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Oral Condition and Salivary pH Down Syndrome Children in the Occurrence of Caries: A Narrative Review

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Abstract

Purpose:. Down syndrome is a genetic disorder caused by trisomy 21, which affects various body systems and morphology, including the oral cavity. Down syndrome shows a intraoral characteristics such as taurodontism, microdontia, hypodontia, and delayed tooth eruption higher salivary pH, elevated bicarbonate levels, and increased IgA concentrations. The higher prevalence of caries in children with DS, mainly due to poor eating habits, neuromuscular dysfunction, and inadequate oral hygiene. Our aim in this study was to analyze the relationship between oral cavity conditions, salivary composition, and caries prevalence in children with Down syndrome highlighting unique factors that contribute to their oral health status.

Methodology: Narrative review analyzing 15 relevant journals on oral health in children with Down syndrome.

Findings: Salivary pH, delayed tooth eruption, and eating habits contribute to the incidence of caries.

Unique contribution to theory, practice and policy: The varying prevalence of caries in children with Down syndrome highlights the importance of a focused approach to dental care, considering the unique challenges they face.

Keywords: *Down Syndrome, Caries , Saliva Ph, Oral Cavity, Human and Health*

1. Introduction

Down syndrome is a genetic disorder caused by trisomy of chromosome 21. The phenotypic manifestations of Down syndrome affect various body systems such as musculoskeletal, neurological, cardiovascular, craniofacial, sensory, respiratory, autoimmune, psychiatric, and brain development (Antonarakis et al., 2020). According to the latest data from the World Health Organization (WHO), the global prevalence of children with Down syndrome is estimated to be between 3,000 and 5,000 babies each year, with 1 case of Down syndrome per 1,000 to 1,100 live births worldwide.

The clinical features that distinguish children with Down syndrome from typical children in the oral cavity include anodontia, hypodontia, microdontia, drooling, fissured tongue, taurodontism, open bite, macroglossia, malocclusion, caries, poor oral hygiene (OHI), delayed tooth eruption, small maxilla, and retained deciduous teeth (Desingu, Adapa & Devi, 2019). Additionally, intraoral characteristics such as large, protruding, and fissured tongues pose challenges for dental care (Welbury, Duggal & Hosey, 2018). Due to dental malformations, dysmorphology, muscle weakness, and poor neuromotor control, Faulks et al. found that people with Down syndrome have difficulty in mastication and have decreased masticatory efficiency. (Anil, Shabnam and Narayanan, 2019). Reduced neuromotor function is due to structural and functional abnormalities of the oropharynx, rudimentary neuromotor development and hypotonia (Nordstrøm et al., 2020, p. 456). These dental anomalies could result to challenges in daily activites such as feeding. Around 50-80% of children with Down syndrome experience feeding problems. Feeding problems in Down syndrome children stem from a combination of medical, anatomical, physiological, and behavioral factors. Down syndrome children may face obstacles related to neuromotor coordination, craniofacial abnormalities, and structural issues, all of which can affect their capability to eat, drink, and swallow adequately (Anil, Shabnam and Narayanan, 2019). Motor skill development delays are frequently observed in children with Down syndrome. When oral-motor skills are delayed, it can hinder effective food manipulation in the mouth and slow the development of chewing patterns necessary for safely consuming solid foods. (Hielscher, L et al, 2023).

Among the various oral characteristics observed in children with Down syndrome is a lower incidence of caries compared to typical children. This reduced caries rate can be linked to the salivary electrolyte composition and a more alkaline pH in children with Down syndrome. Factors contributing to this lower caries incidence include a higher occurrence of microdontia, hypodontia, and bruxism; reduced exposure to cariogenic bacteria in the mouth; increased salivary pH and bicarbonate levels; the presence of diastemas, shallow tooth fissures, and delayed tooth eruption (Al-Biltagi, 2015).

The majority of studies highlight methodological limitations, such as small sample sizes, lack of appropriate control groups, wide age ranges of participants, and inadequate statistical analysis. Studies reporting higher levels of dental decay suggest that this may be related to immune system disorders, poor motor coordination, and intellectual disabilities, leading to inadequate oral hygiene. Additionally, low muscle tone contributes to food remnants remaining

longer in the mouth, increasing the risk of dental damage (Silva, M.C. et al., 2020).

This narrative review highlights several gaps in understanding the relationship between oral cavity conditions, salivary composition, and caries prevalence in children with Down syndrome. Methodological limitations, such as small sample sizes, lack of control groups, and wide participant age ranges, restrict the generalizability of findings, while inconsistent methodologies hinder comparisons across studies. Research on salivary composition is limited, with insufficient exploration of biochemical and microbiological properties, including altered salivary proteins and antimicrobial peptides. Although clinical dental anomalies like microdontia and malocclusion are well-documented, fewer studies address how micro-level factors, such as the oral microbiome, interact with salivary composition to influence oral health. Conflicting findings on caries prevalence reveal gaps in understanding the interplay of protective factors (e.g., alkaline pH) and risk factors (e.g., poor hygiene, immune disorders). Behavioral and social factors, including dietary habits, caregiver involvement, and access to dental care, remain underexplored, as does the role of feeding difficulties and nutritional deficiencies in oral health outcomes. Longitudinal studies tracking changes from childhood into adulthood are scarce, leaving gaps in understanding how oral health challenges evolve over time. Addressing these gaps through standardized methodologies and more comprehensive studies could improve insights into the unique oral health needs of children with Down syndrome.

This narrative review intends to analyze the relationship between oral cavity conditions, salivary composition, and caries prevalence in children with Down syndrome highlighting unique factors that contribute to their oral health status.

2. Methodology

This study utilized a narrative review as its research method. A narrative review involves identifying, analyzing, and summarizing previously published studies. In this study, the relationship between oral cavity conditions, salivary composition, and caries prevalence in children with Down syndrome was examined, emphasizing distinctive factors influencing their oral health.

A total of 15 relevant journals were used in this study. Data sources were obtained from Google Scholar, PubMed, and Elsevier using keywords such as “Down syndrome,” “caries,” “salivary pH,” “oral cavity,” and “feeding problem.” The literature used focuses on the oral cavity conditions of children with Down syndrome and the incidence of dental caries. The inclusion criteria for this study are: (1) experimental studies or research in English or Indonesian that focuses on the oral cavity conditions and salivary pH in children with Down syndrome and the occurrence of caries, (2) studies comparing children with Down syndrome to typical children. Excluded from this review are studies that: (1) were published before January 2019, (2) are duplicate studies.

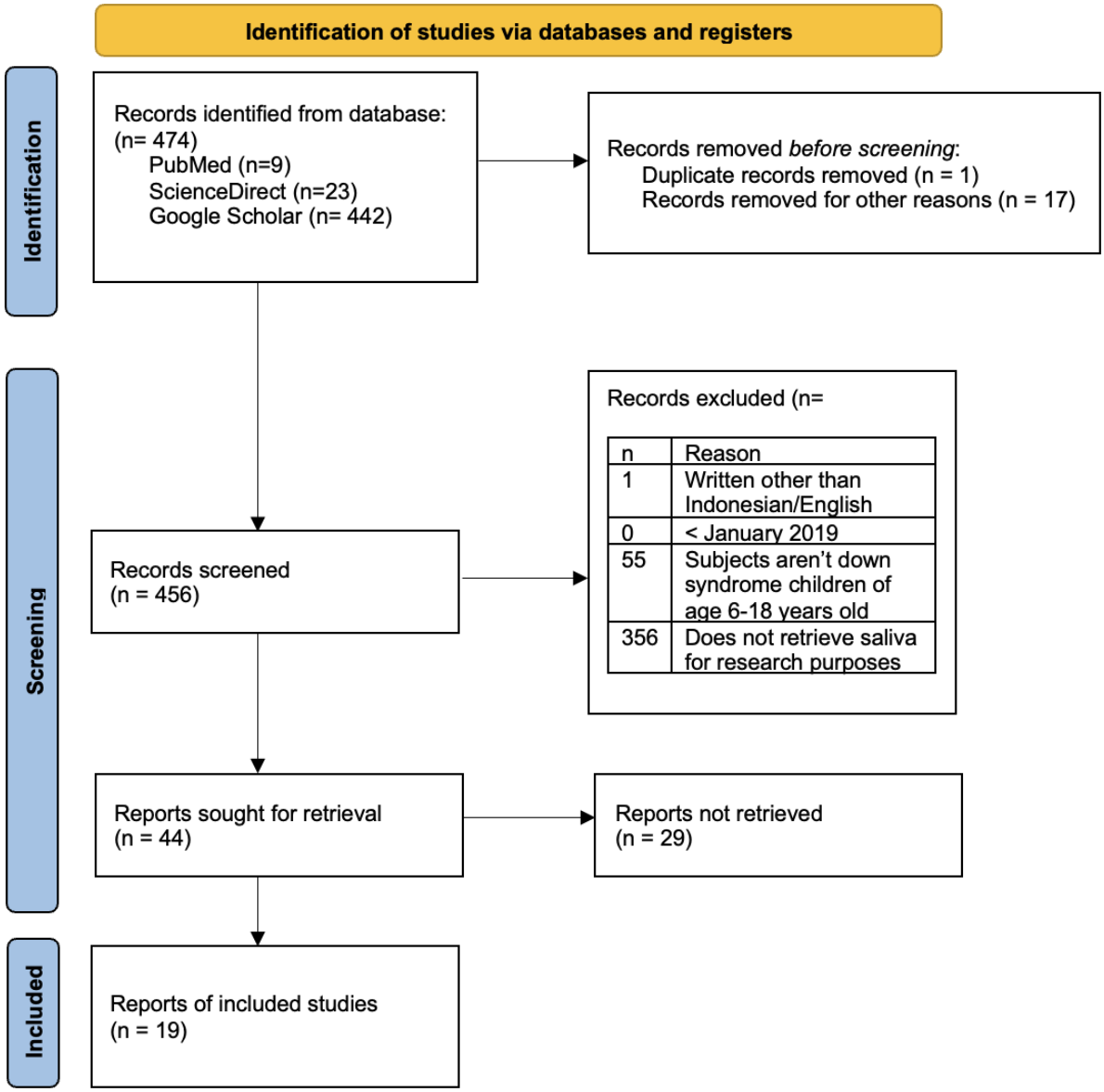

Figure 1: Response Rate

3. Discussion

3.1 Salivary pH Conditions in Children with Down Syndrome

The study by Akhmad, Adhani, Aspriyanto (2019), stated that individuals with Down syndrome were found to have a higher or more alkaline pH compared to non-Down syndrome individuals. Down syndrome patients have higher pH and sodium bicarbonate levels secreted by the parotid glands. This is a factor responsible for the lower incidence of caries in individuals with Down syndrome. Supported by the study of Hamid et al. (2020), children with Down syndrome were found to have increased levels of IgA, thereby enhancing protection against caries. IgA plays a role in neutralizing toxins and enzymes, inhibiting bacterial adhesion to teeth. The study by Pratiwi, Sulistyani, Kiswaluyo (2021), it was stated that the salivary pH in

children with Down syndrome averaged 7.11, which is categorized as alkaline. It was shown that there was no significant difference in salivary pH compared to typical children. However, in the study by Anandan, Lakshminarayan, Nagappa (2022), children with Down syndrome had lower salivary pH compared to children without Down syndrome with the averaged 7,25 and for children without Down syndrome was 7,77. The study by Widyawati, Fadriyanti, Dita (2022), showed that individuals with Down syndrome had salivary composition with higher IgA concentrations, electrolyte flow rate, buffering capacity, and salivary pH. This is due to the manifestation of trisomy in the salivary glands, leading to lower caries prevalence because of increased protection from saliva. The study by Silva et al. (2020) demonstrated that children with Down syndrome have more alkaline saliva with an enhanced buffering capacity, attributed to elevated calcium and bicarbonate ion levels. This contributes to caries prevention by protecting the tooth surfaces, minimizing food stagnation, and reducing cariogenic bacteria. Similarly, Martins et al. (2022) found that caries rates were lower in children with Down syndrome compared to typical children. Factors such as delayed tooth eruption and bruxism, which smooths tooth surfaces and aids in cleaning, contribute to this reduced incidence. Additionally, the increased electrolyte levels, higher pH, elevated bicarbonate, lower Streptococcus mutans levels, and higher IgA concentrations offer further protection against caries.

3.2 Oral Conditions in Children with Down Syndrome

A study done by Desingu, Adapa & Devi (2019) concluded that the most common dental abnormalities were taurodontism, anodontia, delayed eruption, conical-shaped teeth, microdontia, fusion, hypodontia, geographic tongue, retained teeth, and tooth agenesis. In the study by Kowash et al. (2019) showed that children with Down syndrome had a much higher number of carious teeth compared to healthy children. They also received more restorative dental treatments and had higher restorative needs scores. Calculus indices were higher in children with Down syndrome, and they experienced more occlusal problems, particularly open bites and Class III molar malocclusions. Dental erosion was also more likely seen in children with Down syndrome. The study by Anusha et al. (2022) confirmed a higher prevalence of dental caries among children with Down syndrome, with 56.5% affected, in line with several previous studies. Contributing factors include caregivers' lack of awareness, poor eating habits, and inadequate oral hygiene practices. The study concluded that children with Down syndrome (DS) had elevated rates of dental caries and poor periodontal health, highlighting the need for targeted dental care. Mental health conditions were found to be a key factor affecting oral health outcomes across different ages and genders. Research by Gufran et al. (2019) documented a high prevalence and severity of caries among children with Down syndrome in Riyadh, largely attributed to poor oral hygiene. Meanwhile, Sosiawan et al. (2022) reported that the average OHI-S score for children with Down syndrome reflected good oral hygiene, with a notable link between parental knowledge and the children's oral hygiene status.

However, the study by Robertson et al. (2019) showed that children with Down syndrome had lower caries prevalence, although factors such as hypodontia, microdontia, and increased IgA

levels in saliva were thought to provide protection. Delayed tooth eruption (DTE) in Down syndrome children could also affect these outcomes, suggesting that studies on caries in Down syndrome must consider eruption timing. Furthermore, the study by Bhoopathi & Tellez (2021) reported lower caries prevalence in children with Down syndrome compared to typical children. This study explains the differences in oral health in children with Down syndrome, emphasizing the need for specialized dental care considering their unique developmental challenges. While previous studies show varying results regarding caries prevalence in children with Down syndrome, with some reporting lower rates compared to typical children, factors such as orofacial characteristics, including microdontia and delayed tooth eruption, are believed to reduce caries risk.

3.3 Feeding Problems in Children with Down Syndrome

According to the study by Anil MA, S. Shabnam, and S. Narayanan (2019) indicates that genetic factors in children with Down syndrome affect their psychomotor and neuromotor abilities, influencing eating behaviors. Children with DS often face challenges with chewing, swallowing, and sometimes refuse food. Clinical assessments of feeding behaviors also revealed that chewing was impacted by frequent tongue protrusion, immature movement patterns, and extended chewing cycles. The study by Anandan, Lakshminarayan, Nagappa (2022), it was explained that children with Down syndrome have masticatory dysfunction due to poor neuromuscular function. As a result, they tend to consume softer foods with higher carbohydrate content. Additionally, the food they eat remains in the mouth for more extended periods, potentially leading to higher caries incidence in Down syndrome children.

A study by Osaili et al reported that Children with Down syndrome (DS) often have shorter stature and higher rates of overweight and obesity, underscoring the importance of balanced diets and healthy eating habits. Parents play a key role by influencing both the type and amount of food their children eat. For example, “overly permissive” parenting—such as rarely encouraging children to eat during meals or frequently making special meals just for them—accounts for over 34% of the connection between children’s feeding issues and their weight and diet outcomes. Osaili et al measured feeding problems in down syndrome children using STEP-CHILD (Screening Tools for Feeding Problems), as a result parents of 82 out of 83 participants reported feeding difficulties. The most common issues involved food selectivity (62.2%), persistent eating when food was available (57.7%), and swallowing without adequate chewing (50.0%). Significant associations were observed between feeding difficulties and participant age, specifically for challenges in eating independently ($p = 0.004$) and pushing food away or trying to leave the area ($p = 0.001$).

4. Conclusion

We conclude that Children with Down syndrome (DS) experience varying caries prevalence influenced by multiple factors. Protective elements like higher salivary pH, elevated bicarbonate levels, and increased IgA concentrations reduce caries risk, while factors such as delayed tooth eruption, bruxism, and unique dental morphology also contribute. However, poor eating habits, inadequate oral hygiene, and mental or neuromuscular conditions can increase

caries prevalence. Food selectivity, often the highest reported feeding problem, leads to preferences for soft, carbohydrate-rich foods and prolonged food retention, heightening dental issues. Caregiver awareness, fluoride use, and dental care access significantly impact outcomes. Feeding challenges, influenced by age and developmental delays, exacerbate these risks over time. A targeted approach is essential for managing oral health in children with Down syndrome.

Recommendation

To improve oral health in children with Down syndrome, the dental care programs focusing on preventive measures are essential. Caregivers should be educated on oral hygiene, fluoride use, and balanced diets to reduce cariogenic food intake. Addressing feeding difficulties through multidisciplinary collaboration and regular dental check-ups can further enhance outcomes. Future research should explore factors like delayed tooth eruption and bruxism to better guide care strategies.

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