ORIGINAL ARTICLE

Physical Therapy Journal of Indonesia (*PTJI*) 2025, Volume 6, Number 1: 1-5
E-ISSN : 2722-6034 ; P-ISSN : 2722-0125

Cosy development: sensory-motor interventions to improve verbal and expressiveness abilities for Down Syndrome children

Anik Dwi Hiremawati[1*], Endang Rochyadi[1], Sunardi[1], Cece Rakhmat[1]

ABSTRACT

Background: Existing interventions to improve verbal expression for children with Down Syndrome (DS) often neglect sensory and motor development. However, these abilities are essential for receiving input from the environment and responding through gestures during intervention. This study aimed to develop interventions through sensory and motor development that enhance the expressive verbal capabilities of DS children in articulating sounds, syllables, and words.

Methods: This study used quantitative methods with an experimental design. Clinician-rated questionnaires measured the pre-test and post-test verbal expressive abilities of DS children who received the Cosy Development (CD) intervention for 12 months. Participants consisted of 8 DS children, ages ranged 4-15 years. This study was conducted at Tridiva Learning House, Bandung, Indonesia. Families of the DS children were trained by researchers regarding the intervention guidelines, and they performed the CD intervention on their children at home.

Results: The Wilcoxon rank test showed a statistically significant improvement in verbal expressiveness among the eight DS children who received the CD intervention for 12 months, with p-values ranging from 0.016 to 0.008.

Conclusion: The CD intervention, which integrated sensory and motor developments, effectively improved the verbal expressiveness of DS children. The CD intervention was practical and comfortable for DS children, making it a promising approach for improving their communication abilities.

Keywords: Cosy development, down syndrome, expressiveness ability, sensory-motor intervention, verbal ability.
Cite This Article: Hiremawati, A.D., Rochyadi, E., Sunardi., Rakhmat, C. 2025. Cosy development: sensory-motor interventions to improve verbal and expressiveness abilities for Down Syndrome children. *Physical Therapy Journal of Indonesia* 6(1): 1-5. DOI: 10.51559/ptji.v6i1.233

[1]Special Need Department, Universitas Pendidikan Indonesia; Bandung; Indonesia.

*Corresponding author:
Anik Dwi Hiremawati;
Special Need Department, Universitas Pendidikan Indonesia; Bandung; Indonesia;
anikdwi@upi.edu

Received: 2024-09-08
Accepted: 2024-12-17
Published: 2025-01-15

INTRODUCTION

Children with Down Syndrome (DS) usually have problems with their cognitive, affective, and motor skills. A genetic disorder occurs in humans in the form of limited motor and intellectual delays. DS children usually have below-average intellectual functions, such as the inability to communicate, lack of social interaction, avoidance of eye contact, difficulty in developing language, and repetition of behaviour due to damage to some brain functions.[1] DS children usually have difficulty carrying out gross motor skills movements (such as, running, jumping, jumping, or throwing) and fine motor skills (such as picking up small objects, holding a glass/cup, or drawing). In terms of socioemotional conditions, they are emotionally unpredictable and uncontrollable, dependent on adults, and often rejecting others. If not promptly handled, these impediments can impact children's mental health, education, socialization, and academic performance. Therefore, interventions are needed to stimulate the motoric, cognitive, and affective development of DS children.[2]

Children with immature sensory and motor skills experience difficulty learning and could limit their opportunities to adapt to the environment.[3] Sensory and motor maturity result from the ability to receive various stimuli from their environment, such as tactile, visual, and auditory.[4] DS children mostly experience severe delays in motor skills, such as walking, maintaining balance, and exploring objects and the environment. Not many healthcare professionals and parents understand that low expressive verbal skills are correlated with immature sensory and motor development in DS children.[5] Developing integrated sensory and motor functions may improve cognitive, language, and movement abilities to produce motor perception.[6,7]

Many people think that imitating and repeating words is the best way to improve verbal expressivity instead of improving sensorimotor skills in DS children, which may increase brain maturity, independence, self-confidence, and socialization abilities.[8] Sensory tasks from the environment would increase the stimulation to the spinal cord, carry sensory information to the brain and produce adaptive responses through appropriate movements or behaviours to the environment.[9,10]

This research describes the Cosy Development (CD) intervention that helps DS children increase verbal expressivity and adjust the child's sensory and motor conditions as internal factors that can influence children to learn verbal expressions more effectively. Impaired receptive and expressive language skills

occur in DS children due to problems in brain executive function.[6] Researches on DS children demonstrate that sensory-motor input significantly benefits their development, including improved gross and fine motor skills, cognitive function, communication, social skills, emotional regulation, and environmental adaptation.[11-14]

CD intervention is convenient because it considers the prerequisites affecting children and families. The need for intervention methods that assume the characteristics of developmental stages and family resilience capabilities, especially the acceptance of DS children, is a great hope for progressing more effective intervention results.[15,16] This study aimed to explore the application of CD intervention to increase the verbal expressivity of DS children.

METHODS

This research employed an experimental method, a systematic approach to investigate the influence of one variable on another by manipulating treatment and strictly controlling conditions.[17] This 12-month study compared pre- and post-intervention verbal expressivity in eight DS children (aged 4-15 years) at Tridiva Learning House in Bandung. The Ethics Committee of Universitas Pendidikan Indonesia reviewed and approved the research protocol with number B-10371/UN40.A1.1/TD.07/2024. Written informed consent was obtained from all participants before their involvement in the study. Participant confidentiality was maintained throughout the research process.

Participants were selected based on the inclusion criteria, including the absence of significant comorbidities and willingness to participate for 12 months with parental consent. Exclusion of children with conditions (e.g., hearing impairments, other developmental abnormalities) that could impact research outcomes. The intervention program for eight DS children focused on mastering nearby vocabulary using concrete objects (natural), replicas (artificial), and picture cards. The program considered individual sensory and motor needs by adjusting texture, sound, and visual media to ensure comfort and accessibility.

The CD form, a validated and reliable tool assessing five verbal and three expressive abilities in children with Down syndrome, was used to evaluate participants before and after intervention. The CD form scored 0 to 20 for each domain and demonstrated high reliability (Cronbach's Alpha = 0.979). Expert validation confirmed the objectivity of all questions (*P*-value = 1.000 for all).

Data were collected through initial and final tests and observations to assess students' verbal development. The Wilcoxon paired rank test was used to analyze the data. A significant difference in verbal expressive abilities was determined if the calculated Wcount value was less than the critical value at the 0.05 significance level (H0 rejected, H1 accepted). Conversely, no significant difference was found if Wcount exceeded the critical value (H0 accepted, H1 rejected). The results of the Wilcoxon test at the 0.05 significance level revealed the Wcount value.

RESULTS

There was a notable improvement in emotional expression. Initially, the children could not appropriately use words like 'please,' 'thank you,' and 'goodbye.' However, the participating DS children successfully used these words after the CD intervention. Results are presented in Tables 1–3.

In the expressive adjectives dimension, the most significant improvement was seen in children who initially could not say big, small, hurt, sad, surprised, hungry, angry, happy, and tired. After the CD intervention, these children could use these words, although the word thirsty showed limited improvement. The research results indicate a significant difference between DS children before and after the intervention with an Asymp Sig. (2-tailed) value of 0.016 ($p<0.05$) in the "prone-supine phase" (Verbal-I) dimension.

The research results show an Asymp Sig. (2-tailed) value of 0.008 ($p<0.05$) for the "Making sounds/noises" (Verbal-II) dimension, indicating a significant difference in DS children before and after the CD intervention. Similarly, an Asymp Sig. (2-tailed) value of 0.01 ($p<0.05$) for the "Recognizing own body parts" (Verbal-III) dimension also indicates a significant difference following the intervention.

The research results indicate a significant difference in DS children before and after the CD intervention with an Asymp Sig. (2-tailed) value of 0.009 ($p<0.05$) for the "Recognizing shapes around the house" (Verbal-IV) dimension and 0.011 ($p<0.05$) for the "Recognizing objects outside the house" (Verbal-V) dimension.

The research results show a significant difference in DS children before and after the CD intervention with an Asymp Sig. (2-tailed) value of 0.01 ($p<0.05$) for both the "Expressing feelings" (Expression-I) and "Expressing verbs" (Expression-II) dimensions.

The research results indicate a significant difference in DS children before and after the CD intervention with an Asymp Sig. (2-tailed) value of 0.01 ($p<0.05$) for the "Expressing adjectives" (Expression-III) dimension. The table results show a *p*-value <0.05, leading to the rejection of H0, providing sufficient evidence that pre-test and post-test verbal expressiveness scores differ. Post-test scores improved, confirming that the CD intervention using sensory-motor methods enhances verbal expressiveness in DS children, supporting the acceptance of H1.

DISCUSSION

Delays in sensory and motor development must be addressed early using a multidisciplinary approach.[18] Development is multidimensional, encompassing cognitive, language, sensory, motor, and social-emotional domains, all of which are interconnected. Therefore, tailored stimulation therapies are essential for enhancing DS children's physical, cognitive, and emotional abilities, ultimately improving their overall functioning and quality of life.[19]

Typical physical characteristics of DS children include hypotonia (low muscle tone), brachycephaly (a small, distinctively shaped head), smaller frontal and temporal brain lobes, a large protruding tongue, and small hands and feet.[20] DS is often associated with medical conditions such as congenital heart disease, hearing

Table 1. Results of pre-test and post-test on five verbal domains after the Cosy Development intervention

Verbal I		Verbal II		Verbal III		Verbal IV		Verbal V	
Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
7	12	0	14	0	10	0	7	0	18
6	12	0	14	0	10	0	7	0	9
12	12	4	14	3	20	0	14	0	19
6	12	0	14	0	10	0	7	0	9
6	12	0	14	0	10	0	7	0	9
6	12	0	14	0	10	0	7	0	9
9	12	0	14	0	20	0	14	0	20
10	12	4	14	0	16	0	14	0	19

Verbal I: supine-to-prone phase; Verbal II: making sounds/noises; Verbal III: recognizing own body parts; Verbal IV: identifying shapes around the house; Verbal V: identifying objects outside the house.

Table 2. Results of pre-test and post-test on three expression domains after the Cosy Development intervention

Expression I		Expression II		Expression III	
Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
0	8	0	18	0	19
0	4	0	9	0	10
0	8	0	19	0	20
0	4	0	9	0	10
0	4	0	9	0	10
0	4	0	9	0	10
0	8	0	19	0	20
0	8	0	19	0	20

Expression I: expressing emotions; Expression II: expressing verbs; Expression III: expressing adjectives.

Table 3. Results of Wilcoxon signed rank test between pre-test and post-test of verbal and expressiveness abilities

Pre-test vs. post-test	Z score	*P*-value
Verbal I	- 2.4	0.016
Verbal II	- 2.6	0.008
Verbal III	- 2.6	0.010
Verbal IV	- 2.6	0.009
Verbal V	- 2.6	0.011
Expression I	- 2.6	0.010
Expression II	- 2.6	0.010
Expression III	- 2.6	0.010

Expression I: expressing emotions; Expression II: expressing verbs; Expression III: expressing adjectives; Verbal I: supine-to-prone phase; Verbal II: making sounds/noises; Verbal III: recognizing own body parts; Verbal IV: identifying shapes around the house; Verbal V: identifying objects outside the house.

loss, and thyroid disorders.[13] It also causes intellectual disabilities of varying severity, with delays in speech, language development, and motor skills.[21]

The low verbal expressive abilities observed in the eight DS children in this study highlight the need to assess their sensory-motor conditions first, as these are prerequisites for developing expressive verbal skills. The CD intervention integrates sensory and motor activities to enhance cognitive efficiency, including verbal expression.[22] Disruptions in processing sensory stimuli can delay cognitive and language development. Sensory and motor skills are strongly correlated with forming positive environmental responses, while deficits in these areas can lead to atypical behaviours, reduced participation, and limited exploration in daily activities.[23]

Exploring objects and environments helps children acquire new vocabulary through attention and learning. According to Zampini and D'Odorico, motor training at 24 and 36 months predicts future vocabulary mastery.[24] This aligns with Piaget's theory, which identifies the sensorimotor stage as the foundation for later cognitive development. Early and consistent stimulation strengthens motor and expressive verbal development.[25]

Existing intervention methods often focus on teaching selected vocabulary without addressing verbal expressive milestones. The unique characteristics of DS children contribute to their limited expressive verbal skills, and their discomfort with learning verbal skills highlights the need for more effective interventions. These should prioritize foundational abilities to facilitate gradual progress in verbal expressiveness. CD intervention improves verbal expressiveness by enhancing sensory and motor functions, as noted by Karimi and Nelson, who reported that strong sensory-motor skills positively impact verbal abilities in DS children.[5] While the importance of improving sensory abilities is evident, further research is needed to define the stages of verbal expressiveness more precisely.[26]

Parents use CD interventions to improve sensorimotor prerequisites that enhance children's linguistic expressiveness. Sensory and motor deficits in DS children hinder their ability to perform activities consistently, limiting their attention to objects and social interactions and resulting in poor vocabulary acquisition.[27,28] Intellectual challenges further delay vocabulary learning compared to typically developing children. Early stimulation, especially within the home environment, is crucial to their development.[29,30] Additionally, the limited cognitive abilities of DS children affect their sensory, motor, and language progress.[31]

This study has several limitations. First, the small sample size of eight DS children may limit the generalizability of the results to a broader population. Second, participants with varying degrees of DS severity were omitted, reducing the applicability of the findings. Third, conducting the research at a single location may further limit its generalizability to other settings. Future research should address these limitations by recruiting a larger, more diverse sample of DS children, encompassing different severity levels, age groups, and socioeconomic backgrounds. A more diverse sample would enhance generalizability and better represent the population. Additionally, replicating the study with a larger sample across multiple sites would improve external validity and increase confidence in the findings.

CONCLUSION

This study demonstrates that the CD intervention, which incorporates sensory and motor conditions, effectively enhances the expressive verbal abilities of DS children. The findings show significant improvements in verbal expressiveness following the intervention. This study provides a practical guide for using sensory-motor stimulation to improve verbal expressiveness in DS children. Beyond its effectiveness, the CD intervention is also comfortable and well-suited to the unique needs of DS children, making it a valuable therapeutic option.

ETHICAL CLEARANCE

The Ethics Committee of Universitas Pendidikan Indonesia reviewed and approved the research protocol with number B-10371/UN40.A1.1/TD.07/2024.

CONFLICT OF INTEREST

This study contains no conflicts of interest.

FUNDING

The study received no funding from any institution.

AUTHOR CONTRIBUTIONS

ADH designs studies, collects data, processes it, and writes the manuscripts. ER, S and CR collected data and revised the manuscript.

REFERENCES

1. Dixon C, Hessel A, Smith N, Nielsen D, Wesierska M, Oxley E. Receptive and expressive vocabulary development in children learning English as an additional language: Converging evidence from multiple datasets. J Child Lang. 2023; 50(3): 610-631.
2. Xu SY, Lu FM, Wang MY, Hu ZS, Zhang J, Chen ZY, et al. Altered functional connectivity in the motor and prefrontal cortex for children with Down's syndrome: An fNIRS Study. Front Hum Neurosci. 2020; 14(6): 1–10.
3. Lund E, Young A, Yarbrough R. The effects of co-treatment on concept development in children with Down syndrome. Commun Disord Q. 2020; 41(3): 176–87.
4. Hadders-Algra M. Early human motor development: From variation to the ability to vary and adapt. Neurosci Biobehav Rev. 2018; 90: 411–27.
5. Karimi A, Nelson EL. Motor-language links in children with Down syndrome: a scoping review to revisit the literature with a developmental cascades lens. Front Psychol. 2023; 14: 1-7.
6. Çelik A, Yaman H, Turan S, Kara A, Kara F, Zhu B, et al. Effect of heat treatment on green machinability of SiAlON compacts. J Mater Process Technol. 2018; 1(1): 1–8.
7. Anghel M. The role of sensorial integration in motor development in children with Down syndrome. Gymnasium. 2019; 19(1): 42–51.
8. Lukowski AF, Milojevich HM, Eales L. Cognitive functioning in children with Down Syndrome: Current knowledge and future directions. Advances in Child Development and Behavior. 2019; 56: 257–289.
9. Gonzalez CLR, Sacrey LAR. The development of the motor system. The Neurobiology of Brain and Behavioral Development. Academic Press, 2018. 235–256.
10. Arumugam A, Raja K, Venugopalan M, Chandrasekaran B, Kovanur Sampath K, Muthusamy H, et al. Down syndrome—A narrative review with a focus on anatomical features. Clinical Anatomy. 2016; 29(5): 568–77.
11. Winders P, Wolter-Warmerdam K, Hickey F. A schedule of gross motor development for children with Down syndrome. Journal of Intellectual Disability Research. 2019; 63(4): 346–56.
12. Simpson N, Mizen L, Cooper SA. Intellectual disabilities. Medicine (United Kingdom). 2020; 48(11): 732–6.
13. Maclennan S. Down's syndrome. InnovAiT. 2020; 13(1): 47–52.
14. Salkić N, Pašalić A, Mahmutović J, Krnojelac L. Difficulties of tactile sensory system sensory integration of children with Down syndrome. Adv Res. 2022; 23(1): 27–36.
15. Van Riper M, Cosgrove B, Fleming L. Adaptation at the family level in families of individuals with Down syndrome: A Scoping Review. J Fam Nurs. 2023; 29(4): 324–47.
16. Van Riper M, Knafl GJ, Barbieri-Figueiredo M do C, Caples M, Choi H, de Graaf G, et al. Measurement of family management in families of individuals with Down syndrome: A Cross-Cultural Investigation. J Fam Nurs. 2021; 27(1): 8–22.
17. Giustino V, Messina G, Alesi M, La Mantia L, Palma A, Battaglia G. Study of postural control and body balance in subjects with Down syndrome. Human Movement. 2021; 22(1): 66–71.
18. Brugnaro BH, Oliveira MFP, de Campos AC, Pavão SL, Rocha NACF. Postural control in Down syndrome and relationships with the dimensions of the International Classification of Functioning, Disability, and Health–a systematic review. Disabil Rehabil. 2022; 44(11): 2207–22.
19. Baker-Henningham H, López Bóo F. Early Childhood Stimulation Interventions in Developing Countries: A Comprehensive Literature Review. SSRN Electronic Journal. 2021.
20. Baburamani AA, Vontell RT, Uus A, Pietsch M, Patkee PA, Wyatt-Ashmead J, et al. Assessment of radial glia in the frontal lobe of fetuses with Down syndrome. Acta Neuropathol Commun. 2020; 8(1): 1–17.
21. Vorperian HK, Kent RD, Lee Y, Buhr KA. Vowel production in children and adults with Down syndrome: Fundamental and Formant Frequencies of the Corner Vowels. Journal of Speech, Language, and Hearing Research. 2023; 66(4): 1208–39.
22. Vandoni M, Giuriato M, Pirazzi A, Zanelli S, Gaboardi F, Carnevale Pellino V, et al. Motor skills and executive functions in pediatric patients with Down syndrome: A Challenge for Tailoring Physical Activity Interventions. Pediatr Rep. 2023; 15(4): 691–706.
23. Kara ÖK, Şahin S, Kara K, Arslan M. Neuromotor and sensory development in preterm infants: Prospective study. Turkish Archives of Pediatrics. 2020; 55(1): 46–53.

24. Zampini L, D'Odorico L. Communicative gestures and vocabulary development in 36-month-old children with Down's syndrome. Int J Lang Commun Disord. 2009; 44(6): 1063–73.
25. Filipe MG, Cruz S, Veloso AS, Frota S. Early predictors of language outcomes in Down syndrome: A mini-review. Front Psychol. 2022; 13: 1–13.
26. Pejovic J, Cruz M, Severino C, Frota S. Early visual attention abilities and audiovisual speech processing in 5–7 month-old Down syndrome and typically developing infants. Brain Sci. 2021; 11(7): 1-11.
27. Maïano C, Hue O, Lepage G, Morin AJS, Tracey D, Moullec G. Do exercise interventions improve balance for children and adolescents with Down syndrome? A systematic review. Phys Ther. 2019; 99(5): 507–18.
28. Galeote M, Checa E, Soto P. Joint attention and vocabulary development in toddlers with Down syndrome and their peers with typical development: The role of maternal interactive style. J Commun Disord. 2020; 84: 105975.
29. Antonaros F, Ghini V, Pulina F, Ramacieri G, Cicchini E, Mannini E, et al. Plasma metabolome and cognitive skills in Down syndrome. Sci Rep. 2020; 10(1): 1-12.
30. LeJeune LM, Lemons CJ, Hokstad S, Aldama R, Næss KAB. Parent-implemented oral vocabulary intervention for children with Down syndrome. Topics Early Child Spec Educ. 2022; 42(2): 175–88.
31. Ahad WA, Children T, Ehsaan F, Yousaf F, Children T, Qamar R. Cognitive Impairments in Children with Down Syndrome. Journal of Health, Medicine and Nursing. 2020; 71: 96-100.