

Identifying risk factors for articulation disorders in children

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ABSTRACT

Background: Articulation disorders, characterized by difficulties with speech production due to problems with the speech mechanism, can significantly impact a child's speech, language, and communication development. These disorders can arise from various factors, including muscle weakness, limited fine motor skills, hearing loss, swallowing difficulties, tongue positioning issues, pacifier use, muscle spasms, intellectual disabilities, poor coordination of speech organs, and psychological conditions.

Objective: This study aimed to explore the specific risk factors associated with the development of articulation disorders in children.

Methods: The research method used is descriptive research with a literature review approach. Secondary data were collected from journals related to factors affecting articulation disorder in children. Respondents in the study were children with an average age of 3-13 years. The articles reviewed were published within the last 10 years in Indonesian and English. Five journals meeting the criteria were identified and discussed in the review.

Results: The results showed that several factors such as hearing loss, Down syndrome, a history of using pacifiers for more than 18 months, thumb sucking, poor differentiation of oral muscles and AOB conditions significantly affected articulation disorders in children with an average age range of 3-13 years. The most influential factor is the condition of the child with Down syndrome.

Conclusion: There is a significant relationship between several factors that influence the occurrence of articulation disorders in children.

Keywords: anterior open bite, articulation disorder, children, down syndrome, hearing impairment, hearing loss

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Introduction

Communication is one of the human needs to be able to exchange information through codes that are mutually understood by the sender and receiver. Communication is carried out to channel the content of thoughts, ideas, opinions and other needs. Good communication can be formed from the childhood phase. The children's phase is a developmental phase that will be very influential for their future. Child development includes motor, sensory, cognitive, language, moral and social-emotional development. Children's development at each age is certainly different, the time when children begin to grow and develop is precious time. Proper stimulation is needed in children to be able to achieve maximum development. One of the children's developments that needs to be fulfilled is the ability to speak to be able to good in language.

The ability to speak is of course very necessary for children to be able to communicate and convey information

or feelings to others. Speaking is one of the indicators of children's cognitive development. The development of normal speech in children goes through 5 stages, Reflexive vocalization, Babbling, Lalling, Echolalia, and True Speech.² Communication that occurs when speaking is a complex process, the speech process is influenced by the functions of the central nervous system, hearing, intellectual activity, verbal memory and the organs that make up the speech mechanism. When a person speaks, whatever the language is, it will certainly move the organs of the body that make up the speech mechanism.

In the period of children's milestone in speaking, there are several disorders that can occur when children begin to learn to speak for language, such as disorder in mentioning a word or composing words when speaking. Speech disorders can occur because there is a problem in the child's articulation when speaking. Articulation is the ability of a person to pronounce speech sounds correctly with consistent and sequential movements of the constituent organs

involved.³ Articulation disorder is a disorder that occurs due to the formation of inappropriate speech sounds in terms of place, force, speed, time, and pressure.⁴ Articulation disorders can occur because there is a disorder in the organs that make up the speech mechanism. The speech mechanism is the process of producing speech (words) by integrated movements and the role of organs of the body such as the palate, tongue, muscles that make up the oral cavity, vocal cords, esophagus to lungs.⁵

Articulation disorders that occur in children are in the form problem in mentioning several phonemes in a word. The occurrence of articulation disorders with difficulty mentioning these phonemes causes difficulties in analysis the meanings mentioned by the children. Frequently when the child is still not fluent in pronouncing a word, other friends will mock the child's speaking style so that the child becomes less confident, lazy, crying and even becomes angry. This articulation disorder in children can be caused by several factors. For example; dysarthria or weakness of muscles in the mouth (lip muscles, tongue muscles), lack of control and skill in the child's fine motor skills, hearing loss, disturbances when swallowing, the position of the tongue in the mouth, anterior open bite condition, using pacifier, spasms or disorders of the child's vocal cords, suffering from disorders such as cerebral palsy, autism and Down syndrome, inability to coordinate movements of articulated organs such as tongue, lips and palate and psychological disorders (overprotective and traumatic).

This articulation disorder later can affect the socio-emotional development of the child, the child will become less confident, afraid, shy, anxious so the child does not like social life with others. Children with articulation disorders tend to have lower social skills than normal children without articulation disorders.

Methods

The design of this study used a type of descriptive research with a literature review approach. Secondary data were taken through literature such as journals or articles that had been published on websites. To facilitate the search and determine the journals to be used, the article search combined the Boolean operators "AND" and "OR" to expand and specify the article search, "Articulation Disorder" and "Children" were the keywords used in the creation of this literature review. Sources in the form of journals and articles in this literature were related to the factors that affect the occurrence of articulation disorder. This journal and article search used two databases, such as PubMed and Google Scholar. The articles used were articles published in the last 10 years, with articles in Indonesian and English. Based on a search through the database with the keywords "Articulation Disorder" and "Children," the results yielded 5 journals that met the criteria and were reviewed in the discussion section (Figure 1).

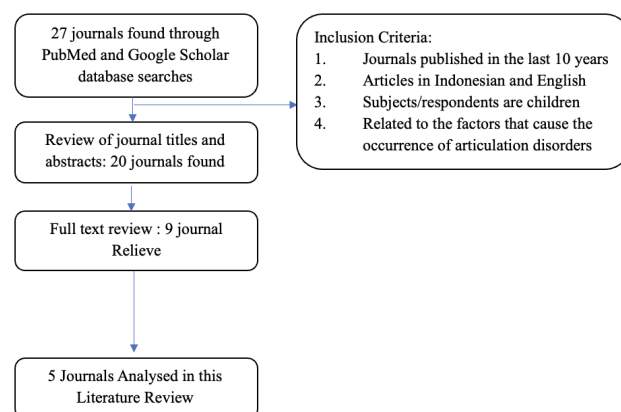


Figure 1. Flow chart literature study search flow

Results

Through a journal search conducted with 2 databases of high and medium standards, such as PubMed and Google Scholar, 5 Indonesian and English journals with publications published 10 years ago were found as the results of this literature review. The journals discussed all the factors that affect the occurrence of articulation disorders in children. Further discussion will be explained through the following Table 1.

Ummi Apriliza et al. (2023) conducted a study titled *"The Relationship Between the Intensity of Social Interaction and Articulation Ability in Children with Hearing Impairment at SLB YRTRW Surakarta."* The study used a descriptive design with a correlational approach. The participants consisted of 102 students with hearing impairments at SLB YRTRW Surakarta, and 25 students met the inclusion and exclusion criteria. Of these respondents, 14 were girls and 11 were boys, with ages ranging from 8 to 13 years. Statistical analysis included validity tests, univariate, and bivariate analysis using the Spearman rank test technique. The study employed questionnaires and observations as measuring instruments. The results showed a correlation coefficient of -0.219 and a significance value of 0.292. Based on these findings, it was concluded that there is no significant relationship between the intensity of social interaction and articulation ability in children with hearing impairments at SLB YRTRW Surakarta, who exhibited low impairment levels.

Nining et al. (2023) conducted a study titled *"The Implementation of the Phonetic Placement Method for Articulation Disorders in a Down Syndrome Client: A Single Case Study."* The study used a Single Subject Research design with a one-group pretest-posttest approach. The participant was an 8.5-year-old girl with Down syndrome. The study employed several measuring tools, including the Observation Form, Speech Tool Examination Form (PAW), Articulation Test Form, Auditory Language Comprehension Test Form (PBSA), and Initial and Final Test Forms. After 10 therapy sessions, the results indicated a p-value of 0.070, suggesting progress in the patient's articulation. The administration of the Phonetic Placement method led to a 60% improvement in the articulation ability of the child with Down syndrome.

Jelena et al. (2021) conducted a study titled *"Risk Factors for the Development of Specific Articulation Disorder in Children."* The study used a Random Controlled Trial (RCT) design with 100 participants aged 5-7 years. The sample was divided into two groups: an experimental group of 50 children with articulation disorders and a control group of 50 children without articulation disorders. Measuring instruments included the Global Articulation Test, a research questionnaire, and the Oral Musculature Test. The study found that children in the experimental group had used pacifiers for over 18 months, sucked their thumbs, and exhibited poor differentiation of mouth muscles, resulting in significantly incorrect pronunciation of sounds. The results showed a p-value of <0.001, indicating statistically significant outcomes.

Kravanja et al. (2018) conducted a study titled *"Three-Dimensional Ultrasound Evaluation of Tongue Posture and Its Impact on Articulation Disorders in Preschool Children with Anterior Open Bite."* This cross-sectional study involved 446 children aged 3-7 years, including 210 females and 236 males. The participants were divided into two groups: 414 children without anterior open bite (AOB) and 32 children with AOB. Data collection and analysis were performed using the R statistical package, employing Fisher's exact test, t-test, or the nonparametric Mann-Whitney test for comparisons. The study used three-dimensional ultrasound as the measuring instrument. The results showed significant differences in resting tongue posture and the prevalence of articulation disorders between children with AOB and the control group, with a p-value of <0.001, indicating a strong association between AOB and articulation disorders.

John et al. (2020) conducted a study titled *"Predicting Speech-Sound Disorder Outcomes in School-Age Children with Hearing Loss: The VicCHILD Experience."* This cohort study included 90 children aged 5-12 years, all of whom were part of the Victorian Childhood Hearing Impairment Longitudinal Data Bank (VicCHILD) and had congenital hearing loss. Statistical analysis was performed using Minitab 18 software, and the Goldman-Fristoe Test of Articulation was used as the measuring instrument. Among children aged 9-12 years (n=52) with hearing loss, 8 children (7.8%) experienced articulation disorders, which is one of the subtypes of speech-sound disorders (SSD).

Discussion

Communication is a human need to be able to interact with each other so that information can be exchanged. Good communication skills begin when children are developing, children's social communication will have a relationship with the parenting style of their parents.⁶ In communicating, speaking skills are needed to express something, often children say words with unclear articulation so other people cannot understand what is being said. The response from the environment that finds it funny results in the child continuing to make these mistakes. These mistakes can trigger bad habits into adulthood, which will cause articulation disorders. Articulation disorder is a disorder in the formation of

inappropriate speech sounds. Problems in this articulation can be divided into 4 groups, substitution (replacement of the phoneme referred to by another phoneme), omission (removal of phonemes in one word), distortion (change in word pronunciation) and addition (addition of phonemes in words). Articulation disorders in children are affected by several factors such as dysarthria, lack of control and skill in the child's fine motor skills, hearing loss, swallowing disorders, spasm or disorders of the child's vocal cords, suffering from disorders such as cerebral palsy, autism and Down syndrome, inability to coordinate the movement of articulated organs such as the tongue, lips and palate and psychological disorders (overprotective and trauma).

According to Bemtrai, et al, (2016) through Umami (2023) the auditory system provides information about the acoustic effects of articulation.⁷ Hearing loss can be defined as a partial or total inability to hear sounds in one or both ears. Yastari (2019) states that articulation is what is defined as structures in the brain that involve speech ability (speech ability area), so it can be interpreted that articulation refers to things related to speech or something that results from brain processing.⁸ So it can be concluded that articulation is needed for children with hearing loss to communicate. Feedback from hearing plays a very important role in coordinating the articulation process. Several factors of hearing loss have been shown to affect speech perception and production, including the level of auditory sensitivity, the configuration of hearing loss and the ability to recognize sounds. Children with hearing loss tend to be less sensitive to hearing.⁹

By looking at the relationship between hearing loss that can affect this articulation disorder, Umami Apriliza, et al. in 2023 conducted a descriptive study with a correlational design that looked for the relationship between social interaction and articulation ability in children with hearing impairment.² The articulation ability of children with Hearing Impairment in the study was obtained as many as 5 (20%) have articulation ability below average, 20 (80%) have articulation ability in the average category and 0 (0%) for children who have articulation ability above average. After conducting a study by giving questionnaires to respondents' parents regarding social interaction and articulation tests, a correlation coefficient value of -0.219 and a significance value of 0.2922 were obtained. Therefore, it can be concluded that there is no significant relationship between social interaction and articulation ability in children and Hearing Impairment at SLB YRTRW Surakarta. However, this is because other factors influence it. These factors are organic and functional. Organic factors consist of loss of hearing acuity, imperfect shape or physical structure of the mouth or face, poor coordination of speech muscles and narrowing of the palate so that the tongue experiences limitations in moving. Functional factors are in the form of inconsistent learning methods by parents in providing speech stimulation to children.

Different from the previous research study, John, et al, in 2020 also conducted a study that predicted problem in voice production in children aged 5-12 years who

experienced hearing loss.¹⁰ With the type of research design of the cohort, it was stated that out of a total of 90 children with hearing loss, as many as 8 children (7.8%) experienced articulation disorder which is one of the subtypes of speech sound disorder (SSD).¹⁰ The study showed that SSD is much more common in children with hearing loss compared to children with normal hearing. 58% of children with hearing loss are affected, one of which is an articulation disorder.

Aside from hearing loss, children with intellectual disabilities often have problems with their verbal communication due to disturbances in their speech production. Patients with Down syndrome have problems with the structure of the palate, the size of the tongue, muscle hypotonia and joint dysfunction in the temporomandibular it can affect articulation when speaking.¹¹ In a study conducted by Nining, et al, in 2023 with an 8.5-year-old child with Down syndrome, it was found that speech therapy is needed to be able to optimize the articulation ability of children with Down syndrome.¹² The 7 tests determined, the child with Down syndrome experienced articulation problems in the form of substitution (replacement of the phoneme referred to with another phoneme) and omission (deletion of the final consonant). Through the intervention carried out for 10 sessions, the patient experienced an increase of 60% by being able to produce consonants /p/ with a combination of vocal /a/ without omission by imitating 5 words, like :[paku], [palu], [pagi], [paha], and [padi].¹²

A randomized controlled trial study conducted by Jelena, et al., in 2021 revealed that risk factors for the occurrence of articulation disorders can be in the form of demographic factors (gender, ethnicity and socioeconomic status) and family factors (family history with articulation disorders, bilingualism and preschool education).¹³ In this era, exposure to electronic media in children is also one of the significant factors in the development of articulation devices. According to the American Academy of Pediatrics Guide, excessive exposure of electronic media to children leads to poor verbal performance. However, another important factor is the use of pacifiers or thumb-sucking in the long term. These habits harm the development of speech tools, such as protruding of the upper jaw, open bite or crossbite.¹⁴ Jelena, et al, found that an experimental group of 50 children with an age range of 5-7 years with articulation disorders obtained significant results with a history of using pacifiers for more than 18 months, thumb sucking and having poor differentiation of the mouth muscles. Children who suck their thumbs have a higher number of vocal errors than children who don't suck their thumbs, as well as children who have poor muscle differentiation.¹³

Another factor that affects articulation disorders is the anterior open bite (AOB) condition. In 2018 Kravanja, et al, conducted a cross-sectional study on 446 children with an age range of 3-7 years.²¹ The study used three-dimensional ultrasound to see the position of the tongue in the mouth. Anterior open bite is defined as the absence of front teeth contact when the back teeth touch. As a result of this

condition, there is a vertical gap in the mouth that causes difficulties in chewing and biting, so which affects articulation.²² 80% of mouth movements when speaking are determined by the front of the mouth, so this has a relationship with articulation disorders. The tongue is an important organ in the oral organs. The resting position on the tongue has a great impact on dentoalveolar, dental occlusion, orofacial function, and dental stability after occlusion treatment. Incorrect tongue posture is one of the etiological factors of AOB and articulation disorders. In the AOB group consisting of 32 subjects (7.2%), as many as 27 (84.4%) children were found to have articulation disorders and in the control group 10 (23.2%) children were also found to have articulation disorders. Significant results were found in children with AOB and articulation disorders seen from the obtained p-value (<0.001). With these results, it was concluded that the majority of children with AOB (84.4%) had articulation disorders when compared to children from the control group (23.2%).²⁰

This study on the factors that affect the occurrence of articulation disorder in children has several limitations. First, the sample size may not be large or diverse enough to represent the broader population, potentially limiting the generalizability of the findings. Second, the reliance on secondary data from various articles and journals may introduce bias or inconsistencies in the quality and reliability of the information. Third, the study does not account for other confounding variables, such as socioeconomic status, multilingual environments, or early intervention services, which may influence articulation development. Additionally, the variation in assessment tools and methodologies across different studies may affect the accuracy of comparisons and conclusions. Finally, the lack of longitudinal data limits the ability to track changes in articulation disorders over time and fully understand their developmental progression.

Conclusions

This literature review resume that several factors significantly affect articulation disorder. Some studies related to factors that affect articulation disorders say that factors such as hearing loss, down syndrome, history of using pacifiers for more than 18 months, thumb sucking, having poor differentiation of the mouth muscles and AOB conditions significantly affect articulation disorders in children with an average age range of 3-13 years. The most influential factor is the condition in children with Down syndrome. However, through research that discusses the factors that affect articulation disorders, further research is still needed to find out how these factors affect the development of articulation in children in their developmental phase. The limitations of each study can also be an obstacle to the research results obtained.

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Conflict of interest

According to the author, there isn't any possible conflict of interest related to this paper's study, writing, or distribution.

Author contributions

LPTMP conceived the study design and data collection and drafted the manuscript; IPYPP and GPK collected and revised the data.

Ethical consideration

This review study used published articles that are accessible. Thus, this study did not require any informed consent or ethical consideration.

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Table 1. Factors that affect the occurrence of articulation disorder in children

References	Title	Methods	Results
Ummi Apriliza, et al., 2023 ²	<i>Hubungan Intensitas Interaksi Sosial Dengan Kemampuan Artikulasi pada Anak Hearing Impairment di SLB YRTRW Surakarta</i>	<p>Study Design: descriptive with correlational design</p> <p>Participants: 102 students at SLB YRTRW Surakarta with children with Hearing Impairment. In taking as a sample, 25 students met the inclusion and exclusion criteria. 14 respondents are girls and 11 are males with respondents ranging in age from 8-13 years.</p> <p>Statistical Analysis: the tests used are validity, univariate, and bivariate. With the <i>spearman rank test technique</i>.</p> <p>Measuring Instruments: Questionnaire and Observation.</p>	Results of data analysis The correlation coefficient value of -0.219 and the significance value of 0.292 were obtained. It can be concluded that there is no relationship between the intensity of social interaction and articulation ability in children with Hearing Impairment at SLB YRTRW Surakarta with low impairment.
Nining et al., 2023 ¹⁸	<i>Implementasi Metode Phonetic Placement pada Gangguan Artikulasi Klien Down Syndrome: Studi Kasus Tunggal</i>	<p>Study Design: Single Subject Research, with one group pretest-post test design</p> <p>Participant: An 8.5 years old girl with Down syndrome</p> <p>Statistical Analysis : -</p> <p>Measuring Tools: Observation Form, Speech Tool Examination Form (PAW), Articulation Test Form, Auditory Language Comprehension Test Form (PBSA) and Initial and Final Test Form</p>	The p-value results in the study showed a .070 number which means The results showed that there was progress in patient articulation by 60% of the administration of the Phonetic Placement method to children with Down Syndrome. After doing 10 therapy sessions.
Jelena, et al., 2021 ¹⁶	<i>Risk Factors for the Development of Specific Articulation Disorder in Children</i>	<p>Study Design : <i>Random Controlled Trial (RCT)</i></p> <p>Participants: n=100 children aged 5-7 years. The sample was divided into 2 groups, n=50 experimental groups consisting of children with articulation disorders and n=50 control groups consisting of children without articulation disorders</p> <p>Statistical Analysis : -</p> <p>Measuring Instruments: <i>The Global Articulation Test</i>, Research Questionnaire and <i>Oral Musculature Test</i></p>	Children who included in the experimental group used pacifiers over 18 months, sucked their thumbs and had Poor differentiation of the mouth muscles results in significantly incorrect pronunciation of sounds. with a p-value of <0.001 which means that it gives significant results.
Kravanja, et al., 2018 ¹¹	<i>Three-dimensional ultrasound evaluation of tongue posture and its impact on articulation disorders in preschool children with anterior open bite</i>	<p>Study Design : <i>cross-sectional study</i></p> <p>Participants: 446 children with an age range of 3-7 years. Female (n=210) and male (n=236). Participants were divided into a group without AOB with children without AOB as many as 414 people and an AOB group with children with 32 AOB.</p> <p>Statistical Analysis: Data collection using R statistical package (www.R-project.org). The data were then analysed and compared using Fisher's exact test, t-test or nonparametric Mann Whitney test.</p> <p>Measuring Instruments : Three-dimensional ultrasound</p>	In the table that compared the general data between resting tongue posture and the prevalence of articulation disorders between the anterior open bite group and the control group, significant results were found between children with AOB and articulation disorders seen from the p-value obtained (<0.001)