

Prevalence of Early Childhood Caries (ECC) in Children Aged 2–6 years in the Highlands and Lowlands of West Java

Maharani Alike Sofian¹, Asty Samiaty Setiawan², Ardena Maulidia Hamdani², Naninda Berliana Pratidina³, Anne Agustina Suwargiani²

¹Undergraduate Programme in Dentistry, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia;

²Department of Dental Public Health, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia; ³Department of Pediatric Dentistry, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia

Correspondence: Asty Samiaty Setiawan, Email asty.setiawan@unpad.ac.id



Background: Early Childhood Caries (ECC) is a major dental health issue that affects children worldwide. The prevalence of ECC can vary between regions, and understanding these differences is essential for targeted public health interventions. This study aimed to compare the prevalence of ECC in children aged 2–6 years from the highland and lowland areas of West Java.

Methods: The research method used a cross-sectional study. Data collection was conducted in Rancabali District, Bandung Regency as a highland with an altitude of 1600 masl and Cijulang District, Pangandaran Regency as a lowland with an altitude of 30 masl. Sampling was determined using purposive sampling technique with a total sample of 201 children consisting of 98 children in the highlands and 103 children in the lowlands. Data were analysed using the Chi-Square test.

Results: The prevalence of early childhood caries in children aged 2–6 years in Bandung Regency was 91.8% with a mean def-t index of 10.03 and in children aged 2–6 years in Pangandaran Regency was 96.1% with a mean def-t index of 10.74. The mean value of the def-t index in both regions is in the very high category according to WHO. Chi-square test results with a p-value >0.05, namely 0.201, showed that there was no significant difference between the prevalence of ECC in children aged 2–6 years in Bandung Regency and Pangandaran Regency.

Conclusion: There is no difference in the prevalence of early childhood caries in children aged 2–6 years in the highlands and lowlands of West Java.

Keywords: early childhood caries, ECC, highlands, lowlands, prevalence

Introduction

Oral health plays a crucial role in each human's quality of life, especially for the children who are in their growing phase. *Early Childhood Caries* (ECC) is one of the most common diseases in children.¹ ECC is a condition in which one or more forms of primary tooth decay occur in children under the age of six, in the form of tooth lesions (whether cavities or not), tooth loss due to caries, or tooth surfaces that have been filled.² ECC is a preventable disease, its prevalence is still relatively high at the global level. Based on World Health Organization (WHO) data it reaches 60–90%.³ Results from the 2018 Basic Health Research (Riskesmas) showed that the prevalence of ECC in five-year-old children in Indonesia reached 90.2%.⁴ This is not in accordance with the FDI target of 50% to have 5–6 years old children free from dental caries. The rate of damaged, decayed or diseased teeth in West Java is 45.7%, including children.⁴

A decay in children's primary teeth can affect their general health, facial development, and self-confidence. ECC may cause speech, sleep and eating disorders, loss of primary teeth, malocclusion, and even more serious problems later on their adult life.⁵ Children with dental caries tend to have a lower quality of life than those without.⁶ ECC is influenced by various factors including family social and economic background, parents' education level, access to dental

health services, and dietary habit.⁷ Different food availability and dietary habits in each region can cause different caries risks. Geographical conditions in coastal or lowland areas tend to consume more animal protein, especially seafood such as fish. Mountainous or highland areas tend to consume more vegetable protein such as tofu, tempeh, and beans. However, the infrastructure development eases the availability of various types of food regardless it comes from highland or lowland areas.⁸ Similar research conducted by Iswanto et al in 2016 showed that caries status in 13–15 years old children in mountainous areas was considered high, while in coastal areas it was low even the fluorine levels in well water were almost the same.⁹ Caries status in highland areas may be higher, lower, or even the same as caries status in lowland areas due to many influencing factors.

The high prevalence of caries in children, the possibility of caries status differences due to various factors, and the limited research available on caries in the highlands and lowlands encouraged the writer to conduct research on prevalence differences of ECC in 2–6 years old children in highlands and lowlands of West Java. The age range of 2–6 years old was chosen as the subject of the examination because the child's primary teeth have already completed, totaling 20. Furthermore, interviews were conducted with the parents to add research information regarding children's habits and dietary habit. This study aims to reveal the prevalence of ECC in Bandung Regency and Pangandaran Regency and expected to guide the development of targeted dental health programs to the unique needs of each area, ultimately improving the oral health and children's quality of life of in West Java.

Materials and Methods

The method used in the study was observational analytic with a cross-sectional research design. This study provides information on prevalence differences of ECC in highland and lowland areas. Before conducting data collection, calibration was carried out with a team of examiners to maintain the validity and reliability of the data. The ICC (Intraclass Correlation Coefficient) value obtained was 0.87. Data collection was conducted in November 2023 in Rancabali District, Bandung Regency as a highland with an altitude of 1600 meters above sea level and Cijulang District, Pangandaran Regency as a lowland with an altitude of 30 meters above sea level. The sample was determined using purposive sampling technique with a total sample of 201 children consisting of 98 children in Bandung Regency and 103 children in Pangandaran Regency. Participating samples have been given an explanation of the research and declared their consent to become subjects in the study.

Data collection was carried out by direct dental examination to the samples. Data collection was conducted after the parents or legal guardians have given their consent after explaining what will be done to the child during the study. Data on children who experienced ECC was recorded using the def-t (decayed, extracted, filling-tooth) caries index. The def-t index is known by summing the d, e, and f values. The letter d in def-t is decayed teeth or primary teeth that are carious, have cavities, including teeth that have been restored, but have secondary caries. The letter e in def-t indicates extracted teeth for caries reasons. The letter f in def-t indicates filled or restored teeth without secondary caries.¹⁰ The def-t index can indicate the severity of ECC based on the classification of the average def-t index according to WHO, namely very low: 0.0–1.1; low: 1.2–2.6; moderate: 2.7–4.4; high: 4.5–6.5; and very high: >6.6.¹¹ In addition, interviews were also conducted with parents or guardians regarding children's dietary habit in each region as additional information in the discussion. In addition to the def-t index, ECC can be classified based on its type by Wyne as shown in Table 1.¹²

Caries examination data in the form of def-t index was processed descriptively then grouped into nominal data of ECC and not ECC. The nominal data was processed to determine the prevalence of ECC in each region. The Chi-Square test was used to analyze the data in determining the existence of prevalence difference in ECC. The results of interviews conducted with parents were processed descriptively to determine the habits and dietary habit of children. Data processing and analysis were carried out using Microsoft Word, Microsoft Excel, and IBM Statistical Program for Social Science (SPSS) 20 software.

Results

The study was conducted on 201 research samples consisting of 98 children in Rancabali District, Bandung Regency and 103 children in Cijulang District, Pangandaran Regency with an age range of 2–6 years old.

Table 1 ECC Classification by Wyne

Category	Carious Lesion Characteristics	Etiology
Type I Mild to moderate	Isolated carious lesions involving incisors and/or molars.	Combination of semisolid/solid diet and lack of oral hygiene.
Type II Moderate to severe	Lesions are seen on the labial/lingual surfaces of the maxillary central incisive teeth. Caries on the molars may or may not occur according to the child's age and extent of disease. The mandibular incisive tooth is not infected.	Due to inappropriate bottle use or incorrect breastfeeding, with or without poor oral hygiene.
Type III Severe or extreme	Carious lesions affect almost all primary teeth.	Due to a combination of cariogenic foods and poor oral hygiene.

Notes: Adapted from Goswami P. Early Childhood Caries- A Review of Its Aetiology, Classification, Consequences, Prevention and Management. *J Evol Med Dent Sci.* 2020;9(10):798–803. Creative Commons.¹²

The sample obtained amounted to 201 children with the characteristics presented in Table 2. The sample was selected based on purposive sampling technique with inclusion criteria that have been determined in the study. Table 2 shows the distribution of sample characteristics based on gender and age of the children. The majority of the samples in the highlands were female, 50 children (51%) with the majority age of 4 years old, 33 children (33.7%). The majority of samples in the lowlands were male, 53 children (51%) with the majority age of 5 years old (68.9%).

Dental examinations were performed using the def-t index calculation, the results of which are presented in Table 3. The mean value of the def-t index with a score of 983 in 98 children in the highland area is 10.03, meaning that there are 10 teeth that have damage, loss, and/or fillings related to caries in each child in Bandung Regency. The mean value of the

Table 2 Distribution of Sample Characteristics

Characteristics	Highlands		Lowlands	
	n	%	n	%
Gender				
Female	50	51	50	49
Male	48	49	53	51
Total	98	100	103	100
Age (years)				
2	4	4.1	1	1.0
3	21	21.4	4	3.9
4	33	33.7	21	20.4
5	28	28.6	71	68.9
6	12	12.2	6	5.8
Total	98	100	103	100

Table 3 Def-t Index and Categories According to WHO

Group	Number of Subjects	d	e	f	def-t	Category
Highlands	98	895	88	0	10.03	Very high
Lowlands	103	951	155	1	10.74	Very high

def-t index with a score of 1107 in 103 children in the lowland area is 10.74, meaning that there are 10 teeth that have caries-related decay, loss, and/or fillings in each child in Pangandaran Regency.

Table 4 shows the distribution of ECC types in highland and lowland areas. The types of ECC experienced by children in the highland area are 7 children (7.8%) including ECC type I, 43 children (47.8%) including ECC type II, and 40 children (44.4%) including ECC type III. The types of ECC experienced by children in lowland areas are 11 children (11.1%) including ECC type I, 46 children (46.5%) including ECC type II, and 42 children (42.4%) including ECC type III.

Table 5 shows the distribution of ECC types by age. Type I ECC is most often experienced by children aged 4 years, type II is most often experienced by children aged 4–5 years, and type III is most often experienced by children aged 5 years in highland areas. Lowland areas show that ECC type I is most often experienced by children aged 5 years, type II is most often experienced by children aged 5 years, and type III is most often experienced by children aged 5 years.

Table 6 shows the prevalence of ECC in highland and lowland areas. In the highland area, a total of 90 children (91.8%) experienced ECC and 8 children (8.2%) did not experience ECC. As in the lowlands, 104 children (96.3%) experienced ECC and 4 children (3.7%) did not experience ECC. The Chi-square test in this study resulted in a *p*-value of 0.201 ($p > 0.05$).

Table 4 ECC Types in Highland and Lowland Areas

ECC Type	Highlands		Lowlands		Total	
	n	%	n	%	n	%
ECC Type I	7	7.8	11	11.1	18	9.5
ECC Type II	43	47.8	46	46.5	89	47.1
ECC Type III	40	44.4	42	42.4	82	43.4
Total	90	100	99	100	189	100

Table 5 Distribution of ECC Type by Ages

Age	Highlands			Lowlands		
	Type I	Type II	Type III	Type I	Type II	Type III
2	0	1	2	1	0	0
3	2	9	8	2	1	0
4	3	15	11	1	12	9
5	1	15	12	7	31	29
6	1	3	7	0	2	4
Total	7	43	40	11	46	42

Table 6 Prevalence of ECC in Highland and Lowland Areas

Prevalence of ECC	Highlands		Lowlands		P
	n	%	n	%	
Yes	90	91.8	99	96.1	0.201
No	8	8.2	4	3.9	
Total	98	100	103	100	

Table 7 Distribution of Children's Sweet Food Consumption in Highland and Lowland Areas

Category	Highlands		Lowlands	
	n	%	n	%
Rarely or never (≤ 1 per week)	20	24	24	24.7
1–3 times per day	38	45.8	52	53.6
≥ 4 times per day	12	14.5	17	17.5
Unknown	13	15.7	4	4.2
Total	83	100	97	100

Table 7 shows the frequency of sweet food consumption among children as reported by parents in highland and lowland areas. In the highland area, 20 parents (24%) reported that their children rarely or never consumed sweet foods (≤ 1 per week), 38 parents (45.8%) reported consumption of 1–3 times per day, and 12 parents (14.5%) reported consumption of ≥ 4 times per day. Additionally, 13 parents (15.7%) selected “unknown”. In the lowland area, 24 parents (24.7%) reported that their children rarely or never consumed sweet foods (≤ 1 per week), 52 parents (53.6%) reported consumption of 1–3 times per day, and 17 parents (17.5%) reported consumption of ≥ 4 times per day. Only 4 parents (4.2%) selected “unknown.”

Discussion

ECC is an oral health problem that often occurs in children. Children with ECC have a lower quality of life because ECC causes interference with speech, sleep, eating, and even other health problems that affect the growth and development of children.⁵ ECC is a multifactorial disease or a disease caused by various factors, one of which is diet which is known to be closely related to the occurrence of ECC.^{13,14} The habit of children who tend to eat sweet foods or snacking makes the risk of caries higher.¹³ This is in accordance with a report written by Butera et al that foods that are considered cariogenic such as sugar, sweet drinks, packaged snacks, chocolate, candy, and even other packaged foods that are considered not to contain sugar actually have a high sugar content and are related to the occurrence of caries in children. In addition, enamel hypoplasia, tooth brushing difficulties, caregiver influence, low income, and low education level are also influential.¹⁵ This study was an observational analytic study conducted by examining children's teeth in the highland and lowland areas of West Java and interviewing several parents or guardians. The highland study was conducted in Rancabali District, Bandung Regency with an altitude of about 1600 meters above sea level. The lowland research was conducted in Cijulang Subdistrict, Pangandaran Regency with an altitude of about 30 meters above sea level. Both the highland and lowland sample groups fall into the category of very high ECC incidence according to WHO because they have a mean def-t index value of more than 6.6 presented in Table 3. The mean def-t index of the two groups had values that were not much different. The very high index value indicates that ECC is easy to occur in children in both highland and lowland areas.

Data on the classification of ECC types according to Wyne are presented in Table 4. Type I or *mild to moderate* ECC is a condition of isolated carious lesions involving incisors and/or molars. Type II or *moderate to severe* ECC is a condition where lesions are seen on the labial/lingual surfaces of the maxillary central incisive teeth, caries on the molars may or may not occur according to the age of the child and the level of disease, and the mandibular incisive teeth are not infected. Type III or *severe* ECC is a carious lesion affecting almost all primary teeth, including mandibular incisors.¹² Examination of ECC in children in the highland area showed that 7 children had Type I ECC, 43 children had Type II ECC, and 40 children had Type III ECC. The types of ECC experienced by children in lowland areas are 11 children including ECC type I, 46 children including ECC type II, and 42 children including ECC type III. The difference in the type of ECC experienced by children occurs according to the cause. Type I occurred due to a combination of semisolid/solid diet and lack of oral hygiene. Type II occurs due to inappropriate bottle feeding or incorrect breastfeeding, with or without poor oral hygiene. Type III occurs due to a combination of cariogenic foods and poor oral hygiene.¹² The majority of children examined in Bandung and Pangandaran districts belonged to type II, according to the results of interviews with several parents regarding bottle-feeding until the age of more than 2 years and incorrect tooth brushing

time. The data in Table 5 shows that the severity of dental caries in children can increase with age. This can happen for several reasons, such as children get older, they may be exposed to foods and drinks that contain sugar and acid for longer and more often. Prolonged exposure to sugar and acids can increase the risk of caries. In addition, older children may receive less attention or assistance in maintaining their dental health because parents assume that children can brush their teeth on their own.

The data on differences in the prevalence of ECC among children in the highland and lowland areas of West Java are presented in Table 6. The chi-square test in this study resulted in a p -value of 0.201 (p value > 0.05) so there is not enough evidence to reject the null hypothesis at the predetermined significance level. This shows that statistically, there is no significant difference in the prevalence of ECC in children aged 2–6 years in the highland and lowland areas of West Java. This is because dental caries is not only dependent on one factor, but also related to the availability of access to oral care services, children's nutritional status, maternal knowledge, consumption of sweet foods, and others.¹⁶ The protein diet in children in Pangandaran Regency consumes sea fish, shrimp, and squid, while the percentage of consumption of these foods in children in Bandung Regency is less. The difference in vegetable consumption is that the percentage of children who consume vegetables and green beans in Bandung Regency tends to be higher than children in Pangandaran Regency. This description is in accordance with research conducted previously by Hamidah et al in 2017, namely that there are differences in the amount of consumption of animal and vegetable protein sources in highland and lowland areas.⁸ However, both highlands and lowlands consume other animal proteins such as fresh fish, chicken, chicken eggs, and beef as well as vegetable proteins such as tofu and tempeh. This is because based on observations, the infrastructure in both regions is good, making access to food easier.

Diet, especially in terms of the frequency of consumption of sweet foods, plays a significant role in influencing the occurrence of caries in children.¹⁷ The interview results show that children in both highland and lowland areas tend to consume sweet or snacking foods such as candy, cakes, donuts, and ice cream, at least once a day presented in Table 7. This finding underscores a shared dietary pattern across both regions, which may contribute to the high prevalence of ECC observed in these populations. In accordance with research conducted by Utami et al in 2019, namely the higher the consumption of cariogenic foods such as sweet foods, the higher the possibility of caries with a high def-t index.¹⁸ Seven research articles are in accordance with the statement of food consumption that can cause the formation of dental caries in children are foods that are high in sugar, high in carbohydrates, and sugary drinks.¹⁹ This study indicates the importance of paying attention to diet, especially in terms of sweet food intake as a factor contributing to the condition of tooth decay in children aged 2–6 years in both highland and lowland areas. The frequent intake of sugar-rich foods, known to be a major risk factor for caries, highlights the need for targeted nutritional interventions. The limitation of this study is that it did not look at the relationship of other factors such as social and economic status, level of parental knowledge, access to dental health services, salivary levels, and others that have a possible relationship with the prevalence of ECC. This causes other possibilities of research results cannot be analyzed more deeply. Suggestions for further research are to analyze the relationship between the prevalence of ECC and other factors, so that more specific prevention and resolution steps can be known.

Conclusion

According to this research, it can be concluded that the occurrence of caries in highland and lowland children is very high. It is based on the high mean value of the def-t index. Type II ECC was most common in both regions, with caries severity increasing with age due to poor oral hygiene and dietary habits. There is no significant difference in the prevalence of ECC in 2–6 years old children in the highlands and lowlands of West Java.

Ethics Approval and Consent to Participate

This research is conducted in accordance with the ethical principles of research set out in the Declaration of Helsinki by reference to the fundamental principles of respect for individual self-determination and the right to make informed decisions. This study has been approved by the Research Ethics Commission of Padjadjaran University with letter number 1387/UN6.KEP/EC/2023.

Acknowledgments

We are grateful to Himpaudi and IGTKI Cijulang Subdistrict, Pangandaran Regency, the Village Head and Posyandu Cadres of Rancabali Subdistrict, and Bandung Regency for giving the writer permission carrying the research by conducting oral examination to children and interviews to parents.

Funding

This research received an Internal Research Grant Universitas Padjadjaran by Directorate of Research and Community Engagement Universitas Padjadjaran (Grant No. 1549/UN6.3.1/PT.00/2023).

Disclosure

The authors report no conflicts of interest in this work.

References

1. Elfari RN, Susilawati S, Suwargiani AA. Oral health related to the quality of life of children aged 4-5-years-old in Cilayung Village. *J Kedokt Gigi Univ Padjadjaran*. 2018;30(2):85. doi:10.24198/jkg.v30i3.18509
2. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. In: *The Reference Manual of Pediatric Dentistry*. American Academy of Pediatric Dentistry: Chicago; 2020; Vol. 40:1.
3. WHO. WHO expert consultation on public health interventions against early childhood caries: report of a meeting, Bangkok, Thailand, 2016, Rep A Meet - Bangkok, Thailand, 2016.
4. RI KK National Riskesdas 2018 Report [Internet]. Balitbangkes Publishing House. Jakarta; 2018.
5. Astuti EY. Etiology, Impact and Management of Early Childhood Caries (Ecc). *Interdental J Dentistry*. 2020;16(2):57–60. doi:10.46862/interdental.v16i2.1297
6. de Lima SL, Santana CCP, Paschoal MAB, Paiva SM, Ferreira MC. Impact of untreated dental caries on the quality of life of Brazilian children: a population-based study. *Int J Paediatr Dent*. 2018;28(4):390–399. doi:10.1111/ipd.12365
7. Anil S, Anand PS. Early childhood caries: prevalence, risk factors, and prevention. *Front Pediatr*. 2017;5(July):1–7. doi:10.3389/fped.2017.00157
8. Hamidah S, Sartono A, Kusuma HS. Differences in Consumption Patterns of Protein Source Foods in Coastal, Lowland and Highland Areas. *J Nutrition*. 2017;3(1):21–28.
9. Iswanto L, Posangi J, Mintjelaskan CN. Profile of caries status in children aged 13-15 years and fluorine content of well water in coastal and mountainous areas. *e-GIGI*. 2016;4(2):1.
10. Jain M, Namdev R, Bodh M, Dutta S, Singhal P, Kumar A. Social and Behavioral Determinants for Early Childhood Caries among Preschool Children in India. *J Dent Res Dent Clin Dent Prospects*. 2015;9(2):115–120. doi:10.15171/joddd.2014.023
11. Amri UH, Nismal H. Effect of Breastfeeding Duration Towards def-t Index of 2-3 Years Old in Posyandu Puskesmas. *Andalas Dent J*. 2016;4(1):39–45. doi:10.25077/adj.v4i1.47
12. Goswami P. Early Childhood Caries- A Review of Its Aetiology, Classification, Consequences, Prevention and Management. *J Evol Med Dent Sci*. 2020;9(10):798–803. doi:10.14260/jemds/2020/173
13. Suherlan MAP, Suwargiani AA, Wihardja R. Early childhood caries and dietary habit of 4-6 years old children. *Padjadjaran Journal of Dental Researchers and Students*. 2023;7(1):6. doi:10.24198/pjdrs.v7i1.37682
14. Heymann HO, Swift Jr EJ, Ritter AV. *Sturdevant's Art and Science of Operative Dentistry*. Elsevier. 2019.
15. Butera A, Maiorani C, Morandini A, et al. Evaluation of Children Caries Risk Factors: a Narrative Review of Nutritional Aspects, Oral Hygiene Habits, and Bacterial Alterations. *Children*. 2022;9(2):262. doi:10.3390/children9020262
16. Suwargiani AA, Yubiliana G, Putri FM. Correlation of oral hygiene status with caries experience of permanent and primary teeth in children aged 11-12 years: a cross-sectional study. *J Dentistry Padjadjaran University*. 2023;35(1):73.
17. Luz S, Botton G, de Rocha RO, Oliveira MDM, Ortiz FR. Early Childhood Caries and sugar: relationships and suggestions for prevention. *RGO - Rev Gaúcha Odontol*. 2021;69:1–7. doi:10.1590/1981-863720210005520200027
18. Utami S, Pinastika R, Astuti NR, Adiningrat A. The Overview of Eating Patterns and Dental Caries Status of the Community of Pendul, Argorejo, Bantul Yogyakarta. *Incisiva Dent J Maj Kedokt Gigi Insisiva*. 2023;12(1):1–6. doi:10.18196/di.v12i1.14749
19. Daud S, Said H. Cariogenic Foods as the Cause of Dental Caries in Children. *e-Gigi*. 2022;10(1):38. doi:10.35790/eg.v10i1.37435

Clinical, Cosmetic and Investigational Dentistry

Publish your work in this journal

Clinical, Cosmetic and Investigational Dentistry is an international, peer-reviewed, open access, online journal focusing on the latest clinical and experimental research in dentistry with specific emphasis on cosmetic interventions. Innovative developments in dental materials, techniques and devices that improve outcomes and patient satisfaction and preference will be highlighted. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/clinical-cosmetic-and-investigational-dentistry-journal>

Dovepress
Taylor & Francis Group