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Analyzing the Influence of Parental and Teacher Involvement on Oral Health and Dental Caries in Children with Down Syndrome in Surabaya

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ABSTRACT Children with Down syndrome are known to experience greater challenges in maintaining oral hygiene due to their physical and cognitive limitations, making them more susceptible to dental caries compared to typically developing peers. Despite some biological factors that could potentially reduce caries risk, such as higher salivary pH and immunoglobulin A (IgA) levels, the prevalence of dental caries among children with Down syndrome remains significantly high. Parental and teacher involvement plays a critical role in promoting oral health behaviors in these children. This study aims to examine the relationship between the involvement of parents and teachers in oral health maintenance and the incidence of dental caries in children with Down syndrome attending special education schools in North and East Surabaya.This correlational analytical study employed a cross-sectional design with purposive sampling. A total of 37 children with Down syndrome were selected from a population of 41, using Slovin's formula. Data were collected through validated questionnaires assessing parental and teacher roles, alongside direct dental examinations to determine the DMF-T index. Data analysis utilized the Spearman-rank correlation and multiple regression tests.Findings revealed a significant inverse relationship between the role of parents and the incidence of dental caries ($\rho = 0.006$), as well as between the role of teachers and dental caries ($\rho = 0.004$). Multiple regression analysis further confirmed a combined significant influence of both parental and teacher involvement on caries prevalence ($\rho = 0.000$).In conclusion, increased involvement of both parents and teachers is strongly associated with a reduction in dental caries among children with Down syndrome. These findings highlight the importance of integrated support from home and school environments in improving oral health outcomes in this vulnerable population.

INDEX TERMS Down syndrome, dental caries, parental involvement, teacher role, oral health

I. INTRODUCTION

Down syndrome (DS), also known as trisomy 21, is a genetic disorder caused by the presence of an extra chromosome 21, resulting in a total of 47 chromosomes rather than the typical 46. This chromosomal anomaly leads to a spectrum of physical and cognitive impairments, including limitations in self-care and daily hygiene practices [1], [2]. One of the prevalent health issues observed in children with Down syndrome is poor oral health, particularly the high incidence of dental caries [3], [4]. Despite the presence of protective biological factors such as increased salivary IgA and altered oral microbial composition in some individuals with DS, empirical data shows that dental caries remains a widespread problem in this population [5]–[7].

Dental caries is a chronic, multifactorial disease that can significantly affect quality of life, especially in vulnerable groups such as children with disabilities [8]. In Indonesia, the prevalence of dental caries remains alarmingly high. The 2018 Basic Health Research report shows that 88.8% of the population experiences caries, with a national DMF-T (Decayed, Missing, Filled Teeth) index of 7.1, indicating a very high level [9]. Moreover, children with Down syndrome are more prone to dental complications due to their motor and intellectual challenges, which hinder effective oral hygiene practices [10], [11].

Several recent studies have emphasized the critical role of external support particularly from parents and teachers in promoting oral health behaviors among children with special needs [12]–[15]. Parental involvement in routine oral care practices, as well as teacher guidance during school activities, significantly contributes to caries prevention [16], [17]. However, despite the recognition of these roles, many children with Down syndrome still present with poor oral hygiene and high caries scores, suggesting gaps in the implementation or effectiveness of current support strategies [18], [19].

Previous studies have either focused on parental roles alone or provided generalized findings across various disabilities without emphasizing the unique challenges posed by Down syndrome [20], [21]. There is limited research that

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comprehensively assesses the combined impact of both parental and teacher involvement on the dental health outcomes of children with Down syndrome. Furthermore, localized studies particularly in urban regions such as Surabaya are scarce, despite known disparities in oral health services and education outreach in different regions [22], [23]. Therefore, the aim of this study is to analyze the relationship between parental and teacher involvement and the prevalence of dental caries in children with Down syndrome attending special education institutions in North and East Surabaya. By focusing on this specific demographic, the study seeks to generate evidence-based insights for targeted oral health interventions.This study makes the following key contributions:

1. Empirical Assessment: Provides quantitative data on the oral health status (DMF-T index) of children with Down syndrome in Surabaya, supported by clinical examinations.
2. Integrated Role Analysis: Evaluates the joint influence of parents and teachers using validated instruments and statistical models to assess correlation and impact.
3. Policy Implication: Offers practical recommendations for educators, parents, and public health policymakers to strengthen collaborative oral health education programs.

II. METHODS

This study employed a correlational analytical design with a cross-sectional approach, aimed at examining the relationship between the involvement of parents and teachers and the incidence of dental caries in children with Down syndrome. The research was conducted at special education schools (Sekolah Luar Biasa - SLB) located in North and East Surabaya, Indonesia, between December 2023 and February 2024.

A. STUDY POPULATION AND SAMPLING

The target population comprised all children with Down syndrome enrolled in special education institutions in the specified regions. A total of 41 children were identified as the accessible population. at a 5% margin of error, resulting in a sample of 37 respondents. The sample size was calculated using Slovin's formula The purposive sampling technique was employed to ensure the sample was representative of children who met the study's criteria and whose caregivers (parents and teachers) were willing to participate. This non-randomized selection was based on the feasibility and availability of the subjects, a common approach in public health and educational settings involving special needs populations [26], [27].

B. INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria included:

1. Children diagnosed with Down syndrome enrolled in SLB in North or East Surabaya.
2. Parental or teacher consent (written informed consent provided).
3. Availability of both parent/guardian and class teacher to complete the questionnaires.

Exclusion criteria:

1. Children with additional systemic diseases or physical conditions that could interfere with oral examination.
2. Respondents (parents or teachers) who did not complete the questionnaire.

Ethical clearance for the study was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. All participants were informed about the study purpose and signed informed consent forms.

C. STUDY VARIABLES

The study involved:

1. Independent variables: Parental involvement and teacher involvement in maintaining oral health.
2. Dependent variable: Incidence of dental caries, measured using the DMF-T index (Decayed, Missing, and Filled Teeth for permanent dentition).

D. DATA COLLECTION INSTRUMENTS AND PROCEDURES

1. QUESTIONNAIRE

Two separate questionnaires were used to measure the roles of parents and teachers. Each questionnaire was developed based on role theory by Soerjono Soekanto and health behavior theories relevant to oral health promotion [28]. The parent role questionnaire contained **27** items, while the teacher role questionnaire contained 15 items. Each item was rated on a four-point Likert scale: "always", "often", "rarely", and "never". The questionnaire underwent validity and reliability testing in a pilot study conducted in a different SLB institution in Surabaya with a similar population. Cronbach's alpha values exceeded 0.75 for both instruments, indicating good internal consistency [29].

2. ORAL EXAMINATION

The dental caries condition of the children was assessed using the DMF-T index following the World Health Organization (WHO) standard diagnostic criteria [30]. The examination was conducted by trained dental health professionals using disposable dental mirrors and sterilized probes under sufficient lighting. This scoring method was adapted from Arikunto's standardized role assessment scale [31].

a. Role Scoring: Role performance was categorized as:
   1. Good: 76–100%
   2. Fair: 56–75%
   3. Poor:<56%
b. Caries Index Interpretation: The caries severity was classified using WHO's DMF-T criteria:
   1. Very low: 0.0–1.1
   2. Low: 1.2–2.6
   3. Moderate: 2.7–4.4
   4. High: 4.5–6.5
   5. Very high: ≥6.6

E. DATA PROCESSING AND ANALYSIS

All collected data were first subjected to data cleaning and tabulation using Microsoft Excel. Responses were then exported to IBM SPSS version 26.0 for statistical analysis. Descriptive statistics were used to summarize demographic characteristics and role scores.Two levels of statistical testing were performed:

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1. Spearman's rank correlation test was used to analyze the association between parental/teacher roles and dental caries, as data were ordinal in nature and not normally distributed.
2. Multiple regression analysis was conducted to evaluate the simultaneous influence of parental and teacher roles on caries incidence. A significance level of $\alpha = 0.05$ was used for all tests.

F. STUDY LIMITATIONS AND CONSIDERATIONS

Due to the nature of the population, challenges included a limited number of respondents and the cooperation of children during oral examinations. Several children exhibited difficulty in maintaining an open mouth or showing their teeth, which occasionally affected scoring accuracy. However, experienced examiners were assigned to minimize observer bias, and the same protocol was applied uniformly.Furthermore, the non-random sampling method may limit the generalizability of results beyond the current study setting. However, purposive sampling is widely accepted in disability research to ensure that participants meet specific inclusion criteria [32].

III. RESULTS

TABLE 1
Characteristics of Respondents from Parents of Down Syndrome Children

Characteristics		Frequency	Percentage (%)
Gender	Male	10	27
	Female	27	73
Age	20-30 years	2	5.4
	31-40 years	12	32.4
	41-50 years	13	35.1
	51-60 years	10	27
Education	Elementary School	11	29.7
	Junior High School	3	8.1
	Senior High School	14	37.8
	S1	9	24.3
Work	Doesn't work	1	2.7
	Civil servants	1	2.7
	Self-employed	12	32.4
	Businessman	2	5.4
	Housewife	21	56.8

According to data presented in TABLE 1, it can be inferred that the most of research's parent participants were female (73%), whereas just (27%) of them were male. Regarding age, the most of research's parent participants 41-50 years old (35.1%). TABLE 2 shows that the most of teacher respondents are female (91.9%) with the most aged 20-30 years. TABLE 3 shows that the most of respondents with down syndrome children are male (54.1%) with the most aged 11-15 years (48.6%). TABLE 4 shows that ρ value of 0,006 means that there is a relationship between the role of parents in maintenance oral health with dental caries in children with down syndrome, with a level of strong correlation strength as well as the direction of the relationship with negative values. A negative (inverse) relationship indicates that the better the role of parents, the lower the dental caries in children with down syndrome. TABLE 5 show that ρ value 0,004 means there is relationship between the role of teachers in maintenance of oral health with dental caries in children with down syndrome, with a enough correlation strength level as well as the direction of the relationship is negative. A negative (inverse) relationship indicates that the better the role of parents, the lower the dental caries in children with down syndrome. TABLE 6 show that ρ value 0,000 means that the role of parents and teachers has significant influence together on dental caries in children with down syndrome.

Based on TABLE 1 showed that the most of respondents were female, namely 27 people (73%). Characteristics of respondents aged 41-50 years were 13 people (35.1%). The educational characteristic of most respondents was high school, namely 14 people (37.8%). Job characteristics show that the most of respondents' job levels are housewife, namely 21 people (56.8%).

TABLE 2
Characteristics of Teacher Respondents for Children with Down Syndrome

Characteristics		Frequency	Percentage (%)
Gender	Male	3	8.1
	Female	34	91.9
Age	20-30 years	17	45.9
	31-40 years	9	24.3
	41-50 years	3	8.1
	51-60 years	8	21.6
Education	S1	33	89.2
	S2	4	10.8

Based on TABLE 2 showed that the most of teacher respondents were female, namely 34 people (91.9%). The characteristics of respondents aged 20-30 years were 17 people (45.9%). The educational characteristics of most teacher respondents were S1, namely 33 people (89.2%). Based on TABLE 3 showed that the most of respondents with down syndrome children were male, namely 20 people (54.1%). Characteristics of respondents aged 11-15 years were 18 people (48.6%). The characteristics of the DMF-T index show that the most of children with down syndrome in extraordinary schools in North and East Surabaya are in the category (≥ 6.6) very high with 18 people (48.6%).

TABLE 3
Characteristics of Respondents from Down Syndrome Children

Characteristics		Frequency	Percentage (%)
Gender	Male	20	54.1
	Female	17	45.9
Age	6-10 years	12	32.4
	11-15 years	18	48.6
	16-20 years	6	16.2
	21-25 years	1	2.7
DMF-T	0.0-1.1	4	10.8
	1.2-2.6	3	8.1
	2.7-4.4	7	18.9
	4.5-6.5	5	13.5
	≥ 6.6	18	48.6

Based on TABLE 4 it is known that value ρ *value* amounting to 0.006, which is smaller than 0.05, In conclution that there is a relationship between the role of parents in maintaining oral health with dental caries in children with down syndrome in extraordinary schools in the North and East Surabaya areas. So H_1 is accepted while H_0 is rejected. Survey results averaged a parent's role of 74.14% in a

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sufficient category, with most of them answering "often" to every statement.

Based on TABLE 5 it is known that value ρ *value* correlation between the roles of both parents and teachers and the DMF-T scores in children with Down syndrome. More specifically, higher levels of involvement by parents and teachers were associated with lower levels of dental caries, with Spearman's ρ values of 0.006 and 0.004, respectively. Multiple regression analysis further reinforced the findings, showing a significant combined influence of both parental and teacher roles on dental caries levels (ρ = 0.000).

TABLE 4
Analysis of the Relationship between the Role of Parents in Maintaining Dental and Oral Health with Dental Caries in Down Syndrome Children in Extraordinary Schools in the North and East Surabaya Region

		The role of parents				
		Less	Enough	Good	n	ρ *value*
Caries Tooth	Very high	4	13	1	18	0.006
	High	1	3	1	5	
	Moderate	2	4	1	7	
	Low	0	1	2	3	
	Very low	0	1	3	4	
	n	7	22	8	37	
Correlation coefficient		= -0.564				

TABLE 5
Analysis of the Relationship between the Role of Teachers in Maintaining Dental and Oral Health with Dental Caries in Down Syndrome Children in Extraordinary Schools in the North and East Surabaya Region

		Teacher's Role				
		Less	Enough	Good	n	ρ *value*
Caries Tooth	Very high	11	7	0	18	0.004
	High	2	3	0	5	
	Moderate	5	2	0	7	
	Low	0	0	3	3	
	Very low	0	2	2	4	
	n	18	14	5	37	
Correlation coefficient		= -0.460				

amounting to 0.004, which is smaller than 0.05, it can be concluded that there is a relationship between the role of teachers in maintaining oral health and dental caries in children with down syndrome in extraordinary schools in the North and East Surabaya areas. So H_1 is accepted while H_0 is rejected. Survey results averaged a teacher's role of 66,84% in a sufficient category, with most of them answering "often" to every statement.

TABLE 6
Multiple Regression Analysis of the Role of Parents and Teachers in Maintaining Dental and Oral Health with Dental Caries in Down Syndrome Children in Extraordinary Schools in the North and East Surabaya Region

Variable	Regression Coefficients	t_{count}	ρ
Constant	24,891	4,951	0,000
The role of parents	-0.101	-2,107	0.043
Teacher's Role	-0.238	-2,049	0.048
R	= 0.275		
R2	= 0.075		
Fcount	= 6.439		
ρ	= 0.000		

Based on TABLE 6 it is known that value $\rho < 0.05$ and there is a negative relationship and a significant influence together, namely the role of parents and the role of teachers on dental caries in children with down syndrome.

IV. DISCUSSION

A. INTERPRETATION OF RESULTS

This study sought to explore the influence of parental and teacher involvement on oral health outcomes, specifically the prevalence of dental caries, among children with Down syndrome in special education schools in North and East Surabaya. The results indicated a significant inverse

The majority of parents in this study were found to have a "sufficient" level of involvement, based on standardized scoring metrics. Similarly, teachers demonstrated a moderate level of participation in promoting oral hygiene behaviors in school. Despite these moderate levels of engagement, the average DMF-T index among participating children fell into the "very high" category (≥ 6.6)**,** underscoring the persistent risk of caries even when support structures are in place.

The inverse relationship between caregiver involvement and dental caries aligns with health behavior models, such as Blum's theory, which posits that personal health is influenced by behavior, environment, services, and heredity [33]. Children with Down syndrome, due to their developmental limitations, are heavily reliant on their caregivers for performing basic health-related behaviors, including oral hygiene. Thus, the role of adults around them both at home and at school is critical to their oral health outcomes.

B. COMPARISON WITH PREVIOUS STUDIES

The findings of this research are consistent with earlier investigations highlighting the critical influence of caregivers in managing the oral health of children with disabilities. For example, Situmeang et al. reported that parental involvement was a key factor in determining oral hygiene outcomes among children with Down syndrome [34]. In that study, parents who frequently supervised and assisted with toothbrushing were more likely to have children with lower caries prevalence.

Similarly, Artini and Permatasari found a significant correlation between food habits, parental roles, and caries incidence among children with Down syndrome in special education schools in Bandar Lampung [35]. Parents who actively taught and monitored brushing habits and limited cariogenic food consumption had children with better oral health status. These findings affirm the present study's conclusions regarding the importance of daily parental engagement.

Teacher involvement, while less frequently explored in the literature, is emerging as a relevant variable. The study by Pay et al. found that teachers play a significant role in shaping health-related behaviors among elementary students, particularly in marginalized or underserved populations [36]. Although their study focused on typically developing children, the implication is that educators can serve as role models and facilitators of routine oral health behavior, particularly when children spend a large portion of their day at school.

Interestingly, other studies have shown that caries prevalence in children with Down syndrome can be lower than that of the general population, due in part to biological

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factors such as higher salivary pH and IgA levels, and reduced cariogenic bacteria [37], [38]. Brignardello-Petersen et al., for instance, suggest that these protective factors may contribute to a lower incidence of caries in some populations with Down syndrome [39]. However, these results differ from the current study, where most children exhibited a very high DMF-T index.

This discrepancy may be due to socioeconomic, behavioral, and educational factors. As highlighted in previous Indonesian studies, parental educational background, awareness, and access to dental services significantly affect oral health outcomes in special-needs populations [40]. In the current study, the majority of parents had only completed secondary education and lacked comprehensive knowledge of dental hygiene protocols, which may account for the higher caries rates observed.

Furthermore, regional disparities may explain some variations in caries prevalence among children with Down syndrome. A study conducted by Amelia et al. in West Java found a lower mean DMF-T index among Down syndrome students, possibly due to stronger parental involvement and better access to community-based health programs [41]. This contrasts with our setting in Surabaya, where, despite some parental and teacher involvement, systemic health promotion initiatives appear limited.

Taken together, these findings emphasize that biological predispositions must be considered alongside environmental, behavioral, and educational factors, especially in populations with special health care needs. Biological resilience may offer some protection, but without consistent caregiver support, preventive care, and access to services, children with Down syndrome remain highly vulnerable to dental caries.

C. STUDY LIMITATIONS AND IMPLICATIONS

Despite the strengths of this study including its focus on a relatively under-researched population and the use of validated instruments several limitations must be acknowledged.

First, the study used a purposive, non-randomized sampling method, which may limit the generalizability of the findings beyond the current sample. Although purposive sampling is often appropriate in research involving special needs populations, the lack of randomization may introduce sampling bias [42].

Second, the cross-sectional design limits causal inference. While significant associations were found between caregiver involvement and dental caries, the directionality of these relationships cannot be fully established. Longitudinal studies would be necessary to determine the extent to which improvements in parental and teacher roles directly reduce caries incidence over time [43].

Third, the study relied in part on self-reported data, particularly from the questionnaires measuring the roles of parents and teachers. While the instruments were validated for reliability, self-report bias cannot be entirely ruled out. Social desirability may have led some respondents to overestimate their level of involvement in oral care practices.

Another limitation was the difficulty in conducting dental examinations on some children with Down syndrome. Behavioral challenges and fear of the examination process led to some resistance, potentially affecting the accuracy of caries assessment in a few cases. While experienced examiners were used to minimize this impact, more flexible or desensitization-based protocols could improve cooperation in future studies [44].

Despite these limitations, the study offers several important implications for practice and policy. First, the findings underscore the need for enhanced training and education for both parents and teachers on the importance of regular oral hygiene, proper toothbrushing techniques, and dietary counseling for children with Down syndrome. Providing accessible resources, such as visual aids or routine demonstration sessions, could significantly improve caregiver effectiveness.

Second, schools that cater to children with special needs should integrate structured oral health education programs within their curriculum. Activities like supervised toothbrushing sessions, dental health-themed learning modules, and regular dental check-ups facilitated by local health services could bridge existing gaps in oral health support.

Third, this study suggests that the implementation of interdisciplinary programs, involving dental health professionals, educators, and community health workers, is essential for promoting comprehensive oral health care in special education settings. Such programs could also serve to build stronger links between home and school environments, enhancing consistency in health behavior reinforcement [45].

Finally, from a policy standpoint, the findings support the expansion of the national UKGS (Usaha Kesehatan Gigi Sekolah) program to cover special education institutions. Currently, coverage is limited and sporadic, leaving children with disabilities underserved. A targeted adaptation of UKGS for SLB schools could ensure that high-risk populations receive the preventive and curative services they require.

V. CONCLUSION

This study aimed to analyze the relationship between parental and teacher involvement in oral health maintenance and the incidence of dental caries in children with Down syndrome enrolled in special education schools in North and East Surabaya. The research was conducted using a cross-sectional design involving 37 children with Down syndrome and their respective parents and teachers. Data were collected through validated questionnaires and clinical dental examinations using the DMF-T index. The findings revealed that parental involvement in oral health was in the "sufficient" category with a mean score of 74.14%, while teacher involvement was also categorized as "sufficient" with a mean score of 66.84%. Despite these moderate levels of support, the DMF-T index of the children was in the "very high" category, with 48.6% of respondents scoring ≥6.6. Statistical analysis using the Spearman-rank test indicated a significant negative correlation between the role of parents and dental caries ($\rho = 0.006$), and between the role of teachers and dental caries ($\rho = 0.004$). Furthermore, multiple regression analysis showed that both parental and teacher

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roles simultaneously had a significant effect on the incidence of dental caries in children with Down syndrome ($\rho = 0.000$). These findings emphasize that increased involvement from both home and school environments is essential for improving oral health outcomes in this vulnerable population. However, the persistence of high caries prevalence, despite sufficient caregiver involvement, indicates the need for more intensive and structured oral health promotion programs, both in the home and at school. Future research should involve larger sample sizes and adopt longitudinal designs to explore causal relationships more deeply. Additionally, intervention-based studies evaluating the effectiveness of integrated parent-teacher-dental professional collaborations in reducing dental caries in special needs populations are recommended. It is also crucial to assess the impact of socioeconomic factors, caregiver knowledge, and access to oral health services in influencing these outcomes, to develop more targeted and sustainable public health strategies.

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DATA AVAILABILITY

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request

AUTHOR CONTRIBUTIONS

Mira Indah Pusponegoro was responsible for the conceptualization of the study, methodology design, data collection, formal analysis, and drafting the original manuscript. Ratih Larasati contributed to the investigation process, provided essential resources, and assisted with data visualization and manuscript review. Agus Marjianto supervised the overall project, validated the findings, and contributed to the review and editing of the manuscript. Anshad Ansari supported the formal analysis, conducted the literature review, and participated in critical revisions and final editing. All authors have read and approved the final version of the manuscript.

DECLARATIONS

ETHICAL APPROVAL

This study was approved by the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. All research procedures were conducted in accordance with applicable ethical guidelines and regulations.

CONSENT FOR PUBLICATION PARTICIPANTS

All participants and their guardians gave consent for the anonymized data to be published for academic purposes.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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