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Original Article

Prevalence of Dental Caries Among a Group of Egyptian Children Using Caries Assessment Spectrum and Treatment Index: A Cross Sectional Study

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Abstract:

Introduction

Dental caries is a multifactorial disease, it could be environmental, genetic or infectious agent. The infectious agents are represented by the microorganisms that colonize the teeth forming dental plaque that adhere to tooth structure by laying down specific glucans.[1]

The distribution of dental caries differs over the world and within the same country. Dental caries affects more than half of school children. Dental caries distribution also varies according to age, sex, socio economic status, race, geographical location, food habits and oral hygiene practices. Approximately, 2.43 billion people (36% of the population) among the world have dental caries in their permanent teeth. Worldwide, dental caries affects about 620 million people (9% of the population) who have full primary dentition.[2]

Dental indices are numerical values that provide reliable picture about prevalence, incidence and severity of caries in the population on a graduated scale with definite upper and lower limits to permit and facilitate comparison with other populations classified by the same criteria and methods. The ideal requirements of an index are clarity, simplicity, objectivity, validity, reliability, quantifiability, sensitivity and acceptability.[3]

Several caries indices are available starting from DMFT caries index that was developed in 1938,[4] then developed for primary dentition as (def) in 1944 [5], and the 21th century include recent advancement in the caries assessment, starting from Significant Caries Index in 2000,[6] International Caries detection and Assessment System (ICDAS) I, ICDAS II in 2001, Specific Caries Index in 2006,[7] Pulp involvement -

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Ulceration -Fistula-Abscess (PUFA) index in 2010 [8] and recently, Caries Assessment Spectrum and Treatment (CAST) index system in 2011. [9-12]

The development of CAST index was indeed to overcome the difficulties of other indices like, DMFT, ICDAS II and PUFA index systems in epidemiological surveys as results from the use of these indices were difficult to be described in words, figures and tables in a simple and easy-to-read manner.

Caries Assessment Spectrum and Treatment index follows the scoring instructions accompanying the use of the ICDAS II. It saves code 1 and combines codes 2 and 3, and 5 and 6 and saves code 'u' and combines codes 'f' and 'a' of PUFA index in codes 6 and 7. [13]

The word spectrum refers to "the complete range" as it mentions the number of non-cavitated and cavitated lesions; it can also report the consequences of the untreated ones, by recording pulp involvement and the presence of fistula and abscess due to caries. It can be easily converted to DMF due to the incorporation of the 'lost' and 'restored' component. [14]

The literature showed that dental caries prevalence in primary teeth was not assessed using CAST index in Egypt or Africa using CAST index to assess prevalence of caries on primary teeth. CAST index is a new promising index to include all spectrum of caries starting from preventive measures to loss of the teeth and may be the alternative to the WHO approved index in the upcoming years. So, further studies are needed to confirm its usefulness in epidemiological studies in Middle East and Egypt.

Materials and methods

The present study was investigated on 201 child attended the Outpatients' Clinic of both of the Pediatric Dentistry and Dental Public Health Department, Faculty of Dentistry, Cairo University and Pediatric Dentistry Department, Faculty of Dentistry, Misr University for Science and Technology during the period from October 2018 to March 2019, according to the eligible criteria which included all medically free children with primary dentition aging from three to six years old, both genders were included, parental or guardian written acceptance for participation in the study and children verbal acceptance for participation in the study.

Specially designed assessment chart was filled for each patient, the chart consisted of three sections; *first section* included personal history of the patient and his guardian, *second section* included medical history of the patient and the *third section* included dental history and clinical examination, caries scoring and severity according to CAST index. All the primary teeth (the occlusal/incisal part, buccal, lingual/palatal and proximal surfaces) were clinically examined and evaluated using CAST index criteria, scoring of the teeth was done using photographs in previous study as a guide and recorded in the assessment chart, then each tooth was given a code from 0-9 according to its status.[13,14] (Table 1)

If two conditions were present on the same surface, e.g. a filling in one pit and an enamel lesion in another, or an enamel lesion in one pit and a cavity in another, the higher score was recorded.

Children were seated on the dental chair; before the examination the child was asked to rinse the mouth under tap water many times to clean the mouth to remove any food debris. Teeth were properly cleaned using a piece of gauze then clinical examination was done under dental unit light source using sterile diagnostic set, then three documentary photographs were taken (maxillary-mandibular- frontal). After the clinical examination, each child was given two custom made printed sheets, translated into Arabic, explaining his diagnosed caries status and refer for treatment and the second colored poster with the oral hygiene measures needed, how to keep good oral health, and dietary bad habits that should be avoided to prevent future caries occurrence.

- **Sample size Calculation**

Sample size was determined by the Center of Evidence Based at the Faculty of Dentistry, Cairo University based on similar previous study.[11] Convenient sampling method was applied to recruit all eligible candidates in the hospitals in a period of six months.

Statistical analysis

Categorical data were presented as frequencies (n) and percentages (%) and were analyzed utilizing fisher exact test. *p* values were adjusted (*p*-value < 0.05 is considered significant) for multiple comparisons using benforroni correction. Statistical analysis was performed with R statistical analysis software[1] version 3.6.2 for windows.

Results

The 201 included children in the study, 45.27% (91) were males while 54.72% (110) were females with mean age for males and females were (3.99± 0.82) and (4.18± 0.80) respectively, the prevalence of dental caries according to CAST index was calculated and evaluated in the study population as follows: *Code (0-2):*2812 of children' teeth (70%) showed sound and restored teeth. *Code (3-4):* 751 teeth (18.7%) had non cavitated dentine with visual changes in enamel and discoloration in dentine. *Code (5):* 258 teeth (6.4%) had cavitated dentin with intact pulp chamber. *Code (6):* 26 teeth (0.6%) had cavitated dentin involved pulp chamber. *Code (7):* 61 teeth (1.5%) had pus containing swelling. *Code (8*): 112 missed teeth due to caries *(*2.8%). *Code (9*): No teeth did not match with any other categories. (Figure 1)

Regarding distribution of caries in maxillary anterior teeth, maxillary central incisors were the teeth with the highest carious lesions and missing teeth among the anterior teeth in the present study. No missing maxillary canines were recorded in both males and females. All the results were statistically significant. as shown in (Table 2).

In the mandibular anterior teeth, more than half of the teeth were healthy (codes 0-2). No teeth were recorded in codes more than code 5. All the results were statistically significant as shown in (Table 3).

Concerning the maxillary posterior teeth, more than half of the first and second primary molars showed healthy teeth (codes 0-2). The distinct visual change in enamel only or internal caries-related discoloration in dentine (codes 3-4) showed higher percentage in maxillary second molar than in maxillary first molar. The maxillary second molar didn't show any codes more than code 5. All the results were statistically significant (Table 4).

In mandibular posterior teeth, the primary first molars showed higher percentage of caries than second primary molar. No recordings of missing teeth in primary mandibular second molar (code 8). All the results were statistically significant (Table 5).

Discussion

The main idea for dental caries indices is the inclusion of all caries stages into one index without the need to use one index for hard tissue and another for soft tissue changes. The caries assessment systems traditionally used for caries detection in epidemiological surveys don't cover the full spectrum of dental caries from incipient caries to teeth loss. The commonly used DMFT index, identified by WHO, doesn't mention the activity of the caries. Also, ICDAS system is difficult to be applied in epidemiological surveys due to its complexity and time consuming. CAST index is a new index to assess caries prevalence and severity which provides more detailed information about teeth than DMFT index and less complex than ICDAS system. [12-13,15-16]

Study sample was convenient, which is a type of non-probability or non-random sampling where members of the target population that meet certain practical criteria. The examined children were seeking dental care in both educational hospitals during a period of six months from October 2018 to March 2019. [17]

Table 1 : Caries Assessment Spectrum and Treatment(CAST) index

CAST codes characteristics	Code	Description	Concept of Health
Sound	0	No visible evidence of a distinct carious lesion is present	Healthy
Sealant	1	Pits and/or fissures are at least partially covered with a sealant material	
Restored	2	A cavity is restored with an (in)direct restorative material	
Enamel	3	Distinct visual change in enamel only. A clear caries related discoloration is visible, with or without localized enamel breakdown	Reversible Pre-morbidity
Dentin	4	Internal caries-related discoloration in dentine. The discolored dentine is visible through enamel which may or may not exhibit a visible localized breakdown of enamel	Morbidity
	5	Distinct cavitation into dentine. The pulp chamber is intact	
Pulp	6	Involvement of the pulp chamber. Distinct cavitation reaching the pulp chamber or only root fragments are present	Serious morbidity
Abscess/ fistula	7	A pus containing swelling or a pus releasing sinus tract related to a tooth with pulpal involvement	
Lost	8	The tooth has been removed because of dental caries	Mortality
Other	9	Does not correspond to any of the other descriptions	

Table 2: Distribution of dental caries among different types of maxillary primary anterior teeth

CAST code		Upper			*p*-value
		Central (n=402)	**Lateral (n=402)**	**Canine (n=402)**	
(0-2) (n=906)	**n**	245^{Aa}	296^{Ba}	365^{Ca}	**<0.001***
	Teeth %	60.9%	73.6%	90.8%	
(3-4) (n=192)	**n**	96^{Ab}	68^{Bb}	28^{Cb}	**<0.001***
	Teeth %	23.9%	16.9%	7.0%	
(5) (n=65)	**n**	33^{Ac}	25^{Ac}	7^{Bc}	**<0.001***
	Teeth %	8.2%	6.2%	1.7%	
(6) (n=0)	**n**	0	0	0	**——**
	Teeth %	0%	0%	0%	
(7) (n=11)	**n**	6^{Ad}	5^{Ad}	0	**0.763ns**
	Teeth %	1.5%	1.2%	0.0%	
(8) (n=32)	**n**	22^{Ac}	8^{Bd}	2^{Bc}	**<0.001***
	Teeth %	5.5%	2.0%	0.5%	
(9) (n=0)	**n**	0	0	0	**——**
	Teeth %	0%	0%	0%	
***p*-value**		**<0.001***	**<0.001***	**<0.001***	

*Different upper and lowercase superscript letters indicate a statistically significant difference within the same horizontal row and vertical column respectively

Table 3: Distribution of dental caries among different types of mandibular primary anterior teeth according to CAST index in number and percentage

CAST code		Lower			*p*-value
		Central (n=402)	Lateral (n=402)	Canine (n=402)	
(0-2) (n=1098)	n	390^{Aa}	367^{Aa}	341^{Aa}	**0.194**
	Teeth %	97.0%	91.3%	84.8%	
(3-4) (n=99)	n	11^{Ab}	31^{Bb}	57^{Cb}	**<0.001***
	Teeth %	2.7%	7.7%	14.2%	
(5) (n=8)	n	0	4^{Ac}	4^{Ac}	**1.000**
	Teeth %	0.0%	1.0%	1.0%	
(6) (n=0)	n	0	0	0	———
	Teeth %	0.0%	0.0%	0.0%	
(7) (n=1)	n	1^{c}	0	0	———
	Teeth %	0.2%	0.0%	0.0%	
(8) (n=0)	n	0	0	0	
	Teeth %	0.0%	0.0%	0.0%	
(9) (n=0)	n	0	0	0	———
	Teeth %	0.0%	0.0%	0.0%	
p-value		**<0.001***	**<0.001***	**<0.001***	

Statistical analysis was made using fisher exact test. ***p*** values were adjusted for multiple comparisons using benforroni correction.

Different upper and lowercase superscript letters indicate a statistically significant difference within the same horizontal row and vertical column respectively *.

Table 4 : Distribution of dental caries among maxillary primary posterior teeth according to CAST index

CAST code		Upper		*p*-value
		First molar (n=402)	Second molar (n=402)	
(0-2) (n=466)	n	231^{Aa}	235^{Aa}	**0.853**
	Teeth %	57.5%	58.5%	
(3-4) (n=225)	n	89^{Ab}	136^{Bb}	**0.002***
	Teeth %	22.1%	33.8%	
(5) (n=57)	n	31^{Ac}	26^{Ac}	**0.508**
	Teeth %	7.7%	6.5%	
(6) (n=12)	n	7^{Ad}	5^{Ad}	**0.564**
	Teeth %	1.7%	1.2%	
(7) (n=12)	n	12^{d}	0	———
	Teeth %	3.0%	0.0%	
(8) (n=32)	n	32^{c}	0	———
	Teeth %	8.0%	0.0%	
(9) (n=0)	n	0	0	———
	Teeth %	0.0%	0.0%	
p-value		**<0.001***	**<0.001***	

Table 5 : Distribution of dental caries among primary mandibular posterior teeth according to CAST index

CAST code		Lower		*p*-value
		First molar (n=402)	Second molar (n=402)	
(0-2) (n=342)	n	160^{Aa}	182^{Aa}	**0.234**
	Teeth %	39.8%	45.3%	
(3-4) (n=235)	n	105^{Ab}	130^{Ab}	**0.103**
	Teeth %	26.1%	32.3%	
(5) (n=128)	n	72^{Ac}	56^{Ac}	**0.157**
	Teeth %	17.9%	13.9%	
(6) (n=14)	n	8^{Ad}	6^{Ad}	**0.593**
	Teeth %	2.0%	1.5%	
(7) (n=37)	n	20^{Ae}	17^{Ae}	**0.622**
	Teeth %	5.0%	4.2%	
(8) (n=48)	n	37^{Af}	11^{Bde}	**<0.001***
	Teeth %	9.2%	2.7%	
(9) (n=0)	n	0	0	**——**
	Teeth %	0.0%	0.0%	
***p*-value**		**<0.001***	**<0.001***	

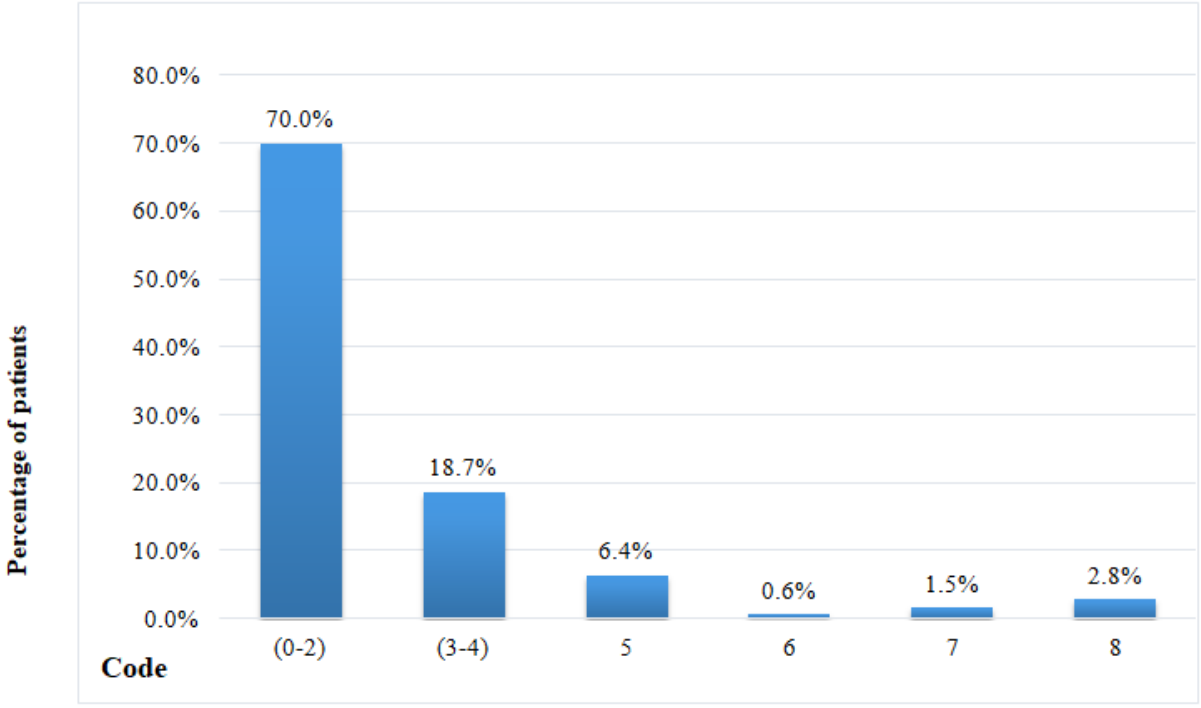

Figure 1: Bar chart showing the prevalence of dental caries among the study population using CAST index in number and percentage

The participants, at the present study, were selected with age ranging from three to six years old to ensure the eruption of all primary teeth only without eruption of any permanent molar (any patient with erupted permanent molars under six years was excluded from the study). Also, to be sure that all primary teeth had erupted before three years old, in order not to affect the accuracy of the study results. [18] Only Egyptian children were included in this study to minimize variables that could affect the results due to different environmental and ethnic factors.[19] Medical compromised children -like children with cerebral palsy and Down syndrome- and uncooperative children were excluded from this study to avoid any change in the accuracy of associated factors like oral hygiene measures which affect dramatically caries prevalence.

Out of the 201 examined children using CAST index, (91) (45.27%) were males and (110) (54.72%) were females with mean age (3.96) and (4.13) years respectively. There was no statistically significant difference between the two groups in CAST codes distribution. This finding was in accordance with similar study[11] and was unlike the findings of another cross sectional study, done in Khulna, that showed that gender might be a factor affecting caries prevalence. [20]

The results of the present study showed that among the whole study population, (2812) (70%) of the children' teeth showed CAST code (0-2) (sound, sealed, restored teeth). This result was in accordance with another study[11] and against other studies [21-23] whom the percentages were lower than the results in current study. The restored tooth is considered a healthy, well-functioning tooth and is therefore positioned at the beginning of the list of codes according to the author of the index.[13]

In the present study, it was noticed that there were no teeth having fissure sealants (code 1) which was similar to a study done before, this may be explained by not adopting preventive measures and focusing on curative modalities in both faculties which may indicate the need of increasing the awareness of sealants importance in prevention of dental caries among the population, especially in Egypt. [24]

Teeth with CAST code 3 (distinct visual change in enamel only or clear caries related discoloration is visible, with or without localized enamel breakdown) which is considered reversible premorbidity, and CAST code 4 (internal caries-related discoloration in dentine and discolored dentine is visible through enamel which may or may not exhibit a visible localized breakdown of enamel) which is considered teeth morbidity, represented (751) (18.7%) of examined teeth which were the most caries lesions in molars. This result agreed with another study [11] and was against another one [15] which was lower**.** Summing up those codes was done according to the previous literature. [15,25-26]

Teeth with CAST code 5 (distinct cavitation into dentine and no (expected) pulp involvement with no history or current complaint of pain were (258) (6.4%) of the examined teeth and (26) (0.6%) of all examined teeth showed CAST code 6 (distinct cavitation into dentine and pulp involvement or only root fragments were present). This percentage was much higher in the study done in ***North Bangalore.***[22] While dentinal carious lesions (code 5(6.4%) and code 6 (0.6%)) were 7%, which was much lower than in another study who combined the both codes together. [15] It must be taken into consideration that it was hard to differentiate between codes 5 and 6 with history of pain only without a radiograph to confirm it. Also, combining both distinct cavity in dentin that

reaching pulp and remaining root fragments into one code was unfair, as tooth with deep cavity can be restored, while remaining root considered non restorable.

The percentage of molars with carious lesions was high, particularly for second primary molars in the mandibular arch followed by the first primary molar, which was similar to some cross sectional studies. [11,27-29] This difference might be due to the anatomy and morphology of primary second molar, its deep fissures and plaque retention due to its position that may lead to difficulty in tooth brushing and more food retention unlike primary first molar which had lesser grooves and fissures. [30]

Maxillary central incisors were the teeth with the highest carious lesions among the anterior teeth in the present study and this was similar to the findings of other studies done. [11,27] The high caries prevalence in these teeth may be due to the direct exposure to food during eating, and pooling of cariogenic fluids around them.[31]

In the current study, the mandibular incisors were almost unaffected (except for the mandibular canines) and that was similar to another study [20] but the percentage was higher when compared with the results of similar study previously done. [11] The reason for these results could be due to the protection by the tongue and the opening of major salivary gland ducts near the mandibular incisors leading to continuous self-washing of the teeth. [31]

Teeth with CAST code 7 (a pus containing swelling or a pus releasing sinus tract related to a tooth with pulpal involvement due to dental caries) represented (61) (1.5%) of the examined teeth, which corresponds to the (pufa) index. This percentage was less than what was reported in other studies [8, 25-26, 32-33] but this percentage was higher than what was revealed in another study. [12]

Teeth with CAST code 8 (tooth removed because of dental caries) represented (112) (2.8%) of all examined teeth, and was most common in the mandibular first molar followed by the maxillary first molar among the posterior teeth, those findings were unlike the results of another study previously done which reported higher percentage in maxillary first molar than mandibular first molar. [24]

Also in this study, in the anterior teeth, primary maxillary central incisor had the highest percentage of missing teeth followed by the maxillary lateral incisor, this disagreed with another study which revealed no missing teeth in study [12].

No teeth were scored with CAST code 9 (teeth that didn't correspond to any of other categories like tooth missed due to trauma). This result was in accordance with some studies. [12,25,34]

Conclusion

The study proved the usefulness of the CAST index in epidemiological surveys. Based on the results of the current study, CAST index can be suggested to be used as an alternative to DMFT index due to its' accuracy in scoring the entire spectrum of dental caries and its' reliability.

Recommendations

Further population based studies are needed to evaluate the prevalence of caries using CAST index in Egyptian children among different age groups. Providing detailed description about CAST index with different codes and pictures to train more about scoring this index. Standardized way is needed to calculate the index to facilitate studies comparison in the future. Increasing the awareness of pediatric dentists about the importance of fissure sealants in primary dentition.

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