Non Comunicable Diseases

Estimation of Dental Caries in Adults coming to a Dental College in Himachal Pradesh (North-West India) using CAST Index: a Cross-Sectional Study

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Keywords

Dental Caries • Caries Assessment Spectrum & Treatment Need Index • DMF • Index and Adults

Summary

Background. *Decayed Missing Filled Index is the universal index of choice to record dental caries however, it is unable to estimate the severity of dental caries. The Caries Assessment Spectrum and treatment (CAST) Index is a new index which can be used to distinguish the intensity of caries.*
Aim. *To ascertain dental caries using CAST index and to compare the association of CAST index with DMF Index values attained using CAST index in adults.*
Materials and Methods. *The cross-sectional survey recorded dental caries using CAST index in adults. 30.6% of adults experienced tooth loss and 32.3% recorded caries lesion advancing to dentin. 29.5% of adults had lesion attacking pulp but the gender predilection was insignificant. Caries severity in adults worsened with increasing age with significant association ($p < 0.00$). Scarcely 7.3% had undergone restorative care owing to dental caries.*
Conclusions. *The CAST index provides all-inclusive knowledge with regard to caries severity and transient shift in oral health in adults.*

Introduction

The global burden of untreated dental caries continues to pose a challenge with India emerging among top five countries and contributing 18.1% of global case-load of dental caries [1]. It is appalling to note that untreated dental caries contracted indirect cost up to 22 US billion dollars. Dental caries problem exacerbates largely due to exposure to sugar-rich food and beverage consumption and to some extent viewing advertisements of sugar-rich foods.
Dental caries influences oral health in all walks of life from infancy, school age, adolescence, adulthood and up to elderly. The consequences of untreated dental caries leads to loss of working hours, loss of productivity and an instance of registered case of blindness [1, 2].There is dose-response relationship between sugar consumption and dental caries such as dental caries worsens with high intake of sugar. High sugar intake precipitates the emergence of non-communicable disease such as diabetes, cardiovascular disease and non-alcoholic fatty-liver disease [3]. Evidence states that dental caries worsens when associated with physical multi morbidity and consuming diet which exacerbates acid-producing and acid-colonizing bacteria promoting the onset of dental caries [4, 5].
There is substantial evidence with pooled data exhibiting the prevalence of dental caries by using the universally applicable DMF Index [6, 7]. However, there is scant evidence pointing to prevalence of dental caries recorded using Caries Assessment Spectrum and Treatment Index CAST index [8]. Although DMF Index is cited to be the most widely used in recording dental caries still it bears constraints resulting in underestimation of caries and its inability to detect enamel lesions. It is unable to distinguish among decayed, missing and filled teeth [9]. CAST Index is a new dental index which is useful in projecting full spectrum of dental caries and in distinguishing severity of dental caries [10]. CAST index is useful in understanding the intensity of dental caries and has demonstrated good face and construct validity [9]. There's dearth of literature concerning dental caries estimation in permanent dentition using CAST index. Hence forth the study was conducted to evaluate dental caries in adults using CAST index and to correlate the association between CAST index values and DMF Index values obtained using CAST index.

Materials and methods

Before commencing the study, ethical clearance was acquired from Institutional ethical committee on 28th October 2022 with reference BDC/BHUD/12361A/28-10-22. The sample size was estimated by considering expected prevalence from previous study be 55% [6], margin of error set at ± 5% and possible attrition of 10% yielded sample size of 424 [11].
The above cross-sectional study duration lasted for 4 months from November 2022 till February 2023. The subjects were clearly explained about the objective of study and only those who were above 18 years of age were enrolled in the study after obtaining written consent while screening from dental out patient department OPD. Convenience sampling was utilized in

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enrolling the participants. Subjects who were physically and mentally incapacitated and minors were excluded from the study. A close-ended questionnaire in English language and translated to Hindi language in accordance with understanding of participants yielded responses for oral hygiene practices. The brushing habits were assessed by asking the type of aid and type of material used for cleaning teeth and the frequency of cleaning teeth by the subjects. Prior to clinical recording intra examiner reliability was assessed by performing calibration on 20 subjects by single examiner. The Cohen's kappa statistics drawn was 0.94 indicating perfect agreement. The subjects were seated on a dental chair and dental caries was recorded using CPI probe, plain mouth mirror and gauze piece using CAST index.

Caries Assessment Spectrum and Treatment Index is a practical and reliable index that provides a broad overview of dental caries. This index is practically useful in recording stages of caries lesions advancing from enamel to dentin and progressing to pulpal tissue [12].

CAST index involves 9 codes in marking dental caries clinically. Code 0, corresponds to sound tooth, followed by Code 1 related to sealed tooth and Code 2 is associated with tooth restored with restorative material. The stages of carious lesions are scored from codes 3 to 7, such that Code 3 corresponds with visual change in enamel, Code 4 affiliated with caries-related discoloration in dentine and Code 5 inter-related with distinct cavitations in dentine.

Codes 6 and 7 relate to caries accelerating to pulp chamber and further deepening into fistula/abscess. Finally tooth lost due to dental caries is classified as 8. Additionally if the recorder is unable to relate with any of the above categories it corresponds with Code 9 [12].

The anonymity and confidentiality of responses obtained was strictly adhered in accordance to Helsinki Declaration of World Medical Association [13].

Statistical Analysis

The derived data was assessed for normality using Shapiro-Wilk Test and due to non-normal distribution of data non-parametric test was performed. Sociodemographic details obtained were age and gender. Mann-Whitney U-Test was performed to differentiate two independent group of samples. Spearman's Rank Correlation coefficient^R was conducted to inspect correlation between DMF index and CAST index. Regression analysis was conducted to associate connection between gender and change of toothbrush with dental caries.

Results

The mean age of the subjects was 36.06 (± 11.11). 60.3% (n = 256) comprised male subjects and 39.7% (n = 168) were females. 50% (n = 212) had caries lesion confined to enamel and just 7.3% (n = 31) underwent restoration of teeth due to dental caries. 4% (n = 17) felt caries related discoloration and one-third (32.3%) experienced progression of caries to dentinal stage. 29.5% perceived pulpal pain with progression of caries and 30.6% (n = 130) reported loss of tooth/ tooth mortality due to dental caries (Tab. I).

Tab. I. Frequency distribution of caries assessment spectrum and treatment codes.

Criteria	Frequency (%)
A cavity is restored with an (in)direct restorative material	30 (7.3%)
Distinct visual change in enamel only; a clear caries-related discolouration is visible, with or without localised enamel breakdown	212 (50%)
Internal caries-related discolouration in dentine; the discoloured dentine is visible through the enamel, which may or may not exhibit a visible localised breakdown	17 (4%)
Distinct cavitation into dentine; the pulp chamber is intact	137 (32.3%)
Involvement of the pulp chamber; distinct cavitation reaching the pulp chamber, only root fragments are present	125 (29.4%)
The tooth has been removed because of dental caries	130 (30.7.%)

Tab. II. Oral Hygiene practices.

Question	Response	Frequency (%)
Type of Aid Used	Toothbrush	408 (96.3%)
	Treestick	3(0.7)
	Toothbrush + Treestick	12(2.8)
	Finger	1(0.2)
Type of Material Used	Toothpaste	382 (90.1%)
	Toothpaste + Toothpowder	33 (7.8%)
	Toothpaste	6 (1.4%)
	Do not Use	3 (0.7%)
Frequency of Cleaning	Once a day	407 (96%)
	Twice a day	17 (4%)

96.3% reported cleaning of their teeth by using toothbrush and dismally 4% had the habit to clean their teeth twice a day. Surprisingly 7.8% used toothpaste and toothpowder to clean their teeth (Tab. II). Regression analysis conveyed that those who changed their toothbrush after 6 months (p = 0.00, OR = 1.538 and CI = .852, 2.225) had higher risk of dental caries as compared with those changing toothbrush within 3 months (p = 0.07, OR = 0.45 and CI = -0.06, 0.94) 7.1% with CAST score of 3 were in reversible premorbidity stage. 6.6% (n = 28) (codes 4 and 5) were in morbidity phase and 1.4% had severe morbidity (Codes 6 and 7). Remaining 1.7% (n = 7) (code 8) had severe mortality of teeth. Differentiating CAST scores with gender was non-significant (Tab. III); however females were slightly predisposed to dental caries in regard to mean DMF 2.26 (± 2.34) when weighed with mean DMF in males 2.10 (± 2.76).

Regression analysis showed females were more plausible to develop dental caries (p = 0.00, OR = 1.957 and CI = 1.204, 2.709) as opposed to males. The CAST scores worsened with age progression (Tab. IV).

Tab. III. Comparing Caries experience association with Gender using Mann-Whitney U Test.

Variable	Gender	Mean Rank	Mean (± SD)	Mann Whitney U (2 Tailed-p value)	Z Value
Cavity is Restored with Restorative Material	Male (n = 256)	213.68	0.14 (± 0.68)	0.586	-.544
	Female (n = 168)	210.70			
Visual Change in Enamel	Male	210.73	1.12 (± 1.65)	0.692	-.396
	Female	215.20			
Internal caries-related discolouration in dentine; the discoloured dentine is visible through the enamel, which may or may not exhibit a visible localised breakdown	Male	213.90	0.04 (± 0.24)	0.393	-.855
	Female	210.37			
Distinct cavitation into dentine; the pulp chamber is intact	Male	216.36	0.56 (± 0.98)	0.333	-.968
	Female	206.62			
Involvement of the pulp chamber; distinct cavitation reaching the pulp chamber, or only root fragments are present	Male	205.51	0.61 (± 1.39)	0.071	-1.804
	Female	223.15			
The tooth has been removed because of dental caries	Male	210.57	0.81 (± 1.96)	0.623	-.492
	Female	215.44			

* p < 0.05. SD: Standard deviation.

Tab. IV. Differentiating caries Experience with Age using Mann-Whitney U Test.

Variable	Age Group	Mean Rank	Mean (± SD)	Mann-Whitney U-(2 Tailed-P Value)	Z Value
Cavity is Restored with Restorative Material	19-44 years	210.18	0.14 (± 0.68)	0.093	-1.679
	45-70 years	221.25			
Visual Change in Enamel	19-44 years	220.99	1.12 (± 1.65)	0.003*	-2.982
	45-70 years	180.54			
Internal caries-related discolouration in dentine; the discoloured dentine is visible through the enamel, which may or may not exhibit a visible localised breakdown	19-44 years	211.62	0.04 (± 0.24)	0.397	-.848
	45-70 years	215.83			
Distinct cavitation into dentine; the pulp chamber is intact	19-44 years	210.80	0.56 (± 0.98)	0.504	-.668
	45-70 years	218.18			
Involvement of the pulp chamber; distinct cavitation reaching the pulp chamber, or only root fragments are present	19-44 years	204.33	0.61 (± 1.39)	0.001*	-3.316
	45-70 years	243.26			
The tooth has been removed because of dental caries	19-44 years	201.31	0.81 (± 1.96)	0.000*	-4.478
	45-70 years	254.62			

* p < 0.05. SD: Standard deviation.

Approximately half of the subjects (54%) had decayed teeth with mean DMF calculated using CAST index as 2.16 (± 2.60). An intriguing observation was that the lower permanent molars were more carious than upper permanent molars with a prevalence of 41.2% and 21.6% involving 1st and 2nd lower right molars. The preponderance of lower left 1st permanent molar being 45% and 25.7% for lower left 2nd permanent molar. The estimated prevalence of caries in upper right permanent molars was 23.8% for 1st molar and 14.8% for 2nd molar and caries prevalence in upper left permanent molars was 21.2% for upper left 1st molar and 12.3% for upper left 2nd molar.

The spread of dental caries in premolars was 26.4% in mandibular arch and 32.2% in maxillary arch. In context to anterior teeth 16% decayed teeth were observed in maxillary arch and in mandibular arch 13.5% had prevalence of dental caries in anterior teeth.

The percentage of decayed teeth in 45-70 year age group was 88.7% and 71.4% had decayed teeth in 19-44 year age group. Similarly percentage of missing teeth in 45-70 year age group was 46% and clinically 26.8% had missing teeth in 19-44 year age group. The Mean number of intact teeth were 29.83 (± 2.54).

The decayed teeth in 45-70 years age were significantly more than 19-44 years (U = 12343)

p = 0.008 and as well as missing teeth in 45-70 years age were significantly higher than 19-44 years (U = 11415), p = 0.000) (Tab. V).

An interesting observation was insignificant association of mean DMF with gender. Spearman's Rank correlation exhibited strong correlation of CAST index scores with DMF index scores (p < 0.000) (Tab. VI).

Discussion

In the above study 50% of subjects had caries lesion confined to enamel (pre morbidity), which

Tab. V. DMFT comparison with Age using Mann-Whitney U Test.

	Age Group	Mean Rank	Mean (± SD)	P Value	Z Value
Decayed Teeth (DT)	19-44 years	204.84	1.19 (± 1.75)	0.008*	-2.653
	45-70 years	241.31			
Missing Teeth (MT)	19-44 years	202.08	0.82 (± 1.96)	0.000*	-4.161
	45-70 years	251.74			
Filled Teeth (FT)	19-44 years	210.43	0.15 (± 0.68)	0.146	-1.452
	45-70 years	220.29			

* p < 0.05. SD: Standard deviation.

Tab. VI. Spearman's Rank Correlation Coefficient between DMF Index and CAST index.

Variable	Spearman's correlation coefficient (r)	P Value
Visual Change in Enamel	-.233**	0.000*
Cavity restored with restorative	-.235**	0.000*
Internal caries-related discolouration in dentine the discoloured dentine is visible through the enamel, which may or may not exhibit a visible localised breakdown	-.065	0.182
Distinct cavitation into dentine; the pulp chamber is intact	.359**	0.000*
Involvement of the pulp chamber; distinct cavitation reaching the pulp chamber, or only root fragments are present	.817**	0.000*
The tooth has been removed because of dental caries	-.704**	0.000*

* p < 0.05. SD: Standard deviation.

was substantially high in contrast to previous studies [8, 10, 14, 15] which could be due to ignorance and delayed approach in seeking dental care necessitating instant restorative care and promotion of oral health maintenance. One-third (32.3%) were detected with dentinal caries involving pulp which was analogous to similar finding from western India [11] and approximated with a previous research from south India [16]. However, none of the subjects had pus releasing sinus tract which might be due to timely dental intervention and prompt treatment but in disagreement with earlier conclusions [8, 10, 14]. Bleakly only 7.3% availed prompt restorative care which was slightly raised collating with earlier observations obtained in children and adolescents [17, 18].

It was compelling to observe that oral hygiene practices influenced the onset of dental caries as those who changed toothbrush after 6 months were succumbing to dental caries which was in tune with similar study showing a direct association of dental caries with frequency of change of toothbrush [19].

45-70 year age group subjects were predominantly having missing teeth and decayed teeth in contrast to 19-44 year age-group and this observation corresponded with previous literature [7, 15]. Tooth mortality resulting in loss of tooth was marginally high as opposed to previous research [8, 15] and preponderance of tooth mortality was more in females when distinguished with males [15]. Women being homebound are involved in home responsibility as a result are less expressive in conveying their oral health problems which eventually contributes to tooth mortality [15]. Women experienced tooth mortality and as a result mean DMF in females was slightly more than males which could be explained because of the early eruption of teeth in females, vulnerability to dental caries due to hormonal changes, variation in salivary flow rate and laying open to cariogenic microflora [20]. Slightly less than one-tenth were having caries-related discoloration which coincided with earlier observations reported previously using CAST index [14, 16]. Lower First permanent molars accounted for severe morbidity and tooth mortality because of variance in tooth morphology and differences in post-eruptive maturation of enamel [21] which complemented with a study involving adolescents [22] but was in disagreement with previous findings [23]. Inter-arch differentiation revealed distribution of dental caries more in maxillary arch than mandibular arch which was synonymous with previous literature [24, 25] and attributed to poor maintenance of oral hygiene and food-lodgement visible in occlusal surfaces of molars [25]. The overall mean DMF obtained projected to higher side when compared to past studies [8, 16]. There were significant association between DMF index scores and CAST index scores which was in concordance with previous studies [17, 26] drawing similar results because of early recognition of non-cavitated lesions and early cavities discerned using CAST index when correlated with DMF index. DMF Index may cause underestimation of caries [26] and lacks the sensitivity in locating minor deviation in caries advancement [18] when weighed with CAST index showing continuum of dental caries on a single tooth.

Limitations

The cross-sectional design of the study bears several short-comings. We could not assess the incidence of dental caries and it would be difficult to draw casual inference. The study design is inadequate to inspect temporal relation between outcomes and risk factors [27].

One-time measurement of disease of interest in a cross-sectional study poses challenge in generalizing the study findings.

Recommendations

The soaring cost of dental services raises alarm bells to address the social and commercial determinants influencing oral health. Tooth mortality can be avoided if oral health promotion and prevention could be channelized at primary care level [28]. Imposition of tax on sugar-laden items may bring-down the caries-attributed tooth-loss [3]. Alternatives measures shall be laid down for instance counselling the school administrators to educate the school going children about the consequences of sugar intake contributing to dental caries. Create trained workforce who may be useful in disseminating knowledge on untreated dental decay through medium of oral health education. Strengthen the on-going Ayushman Bharat Scheme which involves oral component under comprehensive primary health care to full fill the unmet oral health needs of the population [29].

Conclusions

Therefore, CAST index demonstrates comprehensive measurement of extent and severity of dental caries in detail rather than DMF index. CAST index should be effectively utilized in estimating dental caries comprehensively. Health planners can promulgate oral health promotion and prevention in a better way by employing CAST index in detection of dental caries.

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Conflict of interest statement

None.

Author's contributions

Study conception and Design: AV, BR. Acquisition of Data: AV, BR. Analysis and Interpretation of Data: AV, BR. Drafting of Manuscript: AV, BR. Critical Revision: AV, BR.

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