Comparing Walking age, Receptive and Expressive Language Profiles between Speech Delay Children with and without Hearing Loss

Aulia Sakinah[1], Nyilo Purnami, Thtkl K[2], Nuniek Nugraheni S[3], Sulistiawati[4]

[1] Research Scholar, College Student, Faculty of Medicine, UniversitasAirlangga, Surabaya, Indonesia, [2]Research Scholar, Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine, UniversitasAirlangga, Surabaya, Indonesia, [3] Tutor Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60131, Indonesia, [4]Research Scholar Department of Public Health Sciences and Preventive Medicine, Faculty of Medicine, Universitas Airlangga

Abstract

Objectives : The study aimed to investigate whether walking age, receptive, and expressive language profiles differ between speech delay children with hearing loss and speech delay children without hearing loss; to identify walking age, receptive, and expressive profiles between speech delay children with hearing loss and speech delay children without hearing loss.

Methods : The study is an observational analytic with retrospective cross-sectional design using medical records data for two years. Data was collected using a total sampling technique.

Results : The study involved 92 children with speech delay, consisting 72 children in the hearing loss group and 20 children in the normal hearing group. The average age at walk as gross motoric profile shows that speech delays children with hearing loss have an average age that is later than speech delays children without hearing loss. Also, walking age significantly differs between children with speech delay in hearing loss group and normal hearing group. Both receptive and expressive language profiles show no different between the groups.

Conclusions : Findings have consequences for consideration motor developmental delay in children with speech delay, especially in hearing loss group. So that, the findings can be a reference to consideration in further management basis for speech delay interventions with and without hearing loss in children.

Keywords *:walking age, language, hearing, speech delay children*

Corresponding author:
Dr. Nyilo Purnami,dr.,Sp.THTKL(K),FICS
Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine, UniversitasAirlangga, JalanMayjen Prof. Dr. Moestopo 47, Surabaya 60131, Indonesia
Email: nyilo@fk.unair.ac.id
Phone: +629155100081

Introduction

Hearing loss exists in more than 5% of the world's population and 34 million of them are children.[1]This hearing loss can affects the development of speech ability in children, causing delay in speech development children. Delays in a child's speech can be an undiagnosed early symptom of some diseases, such as autism spectrum disease, global development

delay, or loss of hearing.[2] In children with speech delay, there were children with hearing loss.[3] In children who have difficulty hearing, the development of speech ability and hearing ability is delayed compared to normal children.[4] A child's hearing loss can have an impact on their speech ability.

Speech delay can be found as a manifestation of another disease. In 110 children with complaints of being unable to speak, unable to form sentences, and speech delay, it was clinically found that there were 28.18% of them with delay in speech development and others, such as mental retardation, pervasive developmental disorder, and phonological disorder.[5]

Some studies have shown motor delays in hearing loss children. Hearing loss or vestibular disorders especially in children with cochlear anomalies have a history of delays in motor development.[6] Children with hearing loss who showed vestibular dysfunction, had decreased results in motor assessment, meaning that there was a delay in motor development compared to normal hearing children.[7] In this case, hearing loss with motor development has a connection.

The ability to speak in children comes from the combination of language, and the process of producing vibrations that can be heard or known as vocalization, supported by aneural language centerand the coordination of the lip muscles, tongue muscles, jaw muscles, and the vocal tract.[8] Muscle coordination as a child's motor ability can have an impact on their speech ability. Previous research that examined the motor profile of children who experience speech and language delays, concluded that children with impaired speech skills show problems with their motor abilities.[9] The speech impairment category is included in the primary speech delay. However, it is categorized as a secondary speech delay when there is a comorbid factor, such as hearing loss.[10]There are more than one risk factor, such as hearing loss and environmental risk factors in children, causing children to have worse developmental delays than children who have only one risk factor. Two risk factors that are in a child simultaneously can lead to worse developmental delays.[11]

Methods

Participants

Data sources were conducted from the medical records of the occasion clinic in the audiology clinic and installation of physical medicine and rehabilitation from 2015 to 2016 at Dr. Soetomo Hospital, Surabaya, Indonesia.The research was conducted from September 2019 to March 2020. This research is an observational research with retrospective cross-sectional design. Sampling is done by a total sampling technique and taken based on inclusion criteria, which are speech delay children, aged between 18 and 60 months with or without hearing loss. Psychiatric disorders, history of seizures, abnormalities of head size or microcephaly, hydrocephalus, and Patent Ductus Arteriosus are the exclusion criteria in this study.

The whole subject is speech delay children. Speech delay is defined as a delay in speech development or receptive or expressive language. This data is obtained from complaints, diagnoses, or results of receptive or expressive language examinations were listed in medical records. Then, the speech delay children will have their hearing examined and listed in medical records.

The study was divided speech delay children into two groups of research, which are speech delay children with hearing loss (SDHL) and speech delay children with normal hearing (SDNH) group. Hearing loss is defined as a decrease in the child's hearing ability threshold of > 25 dB, indicated from the results of a Brainstem Evoked Response Audiometry (BERA) or Behavioral Observation Audiometry (BOA) examination. Normal hearing is defined as the

threshold of a child's hearing ability < 25 dB, indicated from the results of a BERA or BOA examination, and is considered normal in speech delay children at the installation of physical medicine and rehabilitation.

Materials

Motor profile, receptive, and expressive language are variables to be tested for differences. Gross motor development data is obtained retrospectively through medical record data. Developmental delay is defined by comparing normal references. The normal reference for a child's walking age is 8.2 to 17.6 months.[12]

Expressive or receptive language profiles are presented through nominal data scales (delay or not delay). Receptive or expressive language delay is defined as delay in all or part of the developmental stages of speech or language by comparison to normal references, especially the stages of the child being able to understand simple commands and the stages of the child being able to produce single words. The normal reference for the ability to understand simple commands in children as part of the stages of receptive language development and ability to produce single words as part of the stages of language development are 12 months of age and 10 until 16 months of age respectively.[13]

Statistical Analysis

The gross motor profile was shown through a scale of ratio data and was analyzed to determine the difference between the two groups with the Mann Whitney test. While the different receptive and expressive language skills were analyzed with Fisher's exact test.

Ethical Clearance

Certificate of ethics as a research license to use the medical record data has been given for this research by the Ethics Committee of Dr. Soetomo Hospital, Surabaya, Indonesia.

Results

By Age Group

A total of 92 children had speech delay with an age range of 18 to 60 months, consisting of 72 subjects in the SDHL group and 20 subjects in the SDNH group. Mean age of the SDHLgroup and SDNH group were 35.31 ± 9.25 and 33.02 ± 7.40 months respectively.

The age group differences showed statistically no difference.The group of SDNH had the highest frequency in the age range from over 24 to 36 months by 16 out of 20 (80%). The group of SDHL also had the highest frequency in the same age range by 43 out of 72 (59.7%).

By Gender

Differences between the study groups by gender showed statistically no difference. The group of SDNH showed that the boy had the highest frequency by 14 out of 20 (70%). The group of SDHL showed the same results by 36 out of 69 (52.17%).

Diagnosis

Global developmental delays were found in one child in the SDNH group. Motor delay, hyperlaxity, waste or nutrition disorder, social personal domain delay, and improved bronchopneumonia are known to be found in one child in the SDNH group.

Prenatal, Perinatal, and Postnatal History

A known history of prenatal problems was found in 4 out of 20 children in the group of SDNH, and 24 out of 72 children in the group of SDHL (see table 1). The difference in the number of children who had a history of prenatal problems and children who had no history of prenatal problems between the study groups showed statistically no difference.

History of known perinatal problems is found in 14 out of 20 (70%) in the group of SDNH and were found in 41 out of 72 (56.9%) in the group of SDHL (see table 1). The difference in the number of children who had a history of perinatal problems and children who had no history of perinatal problems between the two study groups showed statistically no difference.

History of known postnatal problems were found in 10 out of 20 (50%) in the group of SDNH and in 41 out of 72 (56.9%) in the group of SDHL. Differences in the number of children who had a history of postnatal problems and children who had no history of postnatal problems in the two study groups showed statistically no difference (see table 1).

Table 1 Prenatal, Perinatal, and Postnatal History

History		N (%)		p value
		SDNH (n=20)	**SDHL (n=72)**	
Prenatal	No	15 (75%)	47 (65.3%)	0.286*
	Yes[a]	4 (20%)	24 (33.3%)	
	unknown data	1 (5%)	1 (1.4%)	
Perinatal	No	6 (30%)	31 (43.1%)	0.292*
	Yes[b]	14 (70%)	41 (56.9%)	
Postnatal	No	10 (50%)	31 (43.1%)	0.580*
	Yes[c]	10 (50%)	41 (56.9%)	

*comparative test with Chi Square test, without using unknown data: p>0.05

[a] SDNH group: Hypertension, preeclampsia, and diabetes mellitus; SDHL : Hypertension, Take Herbal Medicine, Measles, Take Medicine, History of Bleeding, History of Falls during pregnancy, Hyperemesis Gravidarum, Asthma, Hypotension, Pregnancy Induction Disorder, Typhoid, Hypercholesterolemia, Maternal Age >35 y

[b] SDNH: preterm, caesarean, history of not crying immediately after birth, asphyxia, icterus, oxygen delivery, low birth weight baby; SDHL: preterm, postterm, spontaneous birth delivery with forceps or vacuum, caesarean, history of not crying immediately after birth, asphyxia, icterus, cyanosis, oxygen delivery, low and very low birth weight baby.

[c] SDNH: infection history, asthma, trauma, Neonatal Intensive Care Unit entry history, craniofacial anomalies, take medicine, allergic history, and heart disease; SDHL: infection history, asthma, craniofacial anomalies, take a medicine, trauma, allergic history, Neonatal Intensive Care Unit entry history, eyes disorder, surgery history, enlarged lymph nodes, and icterus.

Walking age in SDNH and SDHL groups

The difference in the walking age between the study groups showed statistically significant

differences (see table 2).Mean age of the walking age in SDHL group shows later than SDNH group.

Table 2 Comparative Test of Motor Profile

Variable	Mean (SD)		p-value
	SDNH (N=20)	SDHL (N=72)	
Walking Age	13.75 (±5.46)	17.24 (±5.14)	0.019*

* Comparative test using the Mann Whitney test: $p<0.05$

Receptive and Expressive in SDNH and SDHL groups

Differences in receptive language in the two study groups showed statistically no difference. Same results can be found in expressive language. See table 3.

Table 3 Comparative Test of Expressive and Receptive Language

Variables		N (%)		p-value
		SDNH	SDHL	
Receptive [a]	Normal	3 (23.1%)	16 (22.5%)	0.607*
	Delay	10 (76.9%)	55 (77.5%)	
Expressive [b]	Normal	1 (5%)	1 (1.4%)	0.389*
	Delay	19 (95%)	71 (98.6%)	

*Comparative Test using Fisher's Exact Test: $p>0.05$

[a]Unknown data were excluded so that the SDNH group consisted of 13 children and the SDHL group consisted of 71 children.

[b]The SDNH group was 20 children and the SDHL group was 7

Discussion

A study of children with a diagnosis in one of the areas of hearing, speech, or language, is found the highest frequency in the age group 2-5 y.[14]In this study, the age range from more than 24 to 36 months had the highest frequency in both groups: SDNH and SDHL.

From the results of this study, it is known that the frequency of boys is more than the frequency of girls in both groups: SDNH and SDHL. This result is similar to a study in the age range of 1-7 years with a mean age of 3.1 y,[5] children with hearing, speech, or language problems,[14] and children with communication, language, or speech disorders[Adani, 2019]. Other studies have also found that male gender is one of the risk factors for delay in 24-month-olds.[16] There are sex hormone factors such as estrogen and testosterone, and genetic factors namely FOXP2 that

causes differences in language development, speech, and communication between boys and girls. In estrogen hormones, there is a characteristic tendency to social and verbal abilities, and development in the language center. In genetic factors, FOXP2 has an influence on language development and is known to decrease in boys compared to girls.[15]

Walking Age Differences between the groups

The study of differences in motor profiles in SDNH and SDHL was done on the basis of previous research that among speech delay children were delayed in motor values,[9] and hearing loss has an influence on the motor aspect, namely postural and balance.[7] A study in the literature showed significant differences in the motor aspects of the 48 until 71 months of age group in two groups, children with hearing loss and children with normal hearing.[17] Meanwhile, in other literature, a study showed insignificant results in the degree of hearing loss as a factor in the motor development of 3-year-olds.[18] And in this study, motor differences in the SDNH and SDHL group showed differences. These results were supported by a systematic research review showing that motor profiles between children with normal hearing and those with hearing loss resulted in significant differences, especially in blindfold balance tests and one foot standing, and motor development was not achieved optimally especially in children with hearing loss.[19]

Children's motor development has a role in the development of their language. This is because children's exploration abilities differ in several stages of motor development and this exploration ability influences language development. Children can explore the surrounding environment, such as knowing the name of objects or knowing spatial language (above, under, or besides) on their own without the help of others as they enter the motor development stage of walking without assistance,[20] even before that, when children are able to sit on their own, language skills can be explored further from the surrounding environment compared to when they could not sit by themselves.[21]

Receptive and Expressive Language Profile Differences between the groups

The results showed no difference in receptive and expressive language in SDNH and SDHL groups. This is different to other studies that compared receptive and expressive abilities between children with specific language impairment andchildren with hearing loss. The results showed that there is no better receptive language ability in children with hearing loss compared to children with language impairment, however, in expressive language ability there was no association with the degree of hearing loss.[22] The same results were also shown in linguistic profile research in children with hearing loss and children with specific language impairment, which showed that there were differences in test scores used as linguistic profiles.[23] Children with hearing loss may show decreased language or speech skills when compared to healthy children.[24]

Limitation in this study is the current research conducted has categorized the expressive language and receptive language only by late and not late without knowing more specifically the location of subsections of the stages of development of receptive or expressive language that have not been achieved by each child so that it may produce a clearer result between SDHL and SDNH groups.

In summary, there are no differences in language profiles between the groups. However, motor development between the groupswas found to be different. It is important for health workers and parents to pay more attention to the impact of other developments, such as motor development in children with speech delays, especially those with hearing loss.

Acknowledgements: The authors thank the children, audiology clinic and installation of physical medicine and rehabilitation personnel at Dr. Soetomo Hospital, Surabaya, Indonesia.

Disclosure of Interest

The authors report no conflicts of interest, and no relevant financial and non-financial competing interest for this study. The authors are responsible for the content and writing of this article.

References

1. World Health Organization. Deafness and hearing loss[Internet]. World Health Organization; 2019 [cited 2019 June 14]. Available from: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss
2. Zengin-Akkuş P, Çelen-Yoldaş T, Kurtipek G, Özmert EN. Speech delay in toddlers: Are they only "late talkers"? Turk J Pediatr. 2018;60(2):165–172.
3. Douniadakis DE, Kalli KI, Psarommatis IM, Tsakanikos MD, Apostolopoulos NK. Incidence of hearing loss among children presented with speech-language delay. ScandAudiol. 2002;30(1):204–205.
4. McCreery RW, Walker EA, Spratford M, Oleson J, Bentler R, Holte L, Roush P. Speech Recognition and Parent Ratings From Auditory Development Questionnaires in Children Who Are Hard of Hearing. Ear Hear [Internet]. NIH Public Access; 2015 [cited 2019 May 11];36Suppl 1(0 1):60S-75S.
5. Yasin A, Aksu H, Özgür E, GürbüzÖzgür B. Speech and language delay in childhood: a retrospective chart review. ENT Updat. 2017;7(1):22–27.
6. Cushing SL, Papsin BC. Taking the History and Performing the Physical Examination in a Child with Hearing Loss. OtolaryngolClin North Am. Elsevier Inc; 2015;48(6):903–912.
7. Inoue A, Iwasaki S, Ushio M, Chihara Y, Fujimoto C, Egami N, Yamasoba T. Effect of vestibular dysfunction on the development of gross motor function in children with profound hearing loss. AudiolNeurotol. 2013;18(3):143–151.
8. Tonn CR, Grundfast KM. What an otolaryngologist should know about evaluation of a child referred for delay in speech development. JAMA Otolaryngol - Head Neck Surg. 2014;140(3):259–265.
9. Visscher C, Houwen S, Scherder EJA, Moolenaar B, Hartman E. Motor Profile of Children With Developmental Speech and Language Disorders. Pediatrics. 2007;120(1):e158–e163.
10. McLaughlin MR. Speech and Language Delay in Children. Am Fam Physician [Internet]. American Academy of Family Physicians; 2011 May 15 [cited 2019 May 29];83(10):1183–1188
11. Araujo DM, Cabrera Santos DC, Marconi Pinheiro Lima MC. Cognitive, language and motor development of infants exposed to risk and protective factors. Int J PediatrOtorhinolaryngol. Elsevier B.V.; 2020;138(August):110353.
12. WHOMulticentre Growth Reference Study Group. WHO Motor Development Study: Windows of achievement for six gross motor development milestones. ActaPaediatrInt J Paediatr. 2006;95(SUPPL. 450):86–95. PMID: 16817682
13. R. L, N. B. 12 minute consultation: An evidence-based approach to the management of a child with speech and language delay. ClinOtolaryngol. 2013;38(2):148–153.
14. Molini-Avejonas DR, Ferreira LV, Amato CA de LH. Risk Factors for Speech-Language Pathologies in Children. In: Fernandez FDM, editor. Adv Speech-language Pathol. InTech; 2017. p. 38.
15. Adani S, Cepanec M. Sex differences in early communication development: Behavioral and neurobiological indicators of more vulnerable

communication system development in boys. Croat Med J. 2019;60(2):141–149. PMID: 31044585

16. Hammer CS, Morgan P, Farkas G, Hillemeier M, Bitetti D, Maczuga S. Late talkers: A population-based study of risk factors and school readiness consequences. J Speech, Lang Hear Res. 2017;60(3):607–626. PMID: 28257586
17. Amemiya ÉE, Soares AD, Chiari BM. Communicative indicators, motor and cognitive development of hearing-impaired children. J Hum Growth Dev. 2016;26(1):54–60.
18. Leigh G, Ching TYC, Crowe K, Cupples L, Marnane V, Seeto M. Factors affecting psychosocial and motor development in 3-year-old children who are deaf or hard of hearing. J Deaf Stud Deaf Educ. 2015;20(4):331–342. PMID: 26209447
19. Vidranski T, Farkaš D. Motor Skills in Hearing Impaired Children with or without Cochlear Implant--A Systematic Review. CollAntropol. 2015;39Suppl 1:173–9.
20. Oudgenoeg-Paz O, Volman MJM, Leseman PPM. First steps into language? Examining the specific longitudinal relations between walking, exploration and linguistic skills. Front Psychol. 2016;7(SEP):1–12.
21. Libertus K, Violi DA. Sit to talk: Relation between motor skills and language development in infancy. Front Psychol. 2016;7(MAR):1–8.
22. Keilmann A, Kluesener P, Freude C, Schramm B. Manifestation of speech and language disorders in children with hearing impairment compared with children with specific language disorders. LogopPhoniatrVocology. 2011;36(1):12–20. PMID: 20849246
23. de Hoog BE, Langereis MC, van Weerdenburg M, Knoors HET, Verhoeven L. Linguistic profiles of children with CI as compared with children with hearing or specific language impairment. Int J Lang CommunDisord. 2016;51(5):518–530. PMID: 26864995
24. Hogan A, Shipley M, Strazdins L, Purcell A, Baker E. Communication and behavioural disorders among children with hearing loss increases risk of mental health disorders. Aust N Z J Public Health. 2011;35(4):377–383. PMID: 21806734