Determinant Factors of Dental Caries Incidence Among Elementary School Children in Indonesia

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Abstract. Stunting is a condition where a child has a length or height that is less than their age and the most common form of malnutrition in children. The aim of this study was to analyze the relationship between stunting and salivary flow rate with dental caries (def-t) in elementary school-age children in Abeli District. Material and Methods: This was an analytical observational study with cross sectional design of 100 elementary school-aged children. Results: The study results indicate that a relationship between nutritional status variables (p-value = 0.000 <0.05) and salivary flow rate (p-value = 0.000 <0.05) to the dependent variable (dental caries). There was also a relationship between dental caries with age (p=0.024), parents' education (p=0.001), parents' occupation (p=0.001), and parents' income (p=0.000) while no relationship was observed for gender (p=0.863) with dental caries. Multivariate analysis revealed that salivary flow rate was the most influential variable on dental caries (p=0.013). Conclusion: Stunting and low salivary flow rate are associated with development of dental caries in elementary school-aged children. Health workers at the Puskesmas in Abeli District are encouraged to conduct education on dental health and stunting prevention.

Keywords: Stunting, Salivary Flow Rate, Dental Caries.

1   Introduction

Dental caries is one of the prevalent oral diseases in society, affecting not only adults but also children. Dental caries is a condition where the hard layer of the tooth (enamel) undergoes permanent damage, leading to the formation of gaps or cavities within the teeth. The 2018 Basic Health Research (Riskesdas) revealed that the most significant dental issue in Indonesia was tooth decay (45,3%). In addition, the Indonesian population experiences oral health problems to a substantial extent, with a prevalence rate of 57,6% and a DMF-t score of 7,1%. National data on dental caries prevalence indicates that among children aged 5-9 years, the prevalence of dental caries is 92,6%, while among those aged 10-14 years, the prevalence is 73,4% [1]. Stunting is a condition where a child's height or length is below the normal for their age that represents a common form of malnutrition in children as a result of undernutrition, poor growth due to inadequate nutrition, recurrent infections, and insufficient psychosocial

stimulation. The World Health Organization (WHO) classifies malnutrition into two forms: overnutrition and undernutrition, with the latter encompassing underweight, wasting, and stunting which is a central component of the six global nutrition targets for 2025 adopted by the World Health Assembly in 2012 [2].

Recent estimates on global child malnutrition have been released by the United Nations Children's Fund (UNICEF), the World Health Organization (WHO), and the World Bank, it was estimated that in 2013, there were 161 million children under the age of 5 who experienced stunting. According to data from UNICEF, in the year 2000, approximately 32,4 % of children under 5 years worldwide suffered from stunting, totaling around 199,5 million children and decreased to 21,3 % in 2019, with about 144,0 million children under 5 years affected [3]. Based on the 2020 Nutritional Status Monitoring results in Southeast Sulawesi, the prevalence of malnutrition was assessed in terms of weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH) ratios, with respective figures of 17,3% underweight, 21,2% stunted, and 8,3% overweight. In Kendari City, the prevalence rates based on WFA, HFA, and WFH ratios were 15,9%, 32,4%, and 16,1%, respectively. Notably, Kendari City's nutritional status prevalence significantly exceeded World Health Organization (WHO) standards, which stand at 10,0%, for WFA, 20% for HFA, and 10,1-15,0% for WFH ratios. Southeast Sulawesi Province had a stunting prevalence of 31,4%. Considering early childhood nutritional status data using WFA, HFA, and WFH from each District and Public Health Center in Kendari City of 2019, the percentage of stunted children was 0,32%. Screening examinations of elementary school children in Kendari City in 2022 indicated that Public Health Center Abeli had the highest percentage of children with stunting (98 children) followed by Public Health Center Wua-Wua with 27 cases of stunting, while Public Health Center Kemaraya had 3 cases. No stunting data were found for Public Health Center Mata, Kandai Benu-Benua, Labibia, and Poasia.

Stunting can lead to disruption of the child development, such as oral cavity developmental issues including tooth maturation, enamel development, and delayed eruption of primary teeth. Moreover, stunted children are more susceptible to dental caries due to alterations in saliva characteristics such as reduced flow rate and pH [4]. Dental caries is a disease caused by the interaction of bacteria that produce acid with the host (tooth), substrate (food), and progresses over time. Acid produced by bacteria leads to pH reduction over a certain period of time causing tooth surface demineralization and the onset of caries [5]. Caries susceptibility is also influenced by changes in saliva characteristics. Saliva is produced by major and minor salivary glands, comprising a complex composition with versatile physical properties. Saliva flows into the oral cavity through ducts, contributing 500-600 ml/day and containing inorganic and organic components. Saliva plays a challenging role in the body, facilitating taste and nutritional food detection, as well as protecting teeth from caries. It moistens teeth and oral mucosa so it can prevent dryness. Moreover, saliva flows can also clean the oral cavity from food debris, inhibiting bacterial growth, and safeguarding mucosa from microbial infection [6].

Stunted children are more prone to dental caries due to reduced saliva function, resulting in higher dental caries experience compared to normal children. A study conducted by Angulo et al. in Peru in 2012 indicated that stunted children had a higher

mean def-t score of 15,00±10,63 compared to normal children with a mean def-t score of 9,80±7,20 [7,8]. The nutritional status of school-age children extends from the developmental phase during infancy. Various studies involving infants highlight the association between stunting and cognitive and motor impairments, as well as developmental issues within the oral cavity. However, research investigating the influence of stunting on dental caries among elementary school children in Indonesia remains limited. Therefore, further research is warranted to analyze the impact of stunting on dental caries among elementary school children in the Abeli District.

2   Materials and Methods

This study employed a quantitative research approach utilizing an observational analytical method with a cross-sectional design. The research was conducted from January to March 2023 at primary schools within the Abeli District. A total of 100 samples were determined using the Slovin formula. The sampling technique employed purposive sampling, selecting schools with a high ratio of stunted students.

Primary data sources were obtained through the completion of questionnaires during oral health screening, and utilization of dental diagnostic tools. Additionally, respondent height was measured using a microtoise based on age, saliva flow rate was measured using a stopwatch, and stimulated saliva was collected using the spitting method. Interviews were conducted with the parents of the respondents. Secondary data was derived from annual reports of the Kendari City Health Department and the Screening Reports of Public Health Center Abeli, pertaining to primary school children.

Data analysis comprised univariate analysis in the form of descriptive tests, bivariate analysis employing the Chi-Square test to assess significant relationships between two independent variables: nutritional status (HFA), saliva flow rate (per minute), and early childhood dental caries (def-t) within the Abeli District. Multivariate analysis was conducted to measure influential independent variables on the dependent variable. Binary logistic regression models were used for this analysis with a 95% confidence level, applying the method of determining odds ratios for dichotomous categorical variables. One category was selected as the reference and compared using the chi-square test, which met the prerequisite conditions for the test's outcome. Ethical clearance was obtained for this research.

3   Results

3.1   Characteristics of Elementary School-Aged Respondents in the Abeli District

Table 1 illustrates that among the 100 respondents, the largest age group was between 6-7 years old, comprising 73 respondents (73,0%), while the smallest age group was above 7 years, with 11 respondents (11.0%). The highest recorded respondent age was 7,4 years, and the lowest was 5,1 years. Among the respondents, 55 (55,0%) were female, and 45 (45,0%) were male. The majority of respondents

(57,0%) had a height ranging from 106 to 115 cm, and only 19 respondents (19,0%) was above 115 cm in height.

The highest recorded height was 125 cm, and the lowest was 95 cm. Regarding weight, the majority (61,0%) weighed between 16-20 kg, while the smallest group (14.0%) weighed over 20 kg. The highest recorded weight was 25 kg, and the lowest was 12 kg. Parental education levels indicated that 33,0% of parents had completed high school (SMA/MA), whereas the lowest percentage (16,0%) represented parents with a college education. The most common parental occupation was entrepreneurship, accounting for 46,0%, while the least common was civil servant (PNS) at 13,0%. Regarding parental income, 48.0% fell within the range of Rp 1000.000 – 2.000.000 while 19.0% had a parental income above Rp 3.000.000.

Table 1. Characteristics of Respondents (Age, Gender, Body Height, Body Weight, Parental Education, Parental Ocupation and Parental Income).

Characteristics	n = (Total Sampel)	%
Age (Year)		
5	16	16,0
6-7	73	73,0
>7	11	11,0
Gender		
Male	45	45,0
Female	55	55,0
Body Height		
95-105	24	24,0
106-115	57	57,0
>115	19	19,0
Body Weight		
10-15	25	25,0
16-20	61	61,0
>20	14	14,0
Parental Education		
Primary School (SD/MI)	28	28,0
Secondary School (SMP/MTsN)	23	23,0
High School (SMA/MA)	33	33,0
University	16	16,0
Parental Ocupation		
Fishermen	20	20,0
Entrepreneur	46	46,0
Employee	21	21,0
Civil Servant (PNS)	13	13,0
Parental Income		
0-1.000.000	20	20,0
1.000.000 – 2.000.000	48	48,0
2.000.000 – 3.000.000	13	13,0
>3.000.000	19	19,0

Source: Primary data, 2023

3.2   Univariate Analysis

Univariate analysis in this study encompassed two independent variables, namely nutritional status (HFA) and saliva flow rate among early childhood students in Elementary Schools within the Abeli District, along with one dependent variable. Descriptive tests were conducted in the univariate analysis using SPSS to present the frequency distribution of each variable.

Table 2. Distribution of Respondents Based on Nutritional Status (HFA), Saliva Flow Rate, and Dental Caries (def-t) among Elementary School Children in the Abeli District in 2023.

Variable	n = (Total Sampel)	%
Nutritional Status (HFA)		
Stunting	38	38,0
Normal	62	62,0
Saliva Flow Rate (Per Minute)		
Under	58	58,0
Normal	42	42,0
Dental Caries Index (def-t)		
High	68	68,0
Low	32	32,0

Table 2 reveals that out of 100 respondents, the majority had normal nutritional status, accounting for 62 respondents (62,0%) while 38 respondents (38,0%) exhibited stunted nutritional status. The majority of respondents (58,0%) had insufficient saliva flow rate, while 42,0% exhibited a normal flow rate. A significant proportion of respondents (68,0%) had a high dental caries index (def-t), and a smaller group (32,0%) had a low dental caries index (def-t).

3.3   Bivariate Analysis

Bivariate analysis in this study utilized the Chi-Square test to examine the hypothesis of the relationship between one independent variable and one dependent variable. The objective was to analyze whether there is a significant relationship between the two independent variables: nutritional status (HFA), saliva flow rate (per minute), and early childhood dental caries (def-t) among children in the Abeli District in 2023.

Table 3. Relationship between Individual Characteristics and Early Child-hood Dental Caries (def-t) in the Abeli District in 2023.

Variable	Dental Caries Index (def-t),				Corelation (r)	p-value
	High		Low			
	n	%	N	%		
Age (Year)						
5	14	20,6	2	6,3		
6-7	44	64,7	29	90,6	0,031	0,024
>7	10	14,7	1	3,1		

	N	%	N	%		
Gender						
Male	31	45,6	14	43,8	0,017	0,863
Female	37	54,4	18	56,3		
Parental Education						
Primary School (SD/MI)	22	32,4	6	18,8		
Secondary School (SMP/MTsN)	19	27,9	4	18,8	0,325	0,001
High School (SMA/MA)	23	33,8	10	31,3		
University	4	5,9	12	37,5		
Parental Ocupation						
Fishermen	18	26,5	2	6,3		
Entrepreneur	34	50,0	12	37,5	0,382	0,001
Karyawan	13	19,1	8	25,0		
Civil Servant (PNS)	3	4,4	10	31,3		
Parental Income						
0-1.000.000	15	22,1	5	15,6		
1.000.000 – 2.000.000	42	61,8	6	18,8	0,412	0,000
2.000.000 – 3.000.000	7	10,3	6	18,8		
>3.000.000	4	5,9	15	46,9		

Source: Primary data, 2023

Based on the Spearman rank correlation analysis, the results indicate that age demonstrated a low correlation value ($r = 0,031$) and a p-value of $0,024$ ($<0,05$), rejecting the null hypothesis (H0) and indicating a significant relationship between age and early childhood dental caries (def-t) in the Abeli District in 2023. The analysis also showed that gender exhibited a very low correlation value ($r = 0,017$) and a p-value of $0,863$ ($<0,05$), leading to the acceptance of the null hypothesis, suggesting no significant relationship between gender and early childhood dental caries (def-t) in the Abeli District in 2023.

Based on the Spearman rank correlation analysis, the results indicate that parent's education demonstrated a low correlation value ($r = 0, 325$) and a p-value of $0,001$ ($<0,05$), rejecting the null hypothesis (H0) and indicating a significant relationship between parental education and early childhood dental caries (def-t) in the Abeli District in 2023. The analysis also showed that parental occupation exhibited low correlation value ($r = 0, 382$) and a p-value of $0,001$ ($<0,05$), leading to the rejecting of the null hypothesis, suggesting significant relationship between parental occupation and early childhood dental caries (def-t) in the Abeli District in 2023. Based on the Spearman rank correlation analysis, the results indicate that parental income demonstrated a moderate correlation value ($r = 0, 412$) and a p-value of $0,000$ ($<0,05$), rejecting the null hypothesis (H0) and revealing a significant relationship between parental income and early childhood dental caries (def-t) in the Abeli District in 2023.

Table 4. Relationship between Nutritional Status (HFA) and Early Childhood Dental Caries (def-t) in Elementary School Children in the Abeli District.

Variable	Dental Caries Index (def-t)				*Corelation (r)*	*p-value*
	High		Low			
	N	%	N	%		
Nutritional Status (HFA)						
Stunting	37	97,4	1	2,6	0,493	0,000

Normal	31	50	31	50

Table 4 shows that out of 100 respondents who participated in the survey, 37 (97,4%) stunted children had a high dental caries index, and 1 child (3,1%) had a low dental caries index. The analysis, with a correlation value (r) = 0,412 and a p-value of 0,000 (<0,05), rejects the null hypothesis (H0), indicating a significant relationship between nutritional status (HFA) and early childhood dental caries (def-t) in the Abeli District.

Table 5. Relationship between Saliva Flow Rate and Early Childhood Dental Caries (def-t) in Elementary School Children in the Abeli District.

Variable	Dental Caries (def-t),				*Corelation (r)*	*p-value*
	High		Low			
	n	%	N	%		
Saliva Flow Rate (Per Minute)						
Under	51	87,9	7	12,1	0,502	0,000
Normal	17	40,5	25	59,5		

Table 5 demonstrates that out of 100 respondents, 51 (87,9%) children with insufficient saliva flow rate had a high dental caries index, and 7 (12.1%) children had a low dental caries index. The correlation analysis yielded a value of 0,502 with a p-value of 0,000 (<0,05), leading to the rejection of the null hypothesis (H0) and confirming a significant relationship between saliva flow rate and early childhood dental caries (def-t) in the Abeli District.

Table 6. Relationship between Nutritional Status (HFA) and Saliva Flow Rate in Elementary School Children in the Abeli District.

Variable	Saliva Flow Rate				*Corelation (r)*	*p-value*
	Under		Normal			
	n	%	n	%		
Nutritional Status (HFA)						
Stunting	35	92,1	3	7,9	0,541	0,000
Normal	23	37,1	39	62,9		

Table 6 reveals that out of 100 respondents with stunted nutritional status, 35 children (92,1%) had insufficient saliva flow rate. Among children with normal nutritional status, 39 children (62,9%). had a normal saliva flow rate. However, 23 children (37,1) with normal nutritional status had insufficient saliva flow rate. The table confirming a significant relationship between stunting and saliva flow rate among early childhood students in the Abeli District.

Based on the Spearman rank correlation analysis, the results indicate that Saliva Flow Rate demonstrated a moderate correlation value (r = 0,541) and a p-value of 0,000 (<0,05), rejecting the null hypothesis (H0) and indicating a significant relationship between Saliva Flow Rate and nutrition status in the Abeli District in 2023.

3.4   Multivariate Analysis

Multivariate analysis was conducted to measure the influence of independent variables on the dependent variable. This analysis was carried out using a binary logistic regression model with a confidence level of 95% and the method of determining the odds ratio for dichotomous categorical variables, with one category serving as the reference through the chi-square test, which must meet the requirements of the testing results. The stipulated requirement is that the indicators of independent variables included in the multivariate analysis must have a p-value <0,25 in the bivariate test.

Based on the bivariate test results using the Chi-square method, six independent variables had p-values p < 0,25: age, parental education, parental occupation, parental income, nutritional status (HFA), and saliva flow rate. These variables were included in the multivariate analysis using Binary Logistic Regression. However, gender was not included due to a p-value > 0,25.

Table 7. Simultaneous Multivariate Analysis of Age, Parental Education, Parental Occupation, Parental Income, Nutritional Status (HFA), and Saliva Flow Rate in Relation to Dental Caries (def-t) Among Elementary School Children in the Abeli District in 2023.

Variable	Wald	*p-value*	OR Exp (B)	95% C.I. Lower	95% C.I. Upper
Age	0,002	0,967	1,030	0,257	4,129
Parental Education	0,552	0,458	0,712	0,290	1,745
Parental Occupation	1,254	0,263	1,412	0,772	2,583
Parental Income,	1,915	0,166	1,837	0,776	4,348
Nutritional Status	3,782	0,052	9,384	0,983	89,623
Saliva/minute	6,185	0,013	4,338	1,365	13,791

The results of the multivariate analysis indicate that among the independent variables (Age, Parental Education, Parental Occupation, Parental Income, Nutritional Status, and Saliva/minute), the variable with the most dominant influence on dental caries (def-t) is the saliva flow rate, with a p-value of 0,013. (p<0,05), compared to other variables with p-values >0,05.

Based on these findings, in the endeavor to mitigate the prevalence of dental caries among elementary school children in the Abeli District, prioritizing the variable of saliva flow rate takes precedence over the nutritional status variable.

4   Discussion

4.1   Incidence of Dental Caries

Dental caries is a process of demineralization of hard tooth tissues such as dentin and enamel, which occurs due to the presence of plaque, a cluster of bacteria that forms a biofilm on the tooth surface. The dominant bacteria are Streptococcus mutans, Streptococcus sorbinus dan Lactobacillus sp, which are part of the normal oral flora.

However, certain conditions can lead to the dominance of specific bacteria, resulting in dental caries [9].

Based on the observations in this study, it was found that children aged 6-7 years had a high prevalence of dental caries (def-t) at 64,7%. During interviews, it was revealed that children aged 5-7 years tended to have poor eating habits, consuming sugary foods like chocolate and sweets, and also lacked proper tooth brushing habits. This is in line with the findings of previous research, who reported a high incidence of dental caries among children due to dietary factors as well as poor tooth brushing habits [10]. The results in this study also showed that children aged 6-7 years had a low prevalence of dental caries because some children were already aware of the importance of oral care and how to do it. This is in line with Kohlberg's theory, which suggests that as they grow up, children develop wiser thinking and a better understanding of the value of goodness [11]. However, children aged >7 years still had a significant number with high dental caries at 14,7%. These suggest that while age may lead to an increase in knowledge, this elevation is contingent upon factors such as access to information and personal experiences with advancing in age not necessarily guaranteeing an individual's heightened level of awareness. This phenomenon can be attributed to the limited comprehension among elementary school children regarding the significance of oral health maintenance. The dietary preferences of primary school students, favoring sugary foods (candies, chocolates, ect.), coupled with the lack of parental awareness in seeking dental check-ups for their children, contribute to this situation. Untreated dental caries can lead to pulpal and periapical tissue abnormalities and tooth loss. Knowledge about the importance of caring for damaged primary teeth remains inadequate. Enhancing awareness and instilling positive habits of daily oral hygiene maintenance in children necessitate comprehensive health education that encompasses effective communication, motivation, instruction, and sufficient parental involvement [12].

The high prevalence of dental caries among 6-year-old children can be attributed to various factors. The dietary preferences of primary school students, favoring sugary foods (candies, chocolates, etc.), surpass those of older students. Limited knowledge, awareness, and self-sufficiency in health and hygiene practices among young children also play a role. Children at this age are still heavily reliant on parental guidance. The lack of parental awareness in seeking dental check-ups for their children stems from the misconception that primary teeth will eventually be replaced by permanent teeth. The level of oral hygiene and dental care in children is closely linked to their behavioral patterns and habits. Behavior encompasses the array of responses and reactions exhibited by human beings and living organisms in response to their environment. The study indicated a significant association between age and dental caries (def-t) in young children in the Abeli District in 2023. This is consistent with the findings of previous research which state that age has an association with dental caries prevalence and which established a strong correlation between age and dental caries prevalence [13,14].

4.2   Gender and Dental Caries

This study revealed a higher proportion of female students in elementary schools in the Abeli District compared to males. There were 55 respondents (55,0%) who were

female and 45 respondents (45,0%) who were male. Cross-tabulation analysis in this study indicated that females had a high prevalence of dental caries, with 37 respondents (54,4%) falling into this category. This corresponds to the findings of previous research, which identified a higher incidence of dental caries among female students compared to male students [13]. Prior research indicates that dental caries is more prevalent in females. Several factors contribute to this, including dietary habits involving sugary foods consumed between meals and hormonal factors. The earlier eruption of permanent teeth in girls compared to boys also contributes to prolonged exposure to caries risk factors [15]. The study results of gender and dental caries did not yield a significant relationship, suggesting that the severity of dental caries to be similar for both genders. Other factors such as economic status, education level, oral hygiene practices, dietary habits, and dental check-up frequency have shown to contribute to dental caries incidence and vary widely among individuals, irrespective of gender. Basic factors like tooth morphology, including pit and fissure patterns in posterior teeth, also play a significant role and influence caries susceptibility [16].

4.3   Education and Dental Caries

The maintenance of oral health in primary school children relies significantly on parental involvement, as young children are usually closer to their parents. Education plays a crucial role in shaping an individual's actions [17]. Increased knowledge supports individuals in applying learned information to daily habits. Parental education regarding dental caries prevention greatly influences their children's future dental health [18]. Observations in this study found that children with parents educated up to elementary and high school levels had high levels of dental caries at 33,8% and 32,4%, respectively. Interviews revealed that children from these backgrounds received limited dental health education and lacked proper control over their food consumption. A mother's knowledge also impacts a child's dental health, as it influences early preventive practices [19]. However, knowledge alone is insufficient, positive actions such as regular brushing after meals are equally crucial [20].

The study revealed a significant association between parental education level and dental caries, such that parents with higher education levels including university degrees, had a low dental caries prevalence of 37,5%. This implies that higher parental education is linked to lower dental caries severity, as measured by the def-t index. This finding aligns with previous research, who established a relationship between parental education level and dental caries incidence [21]. In the context of elementary school-aged children, the active involvement of parents is essential to impart knowledge about their children's dental health. As an individual's formal education level increases, so does their aptitude for comprehending and adopting healthy lifestyles. Furthermore, higher education often facilitates better employment prospects, leading to increased income that can be allocated towards healthcare necessities. Conversely, limited educational attainment can hinder the development of an individual's attitude towards newly introduced values [22].

Based on the interview findings, it was observed that children whose parents had pursued higher education were generally aware of the significance of maintaining their

children's oral health. However, there remains a gap in their understanding of proper dental and oral care practices. These observations align with the cross-tabulation outcomes, which indicated that among children whose parents had completed high school education, a notable portion still fell within the high dental caries category, accounting for 33,8%. Dental caries is compounded by parents underestimating the severity of dental caries, failing to prioritize dental health, lacking regular dental check-ups and not teeth brushing twice a day [19]. Most parents have no clue about proper brush criteria, when to renew the brush, how to brush teeth properly, when to brush and when to do dental check-up. Those are the factors causing dental caries [23].

Parents unawareness of factors that causing dental caries was the major reason of high dental caries incidence in School aged kid in Abeli District.

4.4   Socioeconomic Status and Dental Caries

Dental caries represents a significant concern, exacerbated by low socioeconomic status and malnutrition. Dental caries is more prevalent among children from families with low socioeconomic status, single parents, or parents with low levels of education [24]. A substantial proportion of high-level dental caries (def-t) was found among children whose parents had occupations as entrepreneurs and fishermen, accounting for 50% and 26,5%, respectively. This aligns with previous research findings, suggesting that parental occupation reflects the parents' capacity and time to provide dental health knowledge to their children. A child must share attention received from both parents, considering their respective occupations [25]. Based on the Chi-square test, parental occupation yielded a p-value of 0,001 (p-value <0,05), indicating a significant relationship between parental occupation and dental caries (def-t) among young children in the Abeli District in 2023. This finding is consistent with the study conducted by previous researcher, who identified an impact of parental occupation on dental caries incidence (p=0,019) in Muhammadiyah Sambisari Kalasan Elementary School [26]. This can be attributed to statements from the parents of respondents. The fathers' occupation, predominantly classified as middle-level occupations such as fishermen and craftsmen, led to most of the mothers assisting in seeking additional income, resulting in being occupied with their respective jobs. Consequently, they may not have been able to pay full attention to the oral hygiene of their children and might not have taken their children to health centers, hospitals, or dental practitioners for check-ups [27].

The majority of high-level dental caries (def-t) were observed in children whose parents' income was within the range of Rp 1.000.000–2.000.000 totaling 42 (61,8%). Furthermore, children whose parents have an income of Rp 0–1000.000 also exhibit high dental caries, with 15 respondents (22,1%). Additionally, children with low dental caries (def-t) are found in those with parents' income exceeding Rp 3.000.000, totaling 15 respondents (46,9%). A higher parental income corresponds to lower dental caries occurrence in children. Insufficient parental income is a contributing factor that renders individuals unable to afford the necessary types and amounts of food, thereby influencing purchasing power for daily necessities. This, in turn, affects their ability to meet primary, secondary, and tertiary needs. Higher monthly parental income enables

individuals to fulfill both basic and additional needs and covers healthcare expenses [28].

Based on the interview results, the majority of parents of elementary school children in the Abeli District fall into the middle-income category, with an income range of Rp1000.000–2.000.000, and these children exhibit high levels of dental caries. Additionally, the distribution of parental occupations among respondents in the study indicates that low income is due to minimal education, and most respondents work as laborers (factory workers, shopkeepers, etc.), thereby impacting their monthly income. Low income contributes to dental caries due to limited access to teeth-friendly food and restricted healthcare facility utilization. This observation is consistent with Soerjono Soekanto's theory. A higher occupational level is indicative of a family's level of prosperity. Inadequate employment with insufficient income to meet daily needs, particularly healthcare, can result from inadequate education. A higher occupational status corresponds to a higher monthly income. Additionally, higher fertility rates are correlated with an increased ability to meet living expenses [29].

Based on the Chi-square test, a p-value of 0,000 (p-value <0,05), was obtained for the relationship between parental income and dental caries (def-t) in young children in the Abeli District in 2023. This implies that the null hypothesis (H_0) is rejected, indicating a significant association between parental income and dental caries in young children. This finding aligns with research titled "The Relationship Between Education and Head of Household Income with Child Dental Caries in the Seubun Ayon Village Community, Lhoknga Sub-district, Aceh Besar, in 2019." The study revealed a connection between parental education, income, and child dental caries. Children from low-income families tend to face a higher risk of severe caries due to the influence of income on food consumption. In contrast, higher income enables healthier dietary choices and better access to healthcare. While dental and oral treatment costs are covered by the National Health Insurance (BPJS), not all procedures are included [30]. The relationship between parental income and dental caries in children is influenced by various factors. Limited income directly impacts the consumption of teeth-friendly foods, including food type and quantity. Income also directly affects medical care. An increase in income leads to higher healthcare costs, making it difficult for low-income families to afford medical treatment or healthcare services. Consequently, higher parental income is associated with improved lifestyles and teeth-friendly dietary habits, including consuming fiber-rich and hydrating foods to reduce oral plaque and scheduling dental clinic visits every six months for regular healthcare maintenance, thereby reducing dental caries in children [31].

4.5   Relationship between Stunting and Dental Caries

Nutritional deficiencies during critical periods can lead to stunting in children and abnormal dental growth, making children more susceptible to dental caries [32]. Even children born with normal health and good nutrition are not exempt from stunting risk, as prolonged or chronic inadequate nutritional intake can result in stunting. This chronic nutritional deficiency also affects oral health, such as disrupting salivary gland

development and increasing the risk of dental caries [33]. The research findings indicated that out of 100 respondents (100%) with stunting, more children have high levels of dental caries (def-t) with a proportion of 31 respondents (81,6%). Conversely, respondents with normal nutritional status exhibit low dental caries (def-t) with 31 respondents (50,0%). The table above elucidates that the nutritional status of children (stunting) is associated with an increased risk of high dental caries prevalence among elementary school children in the Abeli District. This aligns with previous study in Banjar Regency, which found a significantly higher def-t index in stunted children compared to non-stunted children [34]. Longitudinal research in Peru showed that stunted children experience a higher increase in caries compared to non-stunted children during a three-and-a-half-year follow-up period. Thus, dental caries in stunted children can pose a more significant concern than in non-stunted children [7].

In this study, there is a notable distinction between the nutritional statuses of children with and without dental caries. Children with stunted growth are at a higher risk of dental caries compared to those with normal nutritional status. Meanwhile, children with normal growth experience lower caries incidence. The increased risk of dental caries among children with stunted growth can be attributed to insufficient nutrition for proper tooth growth and development. However, even in cases of normal nutritional status, some children still experience caries due to a lack of awareness and knowledge about oral health practices, such as proper brushing techniques, reducing sweet and sticky foods, consuming fibrous and hydrating foods, and regularly visiting a dentist every six months. The results of univariate analysis of the Family Role variable showed that the supporting category accounted for 24 respondents (69,9%) while the nonsupporting category accounted for 13 respondents (35,1%), indicating that family support in the patient's referral process during childbirth was satisfactory. Based on the Chi-square test, the nutritional status (HFA) exhibited a p-value of 0,000 (p-value <0,05), indicating a significant relationship between nutritional status (HFA) and dental caries (def-t) among elementary school children in the Abeli District in 2023. These findings align with previous research, which reported a strong correlation between stunting and oral health [4]. Additionally, several research highlighted distinct dental caries patterns among stunted individuals and established a significant association between risk factors and caries index in the stunted population [35].

4.6   Relationship between Salivary Flow Rate and Dental Caries

A decrease in buffering capacity can render teeth more susceptible to caries due to reduced capacity to neutralize acids and protect teeth from demineralization caused by plaque acids. A decline in buffering capacity also diminishes protein and peptide metabolism by bacteria in saliva, which produce urea and ammonia. Consequently, the pH associated with buffering activity decreases [36, 37]. The research results demonstrate that out of 100 respondents (100%) with reduced salivary flow rates, more children have high levels of dental caries (def-t) with 34 respondents (58,6%). Conversely, respondents with normal salivary flow rates have low dental caries (def-t) with 26 respondents (61,9%). These findings suggest that children with reduced salivary flow rates are at a higher risk of dental caries, which aligns with Lutfi's study

(2021). Lutfi explains that dental caries is caused by the interaction between bacteria producing acids and the host (teeth), substrate (food), and the progression of time. Bacterial acid production leads to pH decrease, which, when recurrent over time, triggers demineralization of tooth surfaces and the onset of caries [38]. Based on the Chi-square test, the salivary flow rate yields a p-value of 0,000 (p-value <0,05), signifying a significant relationship between salivary flow rate and dental caries (def-t) among elementary school children in the Abeli District in 2023. This observation is consistent with previous research, which found a significant negative correlation (p<0,05) between salivary flow rate and dental caries index. A coefficient of correlation of -0,779 indicates a strong correlation. However, some children in this study with normal nutritional status exhibit high dental caries (def-t), totaling 11 respondents (26,2%). Apart from salivary flow rate, poor oral hygiene is a risk factor for caries. Deficient oral hygiene can be attributed to inadequate oral hygiene practices. Children aged 6-12 or of school age often lack knowledge of and adherence to proper dental and oral care practices. Saliva pH is critical as it promotes remineralization, but decreased pH can lead to demineralization. Acid ions react with phosphate in saliva and plaque or calculus until the critical pH for hydroxyapatite dissociation at 5,5 is reached. Further pH decrease (below 4,5), which is critical for fluorapatite solubility, can lead to fluorapatite dissolution. Continuous imbalance between demineralization and remineralization leads to tooth surface caries formation [39].

4.7 Relationship between Nutritional Status (HFA) and Salivary Flow Rate (Per Minute)

Children with stunting exhibit a risk of reduced salivary flow rate among elementary school children in the Abeli District. This corresponds with previous research on chronic malnutrition and oral health status in 1 to 5 year-old children, revealing a negative impact on children's oral cavities and a decrease in salivary flow rate due to malnutrition. Stunting or malnutrition in children can lead to diminished saliva flow rate [40,41]. Other studies explain that poor nutritional status can influence saliva secretion and composition, leading to reduced salivary flow rate, which affects an individual's quality of life. A low saliva flow rate increases the risk of conditions such as xero-stomia, mucosal inflammation, burning mouth, taste disorders, tooth demineralization, chewing difficulties, speech impairments, poor denture retention, candidiasis, periodontal disease, and a higher bacterial count contributing to caries [42]. Based on the Chi-square test, the nutritional status yields a p-value of 0,000 (p-value <0,05), indicating a significant relationship between nutritional status (HFA) and salivary flow rate among elementary school children in the Abeli District in 2023. This result aligns with previous study, demonstrating a meaningful connection between nutritional status and salivary flow rate [43].

Based on the multivariate analysis results, the most influential variable in this study is the salivary flow rate, with a p-value of 0,013 (p-value <0,05). Additionally, the salivary flow rate has the potential to increase the risk of dental caries by a factor of 1,365 to 13.791. Therefore, in efforts to reduce the high prevalence of dental caries among elementary school children in the Abeli District, the salivary flow rate variable

takes precedence over nutritional status. Saliva plays a crucial role in maintaining oral health, as adequate salivary flow rate allows optimal mouth cleansing. Saliva contains antimicrobial components and maintains the oral cavity's pH balance (buffering) during acid pH drops and alkali pH rises, thus preventing caries formation [18]. Reduced saliva secretion can be caused by insufficient chewing activity, which may occur in children with inadequate food intake. Decreased saliva secretion leads to a reduced buffering capacity of saliva, disrupting oral pH and rendering teeth more susceptible to caries. Dental caries can have adverse effects on children, affecting their quality of life. Caries causes pain and discomfort, disrupting school activities and learning. Other consequences include acute or chronic infections, potential disability, impacts on sleep quality and eating habits due to perceived pain. This affects nutrition, growth, and weight gain [38].

5   Conclusion

Based on the research findings, there is a relationship between individual characteristics (Age, parental education, parental occupation, parental income) and dental caries (def-t) among elementary school children in the Abeli District. However, there is no significant relationship between individual characteristics (gender) and dental caries (def-t) among elementary school children in the Abeli District in 2023. Stunting and salivary flow rate exhibit a significant relationship with dental caries (def-t) among elementary school children in the Abeli District. The dominant and influential variable in this regard is the salivary flow rate.

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