ORIGINAL ARTICLE

The severity of untreated caries in the deciduous and permanent teeth among children aged 6-12 years using PUFA and pufa index: a cross-sectional study

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ABSTRACT

Introduction: The PUFA Index and pufa are used to measure the severity of dental and oral condition which are not commonly used due to its novelty, and this index can be used to measure untreated dental caries[7] and caries activity. The aims of study are to assess the severity of untreated caries in children's deciduous and permanent teeth by using the PUFA and pufa index. **Methods:** An observational study using a cross-sectional study design was conducted among children who lived in Puteran village in Pager Ageung district, Tasikmalaya Regent, West Java, Indonesia. Purposive sampling was used, and the children who met the inclusion and exclusion criteria were invited to participate in the study. Severity of caries was assessed using the pufa and PUFA index for deciduous and permanent teeth, respectively. Severity of caries data were analysed using formulas for pufa and PUFA index. **Results:** A total of 206 children participated in the study. The PUFA assessment showed the severity of caries was high in the deciduous dentition with pufa index of 3.5 with SD 1,9-3,6 However, the PUFA assessment showed a relatively lower severity of caries in permanent teeth, with index PUFA of 0.5 with SD 1,9-3,6. The severity of caries was higher in the maxillary than the mandibular teeth in deciduous teeth. On the other hand, the severity of caries was higher in the mandibular than maxillary teeth in the permanent teeth. **Conclusions:** Each child aged 6 and 12 years in Puteran village had severe untreated caries in one permanent tooth and severe untreated caries in 3 to 4 of deciduous teeth. The findings of the study will be used to develop caries prevention and oral health promotion programs.

KEYWORDS
Caries, Severity, Deciduous, Permanent, teeth, PUFA, PUFA index, children

INTRODUCTION

Dental caries is a common oral health disease characterized by demineralization of the tooth's hard tissues, such as enamel, dentin, and cementum, which result in cavitation. Bacteria such as *Streptococcus mutan*, eating habits, oral and oral hygiene, and contact time play important roles in caries formation.[1]

The activity of caries becomes an essential indicator for providing information regarding the prognosis and optimal treatment for this particular stage.[2] Caries severity could highly affect an individual's quality of life.[2,3] Parents and children are aware that dental problems can negatively affect their quality of life.[4] Caries that are left untreated have the potential to cause severe discomfort and illnesses, in addition to significant public health and economic burden.[5]

Children between the ages of 6 and 12 are more susceptible to developing dental caries during the transition of primary and permanent teeth. During this stage, the immune system in the oral cavity is still developing, and the changes in eating habits occur as a part of transition from home to school. Consequently, the risk factors for dental caries become more prominent at this stage.[1,2] A higher prevalence of caries and oral discomfort among children aged 6-12 delays them in obtaining enough nutrition, consequently limiting their academic performance at school. It also increases the number of emergency room visits and incurs high medical costs.[6]

Over the past decades, the DMFT/dmft index has been used widely throughout the world to assess caries experience in the population. A weakness of this index is that it fails to capture the clinical consequences of untreated carious lesions such as pulp involvement and dental sepsis. Deep carious

lesions with pulp involvement are still considered dentin caries and the presence of pulp involvement is not mentioned in the latest edition of the WHO oral health survey.[7]

There is an urgent need to identify a scoring system that measures the clinical consequences of untreated caries lesions. An index that can measure various advanced stages of caries lesions called the PUFA index was identified from the existing literature. This index records the consequences of untreated carious lesions (P-Pulp involvement, U-Ulceration, F-Fistula and A-abscess).[7]

The novelty of this study is that the presentation of data on the number of caries severity will be presented per tooth in both the right and left maxillary teeth and the right and left mandibles, and compare the number of caries severity in each jaw region in children. The PUFA Index and PUFA are used to measure the severity of dental and oral condition[8] which are not commonly used due to its novelty[8], and this index can be used to measure untreated dental caries[7] and caries activities.[9]

There is a limited amount of data regard the clinical consequences of untreated dental caries because there is no measure to evaluate the prevalence and severity of oral condition caused by untreated caries[10], whereas in Indonesia, the prevalence of untreated caries in primary teeth in children aged 1–9 years involved almost half of the population (46.9%)[11], and there are many cases of untreated caries in children aged 6-12 years.[12] This index is frequently linked to the quality of life and is an ideal tool to use within a community or school environment. In addition, PUFA in the primary, or deciduous teeth may be an important indicator for assessing dental caries in permanent teeth.[13]

The study was performed at an Elementary School located in Puteran District, Tasikmalaya, West Java Province, Indonesia. According to the findings of the previous investigation, parents have been provided with information regarding the oral and dental health of their children and the required treatment. [14] The benefit of the examination in this study is to identify potential problems before the development of the symptoms, thus promoting both preventive and therapeutic oral health care for children. [14]

Additionally, for the prevention of oral diseases, the best time to intervene is during childhood for the development of caries prevention and oral health promotion programs. Moreover, this study aims to assess the severity of untreated caries in children's deciduous and permanent teeth by using the PUFA and pufa index.

METHODS

An observational study using a cross-sectional study design[15] was conducted among children who lived in Puteran village in Pager Ageung district, Tasikmalaya Regent, West Java, Indonesia. Purposive sampling was used, and children who fulfilled the inclusion and exclusion criteria were invited to participate in the study.

The inclusion criteria are children aged 6 -12 years and are not in a state of illness. Exclusion criteria were applied to the children who were neither willing to participate nor complete the study. A total of 206 children who participated in the study met the inclusion criteria.

The study variables are the severity of dental caries, which are assessed using the PUFA and PUFA index for deciduous and permanent teeth, respectively. The severity of dental caries in the deciduous and permanent teeth of children aged 6-12 years was assessed using P/p: Pulpal involvement, U/u: Ulceration, F /f: Fistula, and A/ a: Abscess. Untreated dental caries were assessed using the PUFA and PUFA index for deciduous and permanent teeth, respectively.[7]

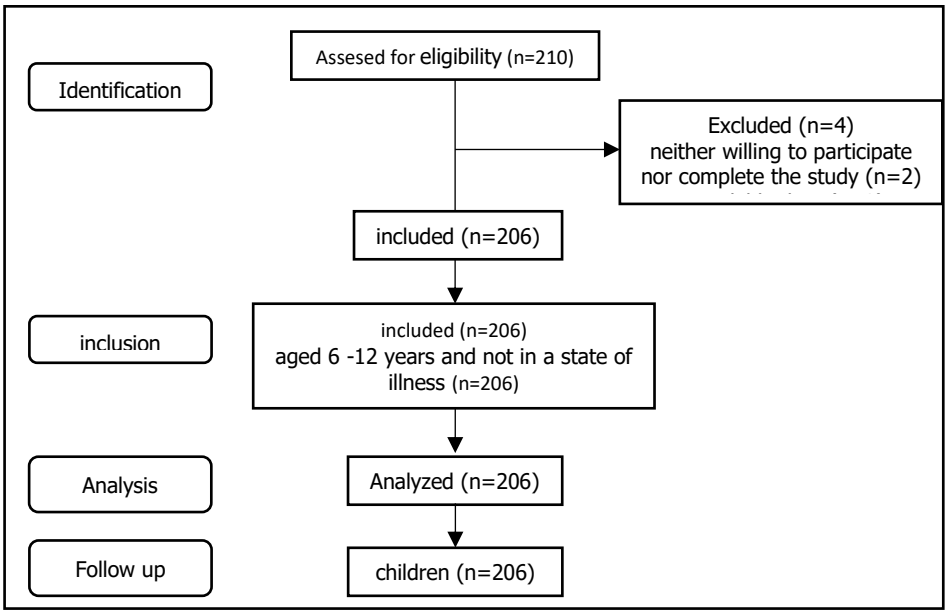

Figure 1. Strobe flowchart

Calibration training for data collector or examiner was conducted using kappa statistic, as an effort to address potential sources of bias, with a kappa value of 0.81. The value ranged from 0.80 to 0.90, which was classified as a strong level of agreement.[16]

Data collection of variables was carried out using Cognito, an electronic application, in Puteran village in Pager Ageung district, Tasikmalaya Regent, West Java, Indonesia, in November 2022. The severity of caries data was analysed using the PUFA formulas and the PUFA index, and it is presented in the table of frequency distribution. In this study, parental informed consent was obtained, and all research subjects were approved for the examination after being provided with research information.

RESULTS

A total of 206 out of 210 children who met the study inclusion criteria participated in the study. The characteristics of the study sample are presented in Table 1.

Table 1. Characteristics of Respondents (n=206)

Variable	F	%
Gender		
Male	113	54.9
Female	93	45.1
Address		
Puteran	206	100
Age (years)		
6	3	1.5
7	10	4.9
8	34	16.5
9	21	10.2
10	36	17.5
11	46	22.3
12	31	15
13	25	12.1
Parent's Occupation		
Doctor	1	0.5
Lecturer	29	13.8
Teacher	1	0.5
Housewife	1	0.5
Private Employee	12	5.7
School Principal	14	6.7
Civil servant	24	11.4
Police	7	3.3
Self-employed	18	8.6
Not Employed	103	49.0
The Position of Child in the Family		
1st child	81	38.6
2st child	64	31.9
3st child	42	20.5
4st child	12	4.8
5st child	4	2.4
6st child	1	1.0
9st child	1	0.5
10st child	1	0.5
School origin		
SDN Puteran 1	81	41.0
SDN Puteran 2	117	55.7
SDN Sirnagalih	8	3.3
Class		
class 1	42	20.0
class 2	20	9.5
class 3	36	17.6
class 4	50	23.3
class 5	30	14.8
class 6	28	14.8

Table 1 displays the study samples, where males were higher in number than the female samples, are all confirmed to be present in Puteran district. Eleven years old is the oldest age group represented in the Table, while fourth grade is the most prevalent. The majority of the samples come from elementary schools. The majority are the first or second-born children of unemployed parents.

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Table 2. Caries Severity of Primary Teeth

Caries severity	Right maxillary teeth					
	55	**54**	**53**	**52**	**51**	**Total**
p	59	50	39	20	21	189
u	0	0	0	1	0	1
f	1	3	1	0	0	5
a	3	0	0	0	0	3
Total	63	53	40	21	21	198
Caries severity	**Left Maxillary Teeth**					
	61	**62**	**63**	**64**	**65**	**Total**
p	18	19	38	46	52	173
u	0	1	0	1	1	3
f	0	0	2	2	1	5
a	0	0	0	0	1	1
Total	18	20	40	49	55	182
Caries severity	**Left Mandibular teeth**					
	75	**74**	**73**	**72**	**71**	**Total**
p	78	61	25	2	1	167
u	4	1	0	0	0	5
f	1	0	0	0	0	1
a	1	1	2	1	0	5
Total	84	63	25	3	1	176
Caries severity	**Right Mandibular teeth**					
	81	**82**	**83**	**84**	**85**	**Total**
p	0	1	16	57	83	157
u	0	0	0	0	1	1
f	0	0	0	1	2	3
a	0	0	0	2	1	3
Total	0	1	16	60	87	164

The caries severity in the deciduous teeth is shown in Table 2. Caries severity is higher in the lower mandible than the upper maxillary teeth. The lower right mandible, lower left mandible, left maxilla, and right maxilla are the areas with the highest level of caries severity..

Table 3. Caries Severity of Permanent teeth

Caries Severity	Right maxillary teeth								
	18	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**Total**
P	0	0	5	0	0	0	2	2	9
U	0	0	0	0	0	0	0	0	0
F	0	0	1	0	0	0	0	0	1
A	0	0	0	0	0	0	0	0	0
Total	0	0	6	0	0	0	2	2	10
Caries Severity	**Left Maxillary Teeth**								
	21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**Total**
P	2	1	1	1	1	6	0	0	12
U	1	0	0	0	0	0	0	0	1
F	0	0	0	0	0	0	0	0	0
A	0	0	0	1	1	0	0	0	2
Total	3	0	0	0	2	6	0	0	11
Caries Severity	**Left Mandibular teeth**								
	38	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**Total**
P	1	0	24	2	0	0	2	2	31
U	0	0	0	0	0	1	1	1	3
F	0	0	0	0	0	0	0	0	0
A	0	0	2	0	0	0	0	0	2
Total	1	0	26	2	0	1	3	3	36
Caries Severity	**Right Mandibular teeth**								
	41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**Total**
P	2	2	1	1	0	32	0	0	38
U	0	0	0	0	0	1	0	0	1
F	0	0	0	1	0	0	0	0	1
A	0	0	0	0	0	1	0	0	1
Total	2	2	1	2	0	34	0	0	41

Table 3 displays the severity of caries in permanent teeth. The severity of caries in permanent teeth is higher in the upper jaw compared to the lower jaw. The severity of caries in permanent teeth is highest in the right upper jaw, then the left upper jaw and followed by the left lower jaw and right lower jaw

Table 4. Severity of Caries

Region	PUFA	pufa
Right Maxilary teeth	10	198
Left Maxilary teeth	11	182
Right Mandibular teeth	36	176
Left Mandibular teeth	41	164
Total	**98**	**720**

Table 4 depicts the comparative severity of caries between deciduous and permanent teeth.

Table 5. Index Calculation Severity of Caries

Index Calculation Severity of Caries Permanent Teeth				Index Calculation Severity of Caries Deciduous teeth			
PUFA	**n**	**Index**	**SD**	**pufa**	**n**	**Index**	**SD**
98	206	0,5	1,9-3,6	720	206	3,5	1,9-3,6

Table 5 shows a caries severity index in permanent teeth of 0.5 and caries severity index in primary teeth of 3.5

DISCUSSION

In respondents aged 6–12 years, the deciduous teeth of the lower right mandible exhibit more severe caries than those of the upper jaw, as shown in Table 1. Meanwhile, the highest number of dental caries is found in the upper right jaw. The level of caries severity in primary teeth is higher than that in permanent teeth, with a primary tooth caries index of 3.5 and a permanent tooth caries index of 0.5.

The aforementioned condition of the dental caries severity found in children aged 6-12 years is in line with a study by Doichinova[15]. His study discovered that children aged 6-12 years had a low consumption of caries-protective food and a high consumption of caries-induced food. Excessive consumption of sugar is believed to contribute to the development of dental caries in children.[16] This finding indicates that medical professionals play an important role in providing education or consultation regarding eating habits to prevent dental caries and reduce the development of the disease. Following diagnostic assessments of the children's eating habits, the children should be given some specific recommendations on what they should or should not consume. A school program that is similar to one in the European program called 'School of Fruit', which offers a healthy diet for the students of primary school and kindergarten, has to be encouraged.[17]

As illustrated in Table 2, the severity of the caries is mostly found in the lower jaw, specifically on the right, rather than in the upper jaw. This finding is in agreement with a study by Macek et al.[18], which indicated that the caries distribution is higher in the lower jaw than in the upper jaw. Furthermore, according to Table 3, the severity of caries in permanent teeth was more common in the upper jaw than in the lower jaw. This finding contradicts the result of Dermici et al. [18] who found that the upper jaw exhibited a bigger distribution of caries compared to the lower jaw. The presence of these inconsistent findings could be due to the complex morphology of the tooth surface and the difficulty of accessing the area to maintain effective oral hygiene.[19]

The level of caries severity, which is higher in primary teeth, is shown in Table 4. This finding is in accordance with a study by Obradovic et al., which discovered that the severity of dental caries in primary teeth was higher than that in permanent teeth.[20] According to prior investigations, this condition might occur due to the significant correlation between the age of the children and the development of caries. [21–23]

Dental caries in children is a chronic condition that is common and could potentially affect the child's quality of life. Dental caries has been a public health problem whose etiology is reflected in the children's eating habits, the type of tooth brush, and socioeconomic indicators [25,26]. In terms of socioeconomic status, there is evidence that the prevalence of dental caries is higher among children from lower-income [25], or poorly educated families. Thus, these aspects may affect the parents' perceptions of their children's oral and dental health. They may be the results of the parents' limited knowledge of factors that contribute to caries development and treatment and their limited access to healthcare providers. [25,26]

Table 5 shows that the caries severity index in deciduous teeth is 3.5. This result is in the same value range as Smadi's research, which is 2.3–4.4.[27] The caries severity index of permanent teeth is 0.5. This result is in the same value range as Smadi's research, which ranges from 0.4 to 1.8. [27] The index value indicates that a child with severe caries has four to five primary teeth affected, whereas the index value of the child's permanent teeth indicates that only one tooth was impacted. The results of this study suggest that social deprivation, unhealthy behaviours, and socioeconomic status are associated with the moderate to severe progression of caries among children of school age. Conducting a study into this particular demographic is of the highest priority, given that the early onset of caries could potentially worsen the oral health prognosis of adolescents.[28]

The children's quality of life could be greatly affected by untreated caries. Furthermore, the correlation between untreated caries and underweight cases among primary school children in low-income countries emphasizes the importance of integrated dental and oral health policy with social policy, [30] as health promotion programs. Promoting oral health and demonstrating good oral health practices are top priorities, so that parents and others can understand and appreciate the importance of oral health and the prevention of oral diseases. A collaborative effort involving parents, dentists, dental hygienists, and other health professionals; childcare and early education providers; and other community members who value children's health is most effective in promoting the significance of good oral hygiene in children.[31,32]

By employing a collaborative approach, it is possible to effectively introduce, reinforce, and demonstrate healthy behaviours. These behaviours may include limiting the consumption of sugary food and drink, maintaining a healthy diet, and brushing teeth twice daily with fluoride toothpaste. Ensuring that children visit the dentist regularly and, when necessary, for treatment, is an additional vital measure in maintaining healthy oral.[31,32]

The limitations of this study were we did not use statistical tests to asses differences in the finding because the variables being compared, namely the severity of caries in permanent teeth and primary teeth at the age of 6-12 years, came from the same respondents. The number of permanent and primary teeth was not comparable.

CONCLUSION

Each child aged 6 and 12 years in Puteran village had severe untreated caries in one permanent tooth and severe untreated caries in 3 to 4 deciduous teeth. The findings of the study will be used to develop prevention and promotion programs in regards to dental caries. The study result for this specific target demographic is essential because early development of caries may have serious implications for the prognosis of an adult's oral health.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study

Data Availability Statement: Data is unavailable due to privacy or ethical r-strictions, a statement is still required.

Conflicts of Interest: The authors declare no conflict of interest.

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