Agrawal and Shah Modified Cast Index – A Novel Index Assessing Prevalence of Dental Caries and Treatment Needs of the Adult Indian Population

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Abstract

Background: Agrawal and Shah modified CAST (Caries Assessment Spectrum and Treatment) is the novel index prepared specifically for the Indian population for the complete evaluation of the spectrum/range of dental caries described hierarchically. **Objective:** To assess the prevalence of dental caries and treatment needs in an adult Indian population using Agrawal and Shah modified CAST index. **Materials and Methods:** A cross-sectional transverse study was performed on 2000 adult patients in the age range of 19–70 years. All the adult patients were scored for caries presence by Agrawal and Shah modified CAST codes on a structured proforma. SPSS version 20 was used to analyze the data. **Results:** The prevalence of dental caries calculated using Agrawal and Shah modified CAST index was 85.6%. 5.2% (104) adults had sound dentition, 4.1% (82) adults had restorations, 2.1% (42) adults had non-cavitated lesions, 13.7% (274) adults had the presence of caries in the enamel, 19% (380) adults had the presence of caries in dentine, and pulpal involvement was observed in 27.7% (554) adults. 10.3% (206) adults had presented with a root surface and cervical caries. 13.6% (272) adults had lost at least one tooth due to caries, and 3% (60) adults had lost teeth due to any other reason except dental caries. 1.3% (26) adult patients do not show any caries-related diagnosis but were having predisposing conditions. **Conclusion:** Agrawal and Shah modified CAST index proved to be simple, useful, and appropriate in assessing dental caries prevalence in the Indian population along with the treatment needs of the Indian population.

Keywords: Adult, dental caries, epidemiology, prevalence

INTRODUCTION

Dental caries, which is caused by the imbalance between the demineralization and remineralization process around the tooth surface, is one of the prime causes of tooth pain and loss worldwide, affecting the health and social lifestyle of an individual. According to the Global Burden of Disease Study of 2017, 3.5 billion population worldwide suffer from oral diseases, out of which 2.3 billion population suffer from caries of permanent teeth.[1] A national survey in 2003 found that 80–96.5% of the Indian population suffered from dental caries.[2]

A reliable caries assessment index covering the total dental caries range is a requisite for any government or health institution to obtain a true definitive picture of a population suffering from dental caries to implement dental caries prevention and treatment programs in an organized manner. World Health Organization implements Decayed, Missing, and Filled Teeth (DMFT) for assessing prevalence of dental caries in epidemiological studies.[3] DMFT index cannot assess the advanced stages of untreated carious lesions and root caries, which are more common in Indians due to the little awareness and access to oral health care in the Indian population.[4] International Caries Detection and Assessment System (ICDAS I and II)[5,6] and the PUFA[7] were developed to overcome the limitations, but they too have their drawbacks. Dental caries encroaching pulp was not recorded by ICDAS, and a two-digit scoring in ICDAS makes it inconvenient in epidemiological surveys. However, PUFA did not evaluate enamel, dentine, or root caries as it only recorded the most severe carious lesions involving pulp and beyond.[8]

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Access this article online

Quick Response Code:

Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.ijcm_878_22

The CAST (Caries Assessment Spectrum and Treatment) index[8] represents the hierarchy of caries from no carious lesions to the presence of caries sealant and caries restoration; caries involving the enamel, dentine, pulp, and tissue surrounding the tooth in the form of abscess or fistulae; and tooth loss. The higher the CAST score, more severe is the carious condition.[9-12] Face and content validation of the CAST index was done by their proposers in 15 different countries, including Canada, Chile, South Africa, Brazil, Tanzania, Nigeria, Iraq, Mexico, Turkey, Germany, Finland, Australia, China, and Thailand, but India was excluded.[10] In India, this was attempted by Phansopkar S et al.,[13] and they found that the CAST index can be considered for epidemiological surveys in India but with some changes in the original index. Henceforth, we have done addition, deletion, or modifications required in the original CAST index and proposed "Agrawal and Shah modified CAST index" for assessing dental caries prevalence and treatment needs of the Indian population [Table 1]. Copyright for Agrawal and Shah modified CAST index was obtained [Copyright registration number: L-107683/2021]. Agrawal and Shah modified CAST index is user-friendly and is more applicable for assessing the full spectrum of dental caries experience and can be used for clinical practice, education, research, and epidemiological purposes in the Indian population.

This study was conducted for assessing dental caries prevalence and treatment needs of the adult Indian population using Agrawal and Shah modified CAST index.

MATERIALS AND METHODS

The present cross-sectional study was conducted on 2000 adult male and female patients (age range 19–70 years) with dental problems visiting the out-patient clinic (from January 2022 to August 2022) of the operative department of M P Dental college and Hospital. Inclusion criteria include adults having all the permanent teeth fully erupted till second molars and no deciduous teeth and who were willing to give written consent. Exclusion criteria were adults with mental retardation, differently abled, immuno-compromised, pregnant females, undergoing radiation, and orthodontic treatment. Ethical clearance for the study was obtained by the institutional ethical committee (Ethical committee approval no: SVIEC/IN/DENT/PhD/18018).

Sample size determination and sampling technique
Sample size calculation was done by taking average of adult patients undergoing caries treatment in a month in the department at 95% confidence interval and 80% power. The purposive sampling technique was used to select 2000 adult male and female patients randomly.

Data collection
Data were recorded on a validated and structured proforma. Clinical examination was done using a sterile mouth mirror and Community Periodontal Index (CPI) periodontal probe ending with a 0.5 mm round ball tip which helps in removing any dental plaque or debris if present, a tweezer, and cotton rolls. The patients were examined for caries on a chair under adequate illumination. In a situation where two separate carious lesions were present on the same tooth, one being a superficial lesion and another deep, a higher score for the deepest lesion was recorded. No drying of teeth while recording scores and no radiographs were taken.

Data processing and analysis
After entering data into Excel sheets, they were exported to Statistical Package for Social Sciences (SPSS) version 20 (IBM

Table 1: Agrawal and Shah modified CAST index

Characteristic	Code	Description	Treatment Needs
Sound	0	Sound – no visible evidence of a distinct carious lesion is present. The surface of the enamel appears smooth and unpitted or discolored.	Tn 0 – No treatment needed (Healthy Dentition)
Restored	1	A cavity restored with a direct/indirect or permanent/temporary restorative material without a dentine carious lesion and no fistula/abscess present.	Tn 0 – No treatment needed (Healthy Dentition)
Non-Cavitated lesions	2	Discoloration of enamel (white or brown in color) without cavitation or enamel breakdown/loss of translucency of enamel.	Tn 1 – Remineralization therapy (Pre-Morbidity stage)
Enamel	3	Distinct cavitation in enamel – localized enamel breakdown without clinical visual signs of dentine involvement.	Tn 2 – Restoration (Mild Morbidity Stage)
Dentine	4	Enamel appears grayish black due to undermining as a result of dentin involvement or the presence of distinct cavitation into dentine. No (suspected) pulpal involvement is present.	Tn 3 – Restoration (Moderate Morbidity Stage)
Pulp	5	Involvement of pulp chamber – distinct cavitation encroaching pulp chamber or only root fragments are present or pulpal involvement with pus, abscess, fistula, sinus tract, etc.	Tn 4 – Endodontic Therapy (Severe Morbidity stage)
Root Surface and Cervical caries	6	Discolored/Cavitated area on the root surface or at the cementoenamel junction	Tn 2, Tn 3, or Tn 4 depending on the extent of the lesion
Lost (missing)	7 a	The tooth has been removed because of dental caries	Tn 5 – No Treatment except replacement of teeth (Mortality stage)
	7 b	Teeth are lost due to other reasons like periodontal problems, orthodontic reasons, trauma, etc.	
Others	8	Does not match with any of the other categories e. g., Amelogenesis imperfecta, Dentinogenesis imperfecta, Fluorosis, etc.	--------------

computers, USA) for analysis. Descriptive statistics such as frequency and proportion were used to present the results.

RESULTS

This cross-sectional study was done on 2000 adults in the age range of 15–70 years, out of which 1082 were males and 918 were females. The maximum code per patient was obtained and tabulated for frequency distribution as shown in Table 2. Only 5.2% (104) adults had sound dentition, 4.1% (82) adults had restorations, 2.1% (42) adults had non-cavitated lesions, 13.7% (274) adults had the presence of caries in the enamel, 19% (380) adults had the presence of caries in dentine, and pulpal involvement was observed in 27.7% (554) adults. 10.3% (206) adults had presented with root surface and cervical caries. 13.6% (272) adults had lost at least one tooth due to caries, and 3% (60) adults had lost teeth due to any other reason except dental caries. 1.3% (26) adult patients do not show any caries-related diagnosis but were having predisposing conditions. The overall prevalence of caries estimated was 85.6%.

According to the epidemiological concept of health and disease and scores of Agrawal and Shah modified CAST index, findings can be descried as healthy dentition denoted by codes 0 and 1, which was observed in our study in 9.3% (104 and 82) adults. Non-healthy dentition can be divided into [Figure 1]:
1) A reversible pre-morbidity stage (code 2) seen in 2.1% (42) of the adults,
2) A mild morbidity stage (code 3) seen in 13.7% (274) of the adults,
3) A moderate morbidity stage (code 4) seen in 19% (380) of the adults,
4) A severe morbidity stage (code 5) seen in 27.7% (554) of the adults, and last,
4) A mortality stage (codes 7a and 7b) with the most severe conditions seen in 16.6% (272 and 60) of the adults.

Based on the stages to carious lesion, treatment needs of the patient can be classified. No treatment (Tn 0) is required in adults with healthy dentition (9.3%). Adults in the pre-morbidity stage (2.1%) require only preventive treatments such as remineralization (Tn1). Adults in mild (13.7%) and moderate (19%) morbidity stages require intervention restorative treatment either intra or extra-coronal (Tn2 or Tn3). Adults in the severe morbidity (27.7%) require interventional root canal therapy (Tn4). Adults in the mortality stage (16.6%) will require replacement of lost teeth either by the prosthodontic crown and bridge procedure or by placing the dental implants (Tn5). Patients presenting with root surface or cervical caries (10.3%) may require Tn2, Tn3, or Tn4 treatment depending upon the extent of lesion.

DISCUSSION

Researchers worldwide are still in the search of an ideal caries index which can be utilized in epidemiological surveys as the DMFT index adopted by WHO has disadvantages of not recording
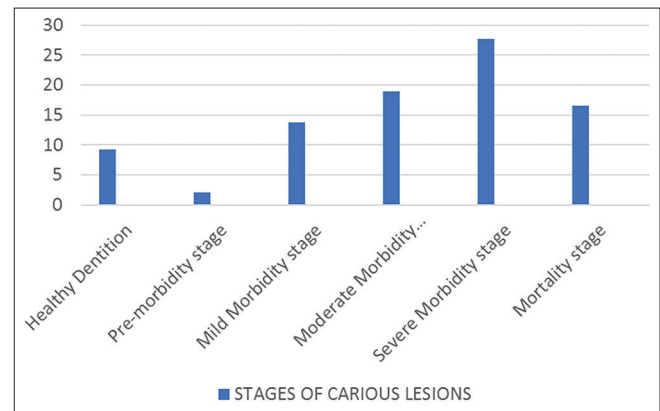

Figure 1: Stages of carious lesions

Table 2: Frequency distribution of AGRAWAL AND SHAH modified cast codes

Characteristic	Code	Description	Frequency (%)
Sound	0	Sound – no visible evidence of a distinct carious lesion is present. The surface of enamel appears smooth and unpitted or discolored.	104 (5.2)
Restored	1	A cavity restored with a direct/indirect or permanent/temporary restorative material without a dentine carious lesion and no fistula/abscess present	82 (4.1)
Non-Cavitated lesions	2	Discoloration of enamel (white or brown in color) without cavitation or enamel breakdown/loss of translucency of enamel	42 (2.1)
Enamel	3	Distinct visual change in enamel – a clear carious related discoloration (white or brown color) is visible, including localized enamel breakdown without clinical visual signs of dentine involvement	274 (13.7)
Dentine	4	Enamel appears grayish black due to undermining as a result of dentin involvement or presence of distinct cavitation into dentine. No (suspected) pulpal involvement is present	380 (19)
Pulp	5	Involvement of pulp chamber – distinct cavitation reaching the pulp chamber or only root fragments are present or pulpal involvement with pus, abscess, fistula, sinus tract etc.	554 (27.7)
Root Surface and Cervical caries	6	Discolored/Cavitated area on the root surface or at cemento-enamel junction	206 (10.3)
Lost (missing)	7 a	The tooth has been removed because of dental caries	272 (13.6)
	7 b	Teeth lost due to any other reason like periodontal problems, orthodontic reason, trauma, etc.	60 (3)
Others	8	Does not match with any of other categories, e.g., Amelogenesis imperfecta, Dentinogenesis imperfecta, Fluorosis, etc	26 (1.3)

Prevalence of dental caries=2000−288=1712=85.6%

the incipient and extreme carious lesions. CAST index to certain extent has shown a promising index for caries epidemiology as it depicts the full range of carious lesions and is also simple, inexpensive, and less time-consuming.[14] But while conducting its validation for use on the Indian population by Phansopkar S *et al*.,[13] he suggested that some modifications are required for its use in a diverse country like India for epidemiological purposes. Hence, we developed Agrawal and Shah modified CAST index [Table 1] that would be more applicable for the caries assessment in epidemiological surveys in India.

Some of the modifications done in Agrawal and Shah modified CAST index include Code 1 (Sealant), which in the original CAST was eliminated as in India, both dentists and patients prefer curative therapy over preventive therapy. Also, studies conducted by Mehta A[15] and Shyam R *et al*.[16] reported that none of the subjects had Code 1 in the Indian population. Description of Code 2 (Restoration) in the original CAST was modified; that is, both permanent and temporary restorations were included along with direct and indirect restorations to avoid confusion during scoring in the modified CAST index. Non-cavitated enamel lesions were included and given a separate code from the cavitated enamel lesions in the modified CAST index. One of the reasons was biased scoring of non-cavitated lesions by the examiner, and it tends to be missed. Also, the treatment is different as such lesions can be treated with remineralization therapy, without any restoration required; they are coded as a separate entity. In our study, 2.1% adults have shown to have non-cavitated enamel lesions.

Code 4 and Code 5 of dentine of the original CAST index were clubbed as the difference among observers is likely to occur due to problems in differentiating between Code 3 (caries in the enamel) and Code 4 (early dentinal caries) and problems in identifying dentinal caries, especially in the proximal regions without the use of radiographs, just on the evidence of discoloration and no visible enamel breakdown/cavitation. Similarly, clubbing of Code 6 and Code 7 of the pulp of the original CAST instrument was done as both codes indicate the involvement of pulp by dental caries and there is not much of an impact on the treatment plan of both codes.

A separate code was introduced in the modified CAST instrument, incorporating root surface and cervical caries, as many epidemiological studies[17,18] conducted on the Indian population have shown the higher prevalence of periodontal disease and gingival recession in the adult Indian population, exposing the root surface to the oral environment and leading to root surface and cervical caries. In our study, 206 adults (10.3%) have shown root surface and cervical caries, which indicates the importance of incorporating this code for the Indian population.

Code 8, which is tooth loss due to dental caries, was divided into two subsets in Agrawal and Shah modified CAST. There can be multiple reasons for tooth loss, ranging from dental caries, trauma, periodontal disease, orthodontic extractions, and so on. An individual should recall accurate history for the reason of tooth loss to record this code, making this code subject to recall bias. In countries like India, extraction is a rule for treating any type of dental disease rather than an exception, especially in rural and urban slum areas.[13] Hence, to reduce bias, the code has been sub-divided into two, tooth loss because of dental caries and other tooth losses due to any other reason.

Code 9 of the original CAST does not specify which other conditions and becomes difficult to understand while scoring. Hence, to be specific, other conditions that predispose to dental caries, such as amelogenesis imperfecta, dentinogenesis imperfecta, and fluorosis, were included in this code in the modified CAST index.

A separate treatment need index [Table 1] was also developed based on the codes of Agrawal and Shah modified CAST index, which divided dentition into the healthy stage, pre-morbidity stage, mild morbidity stage, moderate morbidity stage, severe morbidity stage, and mortality stage. Treatment needs range from no treatment required, remineralization therapy to restoration, root canal treatment, and finally replacement of teeth in the mortality stage.[19] In this study, the majority of the subjects were seen in the severe morbidity or mortality stage, which indicated the need of awareness regarding the caries control measures in the Indian population. Based on results of our study, most of the subjects require either the root canal treatment or the replacement of teeth which were lost due to dental caries.

The overall prevalence of dental caries calculated by Agrawal and Shah modified CAST index was 85.6%. Since this is the first study to calculate prevalence by Agrawal and Shah modified CAST index, its results cannot be compared with another study. Also, while searching the literature prevalence calculated for the adult Indian population by original CAST index, only one study by Mehta A *et al*.[15] was found, which showed 45.9% of dental caries prevalence, while all other studies calculated prevalence in the pediatric population. But more studies on a large scale are required for validation and reliability of Agrawal and Shah modified CAST index to be used in the Indian population in future.

CONCLUSION

Agrawal and Shah modified CAST index is more applicable in measuring the prevalence and full spectrum of dental caries prevalence in the adult Indian population along with the treatment needs of the population.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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