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THE EFFECT OF SENSORY INTEGRATION THERAPY ON MOTOR PLANNING ABILITY IN CHILDREN WITH INTELLECTUAL DISABILITIES

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Abstract

Background: Children with intellectual disabilities are at high risk of experiencing motor planning deficits, which impact their independence and social participation. These deficits are associated with impairments in sensory processing and sensorimotor integration. Although Sensory Integration Therapy (SIT) is widely used to improve motor skills in children with developmental disorders, research specifically evaluating the effectiveness of SIT on motor planning abilities in children with mild to moderate intellectual disabilities remains very limited. Most previous studies have focused on general motor skills or involved populations of children with other developmental disorders. Objective: To determine the effect of Sensory Integration Therapy on motor planning in children with intellectual disabilities at SLB Angkasa Halim in 2025. Methods: A quasi-experimental study using a two-group pretest-posttest design. The measurement tool used was the Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition, Short Form (BOT-2 SF). The intervention group received Sensory Integration Therapy three times a week for four weeks (40-minute sessions), while the control group engaged only in standard daily school activities. Results: Paired T-test results for the intervention group showed a mean value of 4.25 and a p-value of 0.000, whereas the control group showed a mean value of 0.41 and a p-value of 0.096. The Independent T-test yielded a p-value of 0.000, indicating a significant difference in the effect between the intervention and control groups. Conclusion: Sensory Integration Therapy has a significant effect on motor planning abilities in children with intellectual disabilities at SLB Angkasa.

Keywords: Children with Intellectual Disabilities; Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition Short Form (BOT-2 SF); Motor Planning; Sensory Integration Therapy

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1. INTRODUCTION

Children with intellectual disabilities have the potential to have difficulties in planning movements or motor planning disorders (1). This disorder is characterized by difficulty following the sequence of movements, slow initiation of motor activities, confusion when receiving instructions, or difficulty adjusting movements to new situations(2). These barriers have an impact on children's daily activities, independence, and social participation(3).

Motor planning disorders in children with disabilities are influenced by various factors, such as limited cognitive function, sensory integration disorders, and delays in basic sensorimotor development(4). Based on the learning pyramid concept, motor planning skills develop after maturation of sensory functions, proprioceptive, posture control, and movement coordination. Therefore, interference with these basic aspects can hinder motor planning skills (4).

The prevalence of intellectual disability in children is estimated to reach 1–3% of the world's child population, with a fairly high figure in Indonesia(5). Data from the Ministry of Health of the Republic of Indonesia shows that there are around 38,545 school-age children with intellectual disabilities, and most of them have motor delays(6). In addition, more than 70% of children with mild to moderate disabilities experience motor impairments that affect functional activities, as well as involvement in social activities and daily independence(7).

Physiotherapy plays an important role in improving the motor skills of children with disabilities through sensorimotor exercises and functional activities. One of the interventions that can be used is Sensory Integration Therapy (SIT), which is a therapy that aims to help children process and integrate various sensory inputs so that they are able to produce more adaptive movement responses8. SIT is known to improve sensory regulation, coordination, and movement readiness that underlie motor planning(8).

Although some studies have reported the effectiveness of Sensory Integration Therapy in improving motor skills and adaptive behavior in children with developmental disabilities, most studies still focus on children with Autism Spectrum Disorder or generalized developmental disorders. Research that specifically evaluates the effect of Sensory Integration Therapy on motor planning abilities in children with disabilities is still limited, especially those using the BOT-2 SF

measuring device. In addition, research related to sensory integration-based interventions in children with disabilities in special school environments in Indonesia is still rare. In fact, motor planning disorders in children with disabilities can have a direct impact on children's functional activities, independence, and social participation. Therefore, this study was conducted to analyze the effect of Sensory Integration Therapy on motor planning ability in children with disabilities.

2. METHODS

This study uses the quasi-experimental with Two Group Pretest-Posttest Design. The intervention group received treatment Sensory Integration Therapy 3 times/week for 4 weeks with a time of 40 minutes, while the control group ran Daily Activity at School (Academic activities, development life skills, and extracurricular). This research was conducted in January 2025, for 4 weeks at SLB Angkasa, East Jakarta.

The intervention program was carried out in the form of sensorimotor-based play therapy consisting of four training stations. First, sensory-motor novel task, children perform activities of jumping obstacles, following changes in movement sequences, and moving objects to practice sequencing and movement adaptation. Second, follow the path is done by walking along a zig-zag path or a certain pattern to improve visual-motor coordination and balance. Third, push, pull, and carry involves pushing, pulling, and carrying objects to provide proprioceptive stimulation and improve postural stability. Fourth, cross-lateral activities are carried out through cross-body movement activities such as patterned clapping and bilateral movements to improve bilateral coordination and sensorimotor integration.

This research was carried out after obtaining a research permit with the number DP.04.03/F.XI.22/6071/2025 in December 2025 from the Research Ethics Committee of the Jakarta Ministry of Health Polytechnic III. The number of samples in the study was 24 children. The deviation data was 16.78 based on previous research and a correction factor of 10%, so the total sample per group of 12 children was used. The technique of determining the intervention group and the control group used purposive sampling.

The inclusion criteria for this study include: respondents are children with mild disabilities/able to learn (IQ 50-70) or moderate/able to train (IQ 35-50), respondents aged 6-15 years, able to follow instructions, have a standard score of BOT-2 Short Form < 40, are not currently doing

therapy, and parents allow children to become respondents by signing an informed consent. IQ score data was obtained from the results of psychological examinations of SLB Angkasa students in May 2025.

Exclusion criteria include: being a respondent in another study that affects motor planning, respondents having a history of congenital diseases, severe musculoskeletal disorders, or other diseases. The drop-out criterion is not to participate in training for more than two days according to the agreed training schedule.

Data analysis was carried out by normality test using the Saphiro Wilk Test and homogeneity test using Levene's Test. The results were normally distributed and homogeneous, then a hypothesis test was carried out Paired Sample T-Test, and a different test was carried out Independent T-Test.

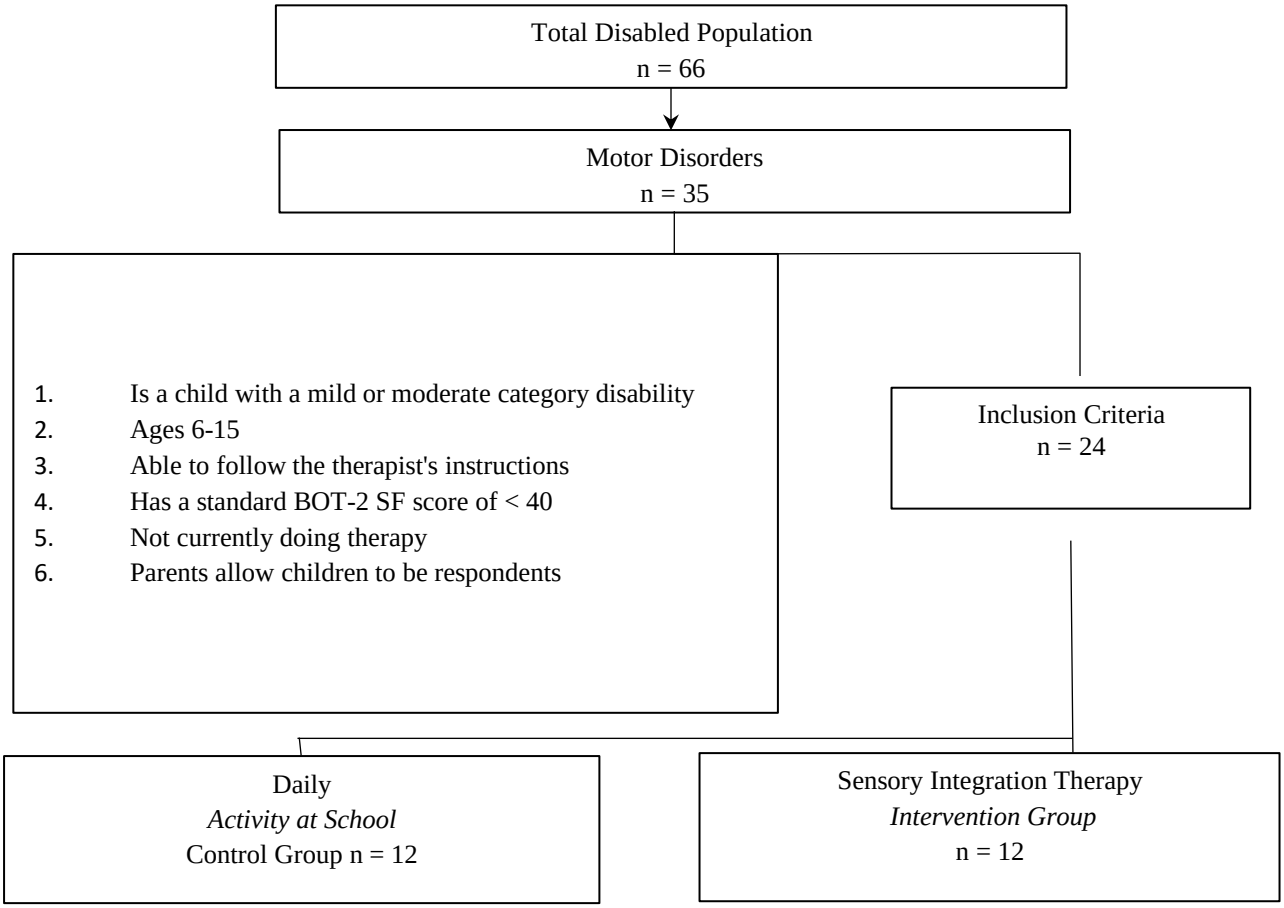

Figure 1. Sampling Technique Scheme

3. RESULTS AND DISCUSSION

Results

1. Sample Characteristics Data

Table 1. Sample Characteristics by Gender, Age, IQ Score and SF BOT2 Score

Characteristics	n	%	Mean±SD	95% CI
Gender				
Intervention Groups				
Male	8	66,7%		
Women	4	33,3%		
Control Group				
Male	9	75%		
Women	3	25%		
Age				
Intervention Groups				
6-15 years	12	100%	10.67±1.614	9,64-11,69
Control Group				
6-15 years	12	100%	10.83±1.899	9,63-12,04
Intellegence Quotient Score				
Intervention Groups				
30-49	2	16,7%	63.83±7.975	58,77-68,90
50-70	10	83,3%		
Control Group				
30-49	2	16,7%	64.42±7.525	59,64-69,20
50-70	10	83,3%		
BOT-2 SF Score				
Intervention Groups				
Pretest			26.67±7.512	21,89 – 31,44
Posttest			30.92±7.549	26,12 – 35,71
Control Group				
Pretest			26.67±5.898	22,92 – 30,41
Posttest			27.08±5.664	23,48 – 30,68

Source: Primary Data, 2025

The table above shows the results of the gender distribution in both groups, both groups are dominated by the male sex. The intervention group numbered 8 people while the control group numbered 9 people. In addition, the majority of the age of the sample in the study was 9 and 11 years old. Mean age in the intervention group was 10.67, while the control group was 10.83. The data in the table above also shows that the majority of the sample of this study are children with mild disabilities with an IQ score of 50-70 totaling 10 people in each group. The average IQ score in the intervention group was 63.83 while the average IQ score in the control group was 64.42. The average score of BOT-

2 SF in the pretest intervention group was 26.67 to 30.92 during the posttest. Meanwhile, in the control group it was 26.67 to 27.08.

2. Paired Sample T-Test

Table 2. Hypothesis Test Results of *Motor Planning Ability of Disabled* Children

Groups		Mean±SD	ΔMean±SD	t	P - value
Intervention Groups	Pretest	26.67±7.512	4.25±0.037	-6,888	0,000
	Posttest	30.92±7.549			
Control Group	Pretest	26.67±5.898	0.41±0.234	-1,820	0,096
	Posttest	27.08±5.664			

Source: Primary Data, 2025

The results of the Paired Sample T-Test in the intervention group obtained a p-value of 0.000 ($p < 0.05$), while in the control group, a p-value of 0.096 ($p > 0.05$) was obtained. It can be concluded that there was a significant effect of the Sensory Integration Therapy intervention on motor planning ability in the intervention group, and there was no significant effect of Daily Activity at School on motor planning ability in the control group.

3. Independent T-Test

Table 3. Results of Different Tests for Intervention Groups and Control Groups

Evaluation	Groups	Mean±SD	t	P - value
Pretest & Posttest Score Difference	Intervention	4.25±2.137	5,825	0,000
	Controls	0.42±0.793		

Source: Primary Data, 2025

The results of the Independent T-Test showed that the p-value in both groups was $p < \alpha$ (0.05). Ho was rejected which indicated that there was a significant difference in motor planning ability between the two groups.

Discussion

The dominant gender frequency distribution of the sample in both groups was males. According to previous research, it was stated that intellectual disabilities are more common in men than women, with a ratio of about 1.3–1.5 times higher(1). It is influenced by the complex interaction between genetic, hormonal, and environmental factors that affect the development of the nervous system (1). Men have only one X chromosome so they are more susceptible to genetic disorders than women who have two X chromosomes. Hormonal factors such as prenatal testosterone exposure and the risk of perinatal complications also increase this susceptibility(1).

The age frequency distribution showed that the majority of the sample was at 9 and 11 years of age. This data is consistent with recent research that states that Sensory Integration Therapy interventions are most commonly administered at that age. In this phase, children are in a period of rapid motor and cognitive development, so that interventions have optimal potential in improving functional abilities, including motor planning(9). In addition, sensory processing and motor skills disorders often begin to be identified at school age due to the increased demands of learning and motor activities(9).

Descriptive data of the average IQ score in both groups showed that the majority of the sample was in the category of mild disability (IQ 50–70). Epidemiologically, most children with intellectual disabilities are in the mild category (IQ 50–70) which covers about 85% of the population, while the rest are in the moderate to severe category (10). This is in accordance with the literature in the American Psychiatric Association which describes the classification of intellectual disability rates based on IQ range as well as the dominance of mild categories in the population(9).

Based on the results of statistical tests Paired Sample T-Test in the Sensory Integration Therapy intervention group in this study, a p-value of 0.000 was obtained, which means There is a significant influence on the ability Motor Planning after being given an intervention. The improvement shows that integrated sensory stimulation through vestibular, proprioceptive, and tactile activities is able to help the planning process and the execution of more organized movements. Engine planning or Praxis requires the child's ability to receive, process, and integrate sensory information before producing an adaptive motor response. (11).

In children with disabilities, limitations in cognitive function and sensory processing often lead to obstacles in movement sequencing, bilateral coordination, and the ability to adapt movement to environmental demands. In addition, limited cognitive function causes ineffective communication between areas to inhibit the feedforward and feedback mechanisms , thus affecting the ideation, planning, and execution processes in motor planning(12). Through sensory integration activities that are carried out in a repetitive and structured manner, children gain sensorimotor experience that can increase the efficiency of sensory integration and motor control so that motor planning skills become better. (13).

Sensory Integration Therapy activates and strengthens the connectivity between the parietal cortex, premotor area, supplementary motor area, basal ganglia, and cerebellum. Improving the quality of sensory inputs through vestibular and proprioceptive stimulation helps to form a more accurate feedforward model and improves postural stability as the basis for the implementation of directed movements. Thus, Sensory Integration Therapy has a positive impact on improving motor planning skills through strengthening sensorimotor integration, adaptive response, and optimization of movement planning mechanisms in children with disabilities (14).

The increase in motor planning scores in the intervention group can also be influenced by the characteristics of active, repetitive, and play-based therapy. Activities such as follow the path, cross-lateral activities, and sensory-motor novel tasks require children to plan the direction of movement, remember the sequence of activities, maintain balance, and adjust motor responses to changing stimuli. This condition is thought to stimulate coordination between the sensory and motor systems simultaneously. In addition, a play-based approach allows the child to be more motivated and engaged during the therapy process thereby increasing active participation in exercise (12).

The results of this study are in line with several previous studies that reported that Sensory Integration Therapy was effective in improving motor skills, coordination, and adaptive function in children with developmental disabilities (11). However, most previous studies have been conducted on children with Autism Spectrum Disorder or generalized developmental disorders(15), while studies that specifically evaluate motor planning abilities in children with disabilities are still limited. Therefore, this study provides additional evidence that the sensory integration approach also has the potential to provide benefits to the population of children with disabilities, especially in the aspect of motor planning.

However, the mild improvement also found in the control group needs to be of concern in the interpretation of the study results. These changes are likely influenced by routine school activities that still involve motor stimulation and environmental interactions during the study period. In addition, maturation factors, adaptation to measurement instruments, and learning effects from test repetition can also contribute to an increase in scores even though they are not statistically significant (p

= 0.096). This shows that a child's motor development is not only affected by a single intervention, but also by the experience of daily activities and the child's natural developmental process.

Based on the results obtained from the Independent T-Test, a p-value of 0.000 was obtained. These findings reinforce the suspicion that Sensory Integration Therapy has a therapeutic effect on motor planning ability in children with disabilities. Although the control group showed a slight improvement in score, the improvement was much lower than that of the intervention group. This condition indicates that Daily Activity at School alone is not enough to provide optimal sensorimotor stimulation to meaningfully improve motor planning skills (16).

This research has several limitations. The duration of the intervention, which lasted only four weeks, could not describe the long-term effects of Sensory Integration Therapy on motor planning ability. In addition, the study did not control for other factors such as intelligence levels, family support, physical activity outside of school, and children's attention levels during therapy that could potentially affect the outcome of the study. In addition, the use of the BOT-2 SF as a measurement instrument needs to be interpreted critically. The BOT-2 SF is essentially a general motor ability measurement tool and not a specific instrument for assessing motor planning directly. However, some components in the BOT-2 SF such as bilateral coordination, balance, upper limb coordination, and running speed & agility are related to praxis and motion planning capabilities so that they can be used to describe the performance of motor planning functionally.

Further research is recommended to use a randomized controlled trial design, longer duration of interventions, and more specific instruments to measure motor planning or praxis directly.

4. CONCLUSION

The administration of Sensory Integration Therapy has a significant influence on improving motor planning skills in children with disabilities Sensory integration interventions involving vestibular stimulation, proprioceptive, and bilateral coordination have the potential to improve sensorimotor integration and adaptive movement responses in children.

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REFERENCES

1. Kavanagh H, Manninen M, Issartel J. Comparing the fundamental movement skill proficiency of children with intellectual disabilities and typically developing children: a systematic review and meta-analysis. Journal of Intellectual Disability Research. 2023 Dec 14; 67(12):1336–53. doi:10.1111/jir.13012
2. Krajenbrink H, Lust J, Wilson P, Steenbergen B. Development of motor planning in children: Disentangling elements of the planning process. J Exp Child Psychol. 2020 Nov;199:104945. doi:10.1016/j.jecp.2020.104945
3. Pesau HG, Widyorini E, Sumijati S. Self-Care Skills of Children with Moderate Intellectual Disability. Journal of Health Promotion and Behavior. 2020; 5(1):43–9. doi:10.26911/thejhpb.2020.05.01.06
4. Hartman E, Houwen S, Scherder E, Visscher C. On the relationship between motor performance and executive functioning in children with intellectual disabilities. Journal of Intellectual Disability Research. 2020 May 20; 54(5):468–77. doi:10.1111/j.1365-2788.2010.01284.
5. Nurazizah Dwinanda A, Yulistika Handayani D, Nursing Studies, Faculty of Health Sciences P. The Influence of Health Education with the Audio Visual Media Drill Method on the Activity Daily Living (ADL) of Disabled Children at SLB BC Bina Harapan Pangandaran. Scientific Journal of Educational Vehicles. 2024; 2024(6):87–106. doi:10.5281/zenodo.10637749
6. Maritska Z, Prananjaya BA, Parisa NP, Suryani PR, Hartati MD. An Insight Into Genetic Conditions Associated With Intellectual Disability In Indonesian Population. International Journal of Neuropsychopharmacology. 2025 Feb

12; 28(Supplement_1):i186–7. doi:10.1093/ijnp/pyae059.323

7. Williams K, Jacoby P, Whitehouse A, Kim R, Epstein A, Murphy N, et al. Functioning, participation, and quality of life in children with intellectual disability: an observational study. Dev Med Child Neurol. 2021 Jan 30; 63(1):89–96. doi:10.1111/dmcn.14657
8. May-Benson TA, Koomar JA. Systematic Review of the Research Evidence Examining the Effectiveness of Interventions Using a Sensory Integrative Approach for Children. The American Journal of Occupational Therapy. 2020 May 1; 64(3):403–14. doi:10.5014/ajot.2010.09071
9. Ouellet B, Carreau E, Dion V, Rouat A, Tremblay E, Voisin JIA. Efficacy of Sensory Interventions on School Participation of Children With Sensory Disorders: A Systematic Review. Am J Lifestyle Med. 2021 Jan 11; 15(1):75–83. doi:10.1177/1559827618784274
10. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Association Publishing; 2022. doi:10.1176/appi.books.9780890425787
11. Oh S, Jang JS, Jeon AR, Kim G, Kwon M, Cho B, et al. Effectiveness of sensory integration therapy in children, focusing on Korean children: A systematic review and meta-analysis. World J Clin Cases. 2024 Mar 6; 12(7):1260–71. doi:10.12998/wjcc.v12.i7.1260
12. Bundy ScD AC, Collins F, Honorary Professor C, Lane SJ, Professor C, Therapy O, et al. Sensory Integration Theory and Practice 3rd Edition [Internet]. 2020. Available from: www.fadavis.com
13. Wen L, Wu Z. The impact of sensory integration based sports training on motor and social skill development in children with autism spectrum disorder. Sci Rep. 2025 June 6; 15(1):19974. doi:10.1038/s41598-025-05393-3
14. Lee K, Cascella M, Marwaha R. Intellectual Disability. 2025. PubMed PMID: 31613434.
15. Ansari NV, Hariandja AMA, Pambudi RA. The Effect of Perceptual Motor Training on Dynamic Balance in Children with Autism Spectrum Disorder. Indonesian Journal of Physiotherapy and Health. 2024 Dec 5; 4(02):356–62. doi:10.59946/jfki.2024.378
16. Punar E, Şevgin Ö. Effect of goal-directed perceptual-motor exercise on children with specific learning

difficulties: a randomized controlled trial. BMC Pediatr. 2024 Dec 19; 24(1):820. doi:10.1186/s12887-024-05309-6

17. Radanović D, Đorđević D, Stanković M, Pekas D, Bogataj Š, Trajkovic N. Test of Motor Proficiency Second Edition (BOT-2) Short Form: A Systematic Review of Studies Conducted in Healthy Children. Children. 2021 Sep 9; 8(9):787. doi:10.3390/children8090787
18. Cermak SA, May-Benson TA. Praxis and Dyspraxia. In: Sensory Integration Theory and Practice. 3rd Edition. 2020.
19. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Association Publishing; 2022.
20. Patel DR, Cabral MD, Ho A, Merrick J. A clinical primer on intellectual disability. Transl Pediatr. 2020 Feb; 9(S1):S23–35. doi:10.21037/tp.2020.02.02
21. Farzadmanesh M, Homaei R, Jayervand H. Effects of Motor Planning on Sensory Profile, Balance, and Academic Achievement in Children with Intellectual Disability. International Journal of Musculoskeletal Pain Prevention. 2024; 9(1):995–1001. doi:10.22034/IJMPP.9.1.995
22. Jírovec J, Musálek M, Mess F. Test of Motor Proficiency Second Edition (BOT-2): Compatibility of the Complete and Short Form and Its Usefulness for Middle-Age School Children. Pediatr Front. 2020;7:153. doi:10.3389/fped.2019.00153 PubMed PMID: 31065548.
23. Damayanti NA, Harsiwi NE. The Role of Teachers in Improving the Self-Development Skills of Medium-Blind Children at SLB Samudra Terra Athena. Journal of Islamic Basic Education. 2025; 5(1).
24. Sativani Z, Pahlawi R. Foot Strengthening Exercise on Postural Balance and Functional Ability of Foot in Children 6-10 Years Aged with Flexible Flatfoot. Journal of Health Sciences (JIKA). 2020 Dec 31; 2(3):99–107. doi:10.36590/if.v2i3.69
25. Trioclarise R, Sitompul M, Syakib A. Differences in the Relationship of Sensory Function and Core Stability to Dynamic Balance in Children Aged 3-5 Years at Al-Fatih Center Tangerang. Indonesian Journal of Physiotherapy and Health. 2022 Dec 15; 2(2):163–74. doi:10.59946/jfki.2022