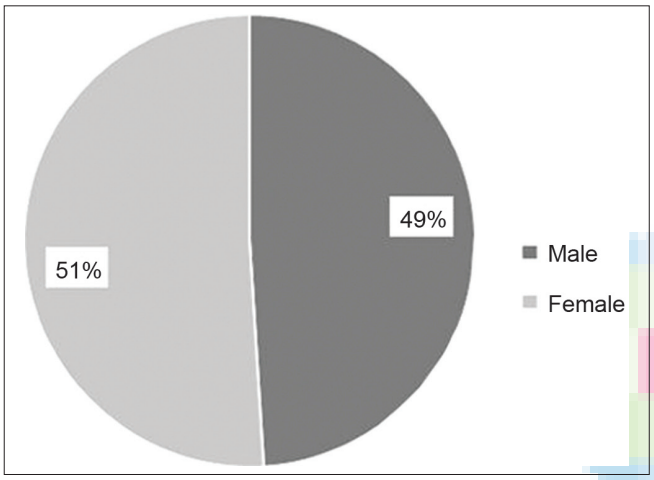

Figure 2: Distribution of study subjects by sex

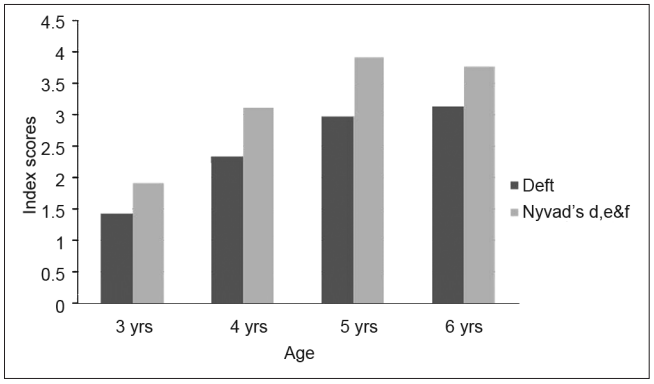

Figure 3: Comparison of deft index with def component of Nyvad's criteria

DISCUSSION

This study was undertaken to compare the def index with Nyvad's new diagnostic criteria and showed a high prevalence of dental caries in three to six years old children. It was seen that as the age increases, the prevalence of dental caries also increases. Nyvad's new diagnostic criteria was used in the present study even though ICDAS II[9] gives better reliability because this diagnostic criteria considers both cavitated and non-cavitated as well as active and inactive caries lesion into consideration.[5]

Table 1: Comparison of mean deft and Nyvad's d, e, and f scores for different age groups

Age	Deft	Nyvad's d,e, and f
3 yrs	1.43 ± 1.67*	1.91 ± 1.08*
4 yrs	2.33 ± 1.16	3.13 ± 1.16
5 yrs	2.97 ± 1.21	3.91 ± 1.31
6 yrs	3.14 ± 1.35	3.76 ± 1.34

Note: *Statistically significant with *P*<0.05 compared with other age group

Table 2: Comparison analysis of mean values of def index with Nyvad's new caries diagnostic criteria

Parameter	Deft (mean±SD)	Nyvad's d, e, and f (mean±SD)	Mean difference	T	*P* value
Overall	2.48 ± 1.33	3.18 ± 1.21	−0.698	−3.47	0.037*

Note: *Statistically significant with *P*<0.05

The prevalence value of dental caries with Nyvad's caries diagnostic criteria were 73% which was higher than those obtained with def index which were 58%. It was similar to a study conducted by M.C.Gonzalez *et al.*[22] in which the prevalence value was 97% for Nyvad's caries diagnostic criteria and 67% for deft index and it was also comparable to a study conducted by Pitts and Fyffe[17] in which they used WHO criteria and the reduction in the percentage of individuals considered caries free decreased from 28.2% to 7.0%.

The mean deft was 1.43, 2.33, 2.97, and 3.14 for the age group of three, four, five, and six years, respectively, which shows an increasing pattern and it was similar to a study conducted by M.C.Gonzalez *et al.*[22] where it was 2.9 for three years of age increasing to 3.7 for four years, and 3.9 for five years. This increasing pattern was also seen in Nyvad's caries diagnostic criteria with mean score of 1.91, 3.13, 3.91, and 3.76 for the age group of three, four, five, and six years, respectively, which was similar to a study conducted by M.C.Gonzalez *et al.*[22] in which it was 8.5 for three years of age increasing to 8.9 for four years.

The comparison result showed that there was a significant difference between mean deft score and mean score for d, e, and f component of Nyvad's caries diagnostic criteria with the '*P*' value of 0.037 which was similar to a study conducted by M.C.Gonzalez *et al.*[22]

The most affected surface according to deft index was occlusal surface, but with Nyvad's caries diagnostic criteria, it was facial surface which was similar to a study conducted by M.C.Gonzalez *et al.*[22] This could happen because most of the non-cavitated lesions (active or inactive) were found on the facial surface and the cavitated lesions on the occlusal surface. When applying the deft index criteria only cavities with definite catch and soft base were registered,

but when Nyvad's caries diagnostic criteria were used, dental caries was registered in the initial stages itself (white spot lesion).

Although it has been recognized that pre-cavitated carious lesion can be diagnosed in the clinical settings, it has been common to omit such diagnosis from recording systems used in epidemiological studies because the diagnosis cannot be made reliably.[23]

However, other studies[22,24,25] have shown that inter and intra-examiner agreement can be high for the diagnosis of non-cavitated lesion following extensive training and calibration of the examiner. Percentage agreement of caries diagnosis varied from 83% to 88% which was similar to a study conducted by Nyvad B *et al.*[21] in which it was between 94.2% to 96.2%.

The intra-examiner reliability was 84.5% (0.68), 83% (0.63), and 85% (0.66) for different cut-off points like sound versus diseased, active versus inactive, and cavity present versus cavity not present, respectively, which was similar to a studies conducted by M.C.Gonzalez *et al.*[22] i.e., 0.70 and Nyvad B *et al.*[21] i.e., 0.74 to 0.85.

The inter-examiner reliability was 86% (0.69), 84% (0.67), and 88% (0.70) for different cut-off points like sound versus diseased, active versus inactive, and cavity present versus cavity not present, respectively, which was similar to a study conducted by M.C.Gonzalez *et al.*[22] i.e., 0.69 and Nyvad B *et al.*[21] i.e., 0.78 to 0.80.

These values show strong agreement within and between the observers i.e., between 0.63 to 0.70 (Cohen's Kappa). Moreover, the kappa values reported here are in the same order of magnitude as those reported by other researchers who have included non-cavitated caries lesion diagnosis into the criteria system.[18] Hence, from the present study, it is evident that Nyvad's criteria are more exact than the conventional def index in caries diagnosis.

This study was conducted by taking only one school with very less sample and therefore the results of the study cannot be extrapolated to the general population of Bangalore city. Hence, if the study is conducted with proper sampling method with larger sample size, it would give more appropriate results.

Nyvad's new caries diagnostic criteria produces dental caries values much higher than those with def index system in the present study within limitations mentioned above. Hence, Nyvad's criteria is a newer caries diagnostic tool that should be used in dental caries diagnosis because it registers the initial stages of the disease, even before a cavity exists as it also measures the activity of the carious lesion.

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