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The association between age and nutritional status on developmental outcomes among children with down syndrome in Indonesia

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Abstract: Children with Down syndrome pose a risk of nutritional problems and developmental delays. The aim of this study is to assess the association between age and nutritional status on development among children with Down syndrome in Indonesia. The study design was cross-sectional. The study group consisted of 55 children with Down syndrome from the POTADS community, an association of parents of children with Down syndrome in Surabaya, Indonesia. Development was assessed using the Developmental Scale for Children with Down Syndrome by Thomas L. Layton, Ph.D. Nutritional status was evaluated using the CDC Growth Charts for Children with Down syndrome. The results showed that the majority (60%) of subjects had normal nutritional status, and 92.7% exhibited delayed developmental status. There was no association between nutritional status and developmental status ($p = 0.699$), while age and developmental status showed a significant correlation ($r = 0.382$; $p = 0.004$). This study can serve as health information, especially for parents of children with Down syndrome, to increase awareness of developmental and nutritional delays in these children.

Keywords: *Developmental outcomes, Developmental status, Down syndrome, Nutritional status.*

1. Introduction

Down Syndrome is one of the most common congenital disorders in children. Chromosomal malformation in the form of an additional chromosome 21 causes many clinical symptoms in Down Syndrome. The appearance of three instead of two chromosomes is known as trisomy [1]. WHO estimates that there is one case of Down syndrome in 1.000 live births. Based on the results of Riskesdas (Riset Kesehatan Dasar) by the Ministry of Health of the Republic of Indonesia, cases of Down syndrome in Indonesia increased from 2010 (0.12%), 2013 (0.13%), to 2018 (0.21%), occupying the top position of birth defects in Indonesia in 2018 [2]. Global developmental delays is expected in children with Down Syndrome, affecting personal-social skills, motor, cognitive and linguistic [3]. One of the most frequently asked concerns by parents of children with Down Syndrome is regarding their child's development. The development assessment of children with Down Syndrome cannot be compared with normal children, their development can be compared with other children with Down Syndrome. Children with Down Syndrome cannot keep up with the rate of development of typically developing children obviously [4]. Nutritional status is a determinant of the overall health status of children with Down Syndrome. Nutritional status indicates the physical growth of children and whether they are at risk of obesity or underweight. Poor nutritional status can lead to poor development in children with disabilities [5]. Children with Down Syndrome are at risk of having an abnormal nutritional status due to eating disorders such as difficulty chewing, swallowing and sucking from an early age which are influenced by abnormalities of the brain [6].

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The present study investigated the association between age and nutritional status on developmental outcomes among children with Down Syndrome in Indonesia especially in Surabaya. These findings are expected to support future research on health information planning for children with Down Syndrome, especially regarding nutritional status and developmental for this population.

2. Methods

A cross-sectional study was conducted among children with Down Syndrome in February 2025 after the ethical statement was released. The study group consisted of 55 children (28 boys and 27 girls) from *Perkumpulan Orang Tua Anak Down Syndrome Surabaya* (POTADS) community, an association of parents of children with Down Syndrome in Surabaya, Indonesia. Informed consent was obtained from parents. Basic demographic, anthropometric, nutritional status and developmental status were performed in all children. The study used a consecutive sampling method. Consecutive sampling refers to a nonparametric sampling method in which children were recruited based on inclusion and exclusion criteria until the sample size was achieved. Inclusion criteria of this study were children diagnosed with Down Syndrome at ages 4 months to 27 years. Children with parents who refused to participate in the study were excluded. The dependent variable in this study was the developmental status, categorized into "delayed" and "normal". The independent variables were the nutritional status and the age of children with Down Syndrome. The nutritional status was further categorized into severely wasted, wasted, normal, overweight, and obesity. In addition, children's demographic data (age and gender) were also collected. To assess the nutritional status, anthropometric measurements were carried out using the CDC Growth Charts for Children with Down Syndrome. The nutritional status was determined based on the body mass index for age. To evaluate the developmental status using the Developmental Scale for Children with Down Syndrome by Layton [4]. A chi-squared test was used to determine the association between developmental status and nutritional status. The association is described with p-value. Significance probability was established at p-value < 0.05. The Spearman Correlation test was used to determine the association between age and developmental status among children with Down Syndrome. Spearman's rho (r) coefficient was used to test the correlations between categorical and numeric data. All statistical analyses were performed using SPSS version 22.0 (IBM, New York, USA) for Windows. This study was approved by Health Research Ethics Committee of the Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia before conducting the study (74/EC/KEPK/FKUA/2025).

3. Results

A total of 55 children with Down Syndrome were included in this study. The child's demographic and clinical characteristics are presented in Table 1. All of the participants were within the age group of 0–27 years, in which 5–12 years olds represented the highest percentage (41.8%) of all subjects. The majority of children were boys with a total of 28 (50.9%) children. Based on nutritional status, the majority of children (60%) were normal. Most children show a delayed development status in the Down Syndrome group.

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Table 1.
Demographic and clinical characteristics of children with Down Syndrome included in the study (n=55).

Variables	Amount	Percentage (%)
Age		
Birth - 5 years	11	20
5 - 12 years	23	41.8
12 -18 years	16	29
>18 years	5	9
Gender		
Boy	28	50.9
Girl	27	49.1
Nutritional Status		
Severely Wasted	6	10.9
Wasted	13	23.6
Normal	33	60
Overweight	2	3.6
Obesity	1	1.8
Developmental Status		
Normal	4	7.3
Delayed	51	92.7

The association between nutritional status and developmental status of children with Down Syndrome is presented in Table 2. Based on the body mass index for age, the majority of children (60%) have normal nutritional status, consisting of 30 children with delayed development and 3 children with appropriate development. Thirteen children (23.6%) have wasted nutritional status, and overall children have delayed development. Overweight (3.6%) and obesity (1.8%) is the least frequent nutritional status in the study. Statistical analyses suggested that there is no association between the nutritional status and developmental status of children with Down Syndrome with $p = 0.699$.

Table 2.
Association between nutritional status and developmental status among children with Down Syndrome.

Nutritional Status	Developmental Status Appropriated	Delayed	Total	p value
Severely Wasted	1 (25%)	5 (9.8%)	6 (10.9%)	0.699
Wasted	0 (0%)	13 (25.5%)	13 (23.6%)	
Normal	3 (75%)	30 (58.8%)	33 (60%)	
Overweight	0 (0%)	2 (3.9%)	2 (3.6%)	
Obesity	0 (0%)	1 (2.0%)	1 (1.8%)	

The relationship between age and development status was tested using Spearman correlation. The results are shown in Table 3. The results of the correlation between age and development status showed a significant correlation ($r = 0.382$; $p = 0.004$) with a positive and weak direction ($0.21 < r < 0.40$). The positive direction indicates that as the child's age increases, the more delayed the development status. Conversely, the lower the child's age, the more appropriate the development status.

Table 3.
Association between age and developmental status among children with Down Syndrome.

Age	Developmental Status Appropriated	Delayed	Correlation Coefficient (r)	p value
Birth-5 years	3 (5.5%)	7 (12.7%)	0.382	0.004
5 - 12 years	1 (1.8%)	23 (41.8%)		
12 -18 years	0 (0%)	16 (29%)		
>18 years	0 (0%)	5 (9%)		

4. Discussion

Based on this study, the majority of children (60%) have a normal nutritional status. This study is contradictory to the theory, most children with Down Syndrome tend to be either overweight or underweight. Children with Down Syndrome are at risk of having an abnormal nutritional status due to eating disorders such as difficulty chewing, swallowing and sucking from an early age which are influenced by abnormalities in the brain [7]. The weight gain of children with Down Syndrome is faster than their height, so they often become overweight especially at 36 months [8].

These results indicate the possibility of increasing parental awareness in maintaining their children's nutrition, especially in the POTADS community in Surabaya. Community support and better access to health information can be driving factors for parents' success in managing the nutritional status of children with Down Syndrome.

The majority of the nutritional status of children with Down Syndrome was found to be normal, and this is in line with research in Saudi Arabia on 108 children with Down Syndrome aged 5-12 years, where the nutritional status was found to be 56.5% normal, 20.45% overweight, and 23.1% obese [9].

This study is in contradictory to the prevalence study by van Gameren-Oosterom, et al. [10]. It was a study involving 1596 children with Down Syndrome. At the age of 4 years, 25% of children with Down Syndrome were overweight. When compared to healthy children, the prevalence rate in children with Down Syndrome is on average twice as high for overweight and obesity, especially at 2-6 years of age [10]. It was found that 92.7% of children had a delayed development status. Children with Down Syndrome experience developmental delay because they need a period of time for achieving development levels that is twice as long as normal children [11]. Overexpression of the chromosome causes a delayed myelination, decrease in the number of nerves in the central nervous system, impaired cell cycle regulation, abnormal neurotransmission and excessive protein production. The presence of several of these conditions causes children with Down Syndrome to have impaired development, body control, communication, memory, concentration and ability to carry out tasks [12]. According to Roksana Malak's research in Poland, which studied the development of children with Down Syndrome using the Gross Motor Function Measure-88 and Pediatric Balance Status, the results indicated that the development of the Down Syndrome population is significantly delayed compared to normally developed children with p=0.043 [1]. A study by Moraleda-Sepúlveda, et al. [13] showed that developmental delays in children with Down Syndrome were primarily seen in the language and gross motor domains, with social skills tending to be better than other domains. This is important to understand in early intervention planning, because interventions targeted at language and motor aspects can provide more significant results in supporting child development [13]. Statistical analyses of the study suggest that there is no association between the nutritional status and developmental status of children with Down Syndrome. This may be attributed to the fact that almost all of the children's developmental data status showed a delay. Only four children had appropriate developmental status. This could be due to the young age of the children. Therefore developmental delays were not yet apparent. Another factor that may causee there is no significant relationship is that the most children have normal nutritional status, this is probably because parents already access information about how to manage the nutrition in children with Down Syndrome so that the parents have a good knowledge, while the level of parental knowledge about nutrition in children with Down Syndrome was not examined in this study. This study showed that there was no significant relationship between nutritional status and developmental status ($p = 0.699$). This is consistent with several previous studies. For example, a study by Bertapelli, et al. [14] concluded that although abnormal nutritional status is common in children with Down Syndrome, its direct effect on development is not always statistically significant. This may be because the developmental status of children with Down Syndrome is greatly influenced by genetic and neurological factors, such as myelination abnormalities, neurotransmission disorders, and excess gene expression on chromosome 21.

However, although there was no significant relationship between nutritional status and development in this study, it is important to consider that children with poor nutritional status tend to

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have a higher risk of developmental disorders in the long term. Some literature suggests that micronutrient deficiencies such as iron and iodine can interfere with the cognitive and motor development of children with Down Syndrome [14].

Although in theory the nutritional status of children is closely related to growth and development, the results of this study indicate that nutritional status does not have a significant relationship with the developmental status of children with Down Syndrome. Several biological, methodological, and environmental reasons can explain why the two variables are not directly correlated in the context of this population.

First, the development of children with Down Syndrome is greatly influenced by underlying genetic and neurological disorders, not solely by nutritional factors. Trisomy 21 causes disruption of the myelination process, neuron reduction, and neurotransmitter imbalances that affect overall brain function. These abnormalities have a direct impact on children's motor, language, and cognitive abilities, which cannot be corrected by good nutritional status alone [11, 12].

In other words, even though a child has a weight and height according to the growth curve, they can still experience developmental delays due to neurological factors that cannot be overcome by nutritional intervention alone.

Second, the measuring instruments used to assess development and growth have different dimensions. Nutritional status assessment in this study used Body Mass Index (BMI) for age, which better describes physical status and weight proportional to age, but does not directly reflect the quality of brain tissue or cognitive function.

Meanwhile, developmental measurement tools better assess adaptive, motor, cognitive, and communication abilities, which are highly dependent on the central nervous system. Therefore, even though physical indicators such as weight and height are within the normal range, the child's neurological development may still be lagging behind [11].

Third, environmental factors and parenting patterns play a major role in development, and can be confounding variables in the relationship between nutritional status and development. Children with good nutritional status may come from families who are economically able to provide nutritional intake, but may not necessarily provide adequate developmental stimulation. Conversely, children with suboptimal nutritional status may receive a lot of educational and social stimulation, so that their development remains relatively good. Research shows that the quality of interaction between children and caregivers, including daily communication and mental stimulation, has a stronger influence on development than nutritional factors alone [13].

Fourth, the majority of children in this study (60%) were in normal nutritional status, and the distribution of children in the category of malnutrition or obesity was relatively small. This limits the variation of the data and can cause statistically significant relationships not to be detected.

In statistics, this condition is known as restriction of range, where the variability of the data is too narrow to reveal a real correlation. If the proportion of children with poor or very good nutritional status were larger, a different relationship might have been detected.

Fifth, age also plays an important role as a confounder variable. As found in this study, there is a significant correlation between age and developmental delay. This shows that the older the child, the more obvious the developmental delay. So, if most children with good nutritional status are in the younger age group, it is likely that their development has not shown severe delays. Thus, age can obscure the relationship between nutrition and development, which can reduce the statistical power of the relationship.

Therefore, in the population of children with Down Syndrome, nutritional status is not always a strong predictor of developmental status, because genetic, neurological, psychosocial factors, and the quality of environmental stimulation are more dominant in influencing their development.

This serves as a reminder that efforts to improve nutritional status remain important for overall quality of life, but must be accompanied by other interventions that directly target children's

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developmental abilities such as occupational therapy, speech therapy, and training for parents and caregivers.

It should also be noted that the physical growth and development of children with Down Syndrome are often not parallel. This means that children can show good growth (weight and height within the normal range) but experience significant obstacles in fine motor, cognitive, and social aspects. This is reinforced in a study by Kim, et al. [11] who found that although some children with Down Syndrome have physical growth close to average, they still experience severe obstacles in executive function and the ability to complete daily tasks independently [11].

The results of the correlation between age and development status show a significant correlation ($r = 0.382$; $p = 0.004$) with a positive and weak direction ($0.21 < r < 0.40$). The positive direction indicates that the higher the child's age, the more delayed the development status is. Conversely, the lower the child's age, the more appropriate the development status is. According to a study by Miller et al [15] 56 children with Down Syndrome were found to present no delay until the child should have been able to say their first words. At the age of over 18 months, 60-75% of children with Down Syndrome experience delays, while 25-40% of children will not experience delays [8].

This supports the hypothesis that although children with Down syndrome may show relatively appropriate development at an early age, they experience a progressive developmental delay, particularly after the age of two.

This finding is consistent with Piaget's sensorimotor development theory, in which children with Down syndrome typically show increasingly pronounced delays after the second year of life. In the sensorimotor period (mental age 0-2 years) of children with Down Syndrome, sensorimotor development (as assessed by the "Piagetian Tasks of Object Permanence") often appears close to normal in the first year, delayed in the second year, and further delayed at ages 2–4 years. Significant weaknesses occur in communication skills, impacting the ability to socialize in everyday life [8].

The role of parents and caregivers is very important in supporting the growth and development of children with Down Syndrome. Research by Habib-Hasan, et al. [16] highlighted that parental knowledge about nutrition and development is directly related to the success of early intervention programs. In this context, education and training for parents are important components in the management of children with Down Syndrome [16].

Furthermore, it is important to consider that environmental and psychosocial factors also influence the development of children with Down syndrome. Lack of social interaction, minimal stimulation at home, and lack of access to developmental therapy can worsen developmental delays. In this study, these variables were not explored, but could be considered in further studies. Children with Down Syndrome can be identified from birth, which allows intervention to be started early.

Training parents to become primary caregivers for children is certainly essential, parent-child interactions involve development and communication. This study can be used as health information, especially for parents of children with Down Syndrome so that they are more aware of the developmental and nutritional delays in children with Down Syndrome.

Other limitations of this study are the relatively small sample size and large age heterogeneity (0–27 years). The wide age range may cause bias due to differences in developmental needs at different age stages. Further research with a more homogeneous age group and larger sample size will provide more representative results. These findings provide important implications for policy planning and health programs for children with special needs in Indonesia. A multidisciplinary approach, involving pediatricians, nutritionists, occupational therapists, psychologists, and active parental involvement, is needed to support optimal development of children with Down Syndrome. In addition, nutritional and developmental status assessments should be conducted periodically to detect and address problems early. In conclusion, although there is no significant relationship between nutritional status and developmental status in children with Down Syndrome, the results of this study confirm that age is correlated with developmental delays. Therefore, early intervention remains key to maximizing the developmental potential of children with Down Syndrome [1].

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In the Indonesian context, a systemic approach to children with Down Syndrome remains a challenge. Access to speech therapy, occupational therapy, and inclusive education is not evenly distributed. Moreover, social stigma is still a major barrier for families in seeking help or available services. Therefore, a community-based approach such as that carried out by POTADS in Surabaya is very important in bridging the needs of children and families with the existing service system.

The implications of the results of this study can be directed at two main things. First, the need for early detection and intervention programs since infancy. Given that developmental delays tend to worsen with age, early age is the golden period for the most effective intervention. A longitudinal study by Cuskelly, et al. [17] showed that cognitive and social interventions started before the age of two significantly improved the development scores of children with Down Syndrome compared to interventions started at an older age [17]. Second, the results of this study indicate that good nutritional status does not necessarily guarantee optimal development. Therefore, multidisciplinary interventions are needed. This includes regular monitoring of nutritional status, training of parental skills in stimulating child development, and education on the importance of two-way communication from an early age. A study by Sapiets, et al. [18] emphasized that the role of parents as the first therapist greatly influences the cognitive and emotional development of children, especially in special needs populations such as Down Syndrome [18]. In addition, it is important to observe common comorbid medical conditions in children with Down Syndrome, such as thyroid disorders, congenital heart disease, and hearing or vision disorders. All of these can contribute to developmental delays indirectly. For example, congenital hypothyroidism that is not detected at an early age can cause mental and growth delays. Therefore, a comprehensive health evaluation should be part of the developmental management approach for children with Down Syndrome [14]. From a policy perspective, this study reinforces the urgency to include early intervention programs and growth and development monitoring in the primary health care system, especially in health centers. Health workers at the primary level must be equipped with training to recognize and follow up on developmental delays in children with Down syndrome, as well as provide relevant nutrition education for parents.

Finally, it is important to emphasize that children with Down syndrome are not only a population with limitations, but also have great potential if given the right support. With a strength-based approach, interventions not only aim to "correct" delays, but also foster self-confidence, adaptive skills, and the unique potential of each child. This should be a new direction in education and health services for children with special needs in Indonesia.

5. Conclusion

In this study, the nutritional status of children with Down Syndrome is not associated with developmental status, while age with developmental status has a significant correlation. Especially at a young age, as the child's age increases, the development status delayed. Conversely, the lower the child's age is, the more appropriate the development status is. During the first two years of a child's life with Down Syndrome, the development is still appropriate, but as they get older, their development will be seen to be delayed.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References
[1] R. Malak, M. Kotwicka, A. Krawczyk-Wasielewska, E. Mojs, and W. Szamborski, "Motor skills, cognitive development and balance functions of children with Down syndrome," *Annals of Agricultural and Environmental Medicine*, vol. 20, no. 4, pp. 803–806, 2013.
[2] E. Zevanya, "down syndrome: Screening, diagnosis, and health consequences: A literature review," *Cermin Dunia Kedokteran*, vol. 52, no. 2, pp. 90-99, 2025.
[3] A. T. Ferreira-Vasques and D. A. C. Lamônica, "Motor, linguistic, personal and social aspects of children with Down syndrome," *Journal of Applied Oral Science*, vol. 23, no. 4, pp. 424-430, 2015. http://dx.doi.org/10.1590/1678-775720150102
[4] T. Layton, *Developmental scale for children with down syndrome*. Durham, NC: Extraordinary Learning Foundation, 2004.
[5] N. S. M. Nor, N. S. A. Aziz, S. M. Cheong, R. Ambak, and M. A. Omar, "Nutritional status of children with autism spectrum disorders, cerebral palsy and down syndrome: A scoping review," *Open Access Journal of Science and Technology*, vol. 3, 2015. https://doi.org/10.11131/2015/101174
[6] S. Cañizares-Prado, J. Molina-López, M. T. Moya, and E. Planells, "Oral function and eating habit problems in people with Down syndrome," *International Journal of Environmental Research and Public Health*, vol. 19, no. 5, p. 2616, 2022. https://doi.org/10.3390/ijerph19052616
[7] S. Anniza, R. Andriani, and P. E. Vinny, "Special needs children nutritional status with gross motor delay age 0-6 years: An overview," *Indonesian Journal for Health Sciences*, vol. 6, no. 2, pp. 24-35, 2022.
[8] Irwanto, H. Wicaksono, A. Ariefa, and S. M. Samosir, *A-Z sindrom down*. Surabaya: Airlangga University Press, 2019.
[9] M. M. Samarkandy, B. A. Mohamed, and A. A. Al-Hamdan, "Nutritional assessment and obesity in Down syndrome children and their siblings in Saudi Arabia," *Saudi Med J*, vol. 33, no. 11, pp. 1216-21, 2012.
[10] H. B. van Gameren-Oosterom, P. van Dommelen, Y. Schönbeck, A. M. Oudesluys-Murphy, J. P. van Wouwe, and S. E. Buitendijk, "Prevalence of overweight in Dutch children with Down syndrome," *Pediatrics*, vol. 130, no. 6, pp. e1520-e1526, 2012.
[11] H. I. Kim, S. W. Kim, J. Kim, H. R. Jeon, and D. W. Jung, "Motor and cognitive developmental profiles in children with Down syndrome," *Annals of Rehabilitation Medicine*, vol. 41, no. 1, pp. 97-103, 2017. https://doi.org/10.5535/arm.2017.41.1.97
[12] Z. Hasina, N. Wang, and C. C. Wang, "Developmental neuropathology and neurodegeneration of down syndrome: Current knowledge in humans," *Frontiers in Cell and Developmental Biology*, vol. 10, p. 877711, 2022. https://doi.org/10.3389/fcell.2022.877711
[13] E. Moraleda-Sepúlveda, P. López-Resa, N. Pulido-García, S. Delgado-Matute, and N. Simón-Medina, "Language intervention in down syndrome: A systematic literature review," *International Journal of Environmental Research and Public Health*, vol. 19, no. 10, p. 6043, 2022. https://doi.org/10.3390/ijerph19106043
[14] F. Bertapelli, K. Pitetti, S. Agiovlasitis, and G. Guerra-Junior, "Overweight and obesity in children and adolescents with Down syndrome—prevalence, determinants, consequences, and interventions: A literature review," *Research in Developmental Disabilities*, vol. 57, pp. 181-192, 2016. https://doi.org/10.1016/j.ridd.2016.06.018
[15] Miller et al, "Revisited: A reflection on EO research and some suggestions for the future," *Entrepreneurship Theory and Practice*, vol. 35, no. 5, pp. 873-894, 2011.
[16] Z. Habib-Hasan, M. S. Sheikh, Z. Hoodbhoy, I. Azam, and M. O'Neil, "Early intervention physical therapy using "parent empowerment program" for children with Down syndrome in Pakistan: A feasibility study," *Journal of Pediatric Rehabilitation Medicine*, vol. 13, no. 3, pp. 233-240, 2020.
[17] M. Cuskelly, P. Hauser-Cram, and M. Van Riper, "Families of children with Down syndrome: What we know and what we need to know," *Down Syndrome Research and Practice, 21(3),*, vol. 21, no. 3, pp. 137–146, 2008.
[18] S. J. Sapiets, R. P. Hastings, C. Stanford, and V. Totsika, "Families' access to early intervention and supports for children with developmental disabilities," *Journal of Early Intervention*, vol. 45, no. 2, pp. 103-121, 2023. https://doi.org/10.1177/10538151221083984
[19] A. Suryawan, "Malnutrition in early life and its neurodevelopmental and cognitive consequences: A scoping review," *Nutrition Research Reviews*, vol. 35, no. 1, pp. 136-149, 2022.
[20] T. Ariani, "Analysis of students' critical thinking skills in physics problems," *Kasuari: Physics Education Journal*, vol. 3, no. 1, pp. 1-17, 2020.
[21] H. Wulandari, *Child abuse and neglect*. Malang: Universitas Brawijaya Press, 2021.

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