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Original Article

Risk factors of speech and language disorders in children

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Abstract

Background Speech and language problems are developmental disorders often observed in children. Risk factors for speech and language disorders can occur prenatally, perinatally, or postnatally. Recognizing the risk factors for speech and language problems is essential for early diagnosis and intervention.

Objective To identify risk and protective factors of speech and language disorders in children.

Methods This case-control study was conducted in the Growth and Development Clinic at Dr. Soetomo Hospital, Siloam Hospital, Kendangsari Merr Hospital, and Darmo Hospital, Surabaya, East Java. Subjects with normal development were included in the control group, subjects with speech-language development disorders with no additional problems were included in the primary case group, and subjects with speech-language disorders and additional problems were included in the secondary case group. Subjects underwent history-taking and developmental examinations to assess for risk factors and types of speech-language disorders.

Results During March - July 2023, 162 subjects aged 2-6 years met the inclusion criteria. The significant risk factors in the primary group were male sex (P=0.000), age 2-3 years (P=0.01), and maternal age 19-35 years (P=0.018). The protective factor identified was not bilingual (P=0.046). In the secondary group, the significant risk factor was male gender (P=0.002). The protective factors obtained were absence of seizures (P=0.028) and not being bilingual (P=0.045).

Conclusion Male gender is a risk factor while non-bilingual is protective for speech-language disorders in children. **[Paediatr Indones. 2024;64:430-8; DOI: https://doi.org/10.14238/pi64.5.2024.430-8].**

Keywords: *speech language disorder; risk factors; gender; bilingual*

Speech and language disorders are common pediatric developmental problems. The prevalence of speech and language disorders worldwide varies between 2-19% in various age ranges.[1,2] Children with speech and language problems are often referred for further evaluation. Most children are referred at preschool age.[3,4]

Preschool age language skills at 2-6 years of age are the basis for learning abilities at school.[5] Children with speech and language problems can develop learning and reading disorders and/or behavioral problems.[6] *The 2020 Indonesian Child Profile Report* found that 1.59% children aged 2-17 years had disabilities. The most common type of disability was difficulty/impairment with speaking and/or understanding/communicating at 0.34%.[7]

Speech and language disorders can be grouped into primary language disorders without accompanying problems, and secondary language disorders with accompanying problems. Various terms have been used for primary language disorders, such

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as developmental language disorder (DLD) and specific language impairment (SLI). Primary language disorders can be divided into expressive, receptive, or a combination of receptive and expressive language disorders. Secondary language disorders can be caused by hearing loss, global developmental delay (GDD), intellectual disability, autism spectrum disorder (ASD), genetic disorders such as trisomy 21, or neurological disorders such as cerebral palsy.[6]

Risk factors for speech and language disorders can occur prenatally, perinatally, or postnatally. A systematic review and meta-analysis of risk factors for children with SLI found that significant risk factors were male gender, low maternal education, later born in birth order, prematurity, pregnancy complications, low 5th minute APGAR score, and family history of speech problems.[8] Recognizing the main risk factors and sociodemographic characteristics that are associated with speech and language problems is critical for early diagnosis and intervention to minimize the negative effects of speech and language disorders on future academic abilities.[2] However, studies on risk factors for speech and language disorders in children in Indonesia are still limited.

Methods

This case-control study was conducted in March - July 2023 at the Growth and Development Clinic of Dr Soetomo Hospital, Siloam Hospital, Kendangsari Merr Hospital, and Darmo Hospital, Surabaya, East Java. Our study included 162 subjects aged 2-6 years and were divided into 3 groups: control, primary, and secondary. Subjects with normal development were included in the control group; subjects with speech and language development disorders with or without personal social delay and no other comorbidities were included in the primary group; and subjects with speech and language disorders with motor delay or other comorbidities were included in the secondary group. Children with Down's syndrome and hypothyroidism were excluded. This study was approved by the Ethics Committee of Dr Soetomo Hospital, Surabaya, East Java.

Data collection was done with a purposive sampling method. Subjects' parents or guardians were interviewed using a questionnaire to obtain information about the subjects' gender, age, both parental age at the time of birth and study, parental education, number of siblings, and birth order. Parental age was defined as parents age at study while parental age at birth was defined as parents age at birth. Prenatal risk factors assessed were pregnancy complications and family history of language-speech disorder; perinatal risk factors assessed were mode of birth, prematurity, low birth weight, perinatal asphyxia, and neonatal jaundice; postnatal risk factors assessed were intensive care stay, seizures, exclusive breastfeeding status, growth problems, primary caregiver, duration of screen time, and bilingualism. History of language-speech disorder was considered positive if nuclear family members (biological father, mother, or siblings) had speech problems. Parental education was considered to be high if the parent had a diploma (post-high school degree) or bachelor's degree. Subjects born at under 37 weeks were considered to be premature, and those with birth weight <2,500 grams were considered to have low birth weight (LBW). Growth problems were defined using the Indonesia Ministry of Health Regulation No 2/2020 about child anthropometric standards.[9] Screen time was considered to be high if more than 1 hour per day. Bilingualism was considered when there were 2 or more languages used at home.

Developmental evaluation was carried out using Denver II.[10] Primary group subjects underwent ELMS-2 examination,[11] to group them into expressive language disorder or both receptive and expressive language disorder. Secondary group subjects aged ≥5 years underwent IQ examination to determine the possibility of intellectual disability.[12]

Subjects with suspected ASD and age <30 months were screened with *m-CHAT R/F*.[13] In children aged >30 months, ASD was diagnosed according to *DSM V*.[14] Children aged >36 months with suspected attention-deficit/hyperactivity disorder (ADHD) were screened with *ACRS*.[15] An ADHD diagnosis was made according to *DSM V*.[14] Data were processed with *SPSS Statistics software* and analyzed by Chi-square test and logistic regression method. The significance level in both tests was $P < 0.05$.

Results

Of 162 subjects, 105 (64.8%) were male and 57 (35.2%) were female. Most subjects were aged 2-≤3 years (67; 41.4%). The largest maternal age group was 19-35 years (111; 68.5%). The majority of fathers and mothers had high education level (108; 66.7%). Most subjects were firstborn children (83; 51.2%); 63 (38.9%) subjects had 1 sibling.

In the control group, the number of boys and girls was comparable, but there were more boys in the primary (77.8%) and secondary (68.5%) groups. The most common age grouping in the control group was 3-≤4 years (29.6%), while the age of 2-≤3 years was more common in the primary (59.3%) and secondary (37.0%) groups. High maternal education group was most common in the control (83.3%) and primary (74.1%) groups, while low-medium education was more common in the secondary group (57.5%). High paternal education was most common in the control (77.8%) and primary (75.9%) groups, while low-medium education was more common in the secondary group (53.7%). Significant differences were found in gender, age, maternal age at study, and parental education among the three groups (P<0.05 for all) (**Table 1**).

In the primary speech language disorder group, expressive disorders were found in 24 (44.4%) subjects and mixed disorder in 30 (55.6%) subjects. The most common secondary speech language disorders found were global developmental delay in 34 (62.9%) subjects and ASD in 17 (31.5%) subjects. Hearing impairment was found in 2 (3.7%) subjects and ADHD in 1 (1.9%) subject (**Table 2**).

In the prenatal history, the majority of pregnancies were not accompanied by pregnancy problems (90.1%). Also, there were no significant differences in pregnancy problems among the three groups. Speech problems in the family were generally not found in the control (98.1%) and secondary (94.4%) groups, but there were significantly more family history of speech problems (14.8%) in the primary group (P=0.039).

In the perinatal history, 106 subjects (65.4%) underwent cesarean delivery. A total of 134 (82.7%) subjects were born full term and 140 (86.4%) had normal birth weight. There was only 1 patient with a history of prematurity <32 weeks and LBW <1500g in the secondary group. A history of jaundice requiring phototherapy was found in 38 (23.5%) subjects, a history of asphyxia at birth in 20 (12.3%) subjects. None of these variables showed significant differences among the three groups (P>0.05).

In the postnatal history, 24 (14.8%) subjects had history of intensive care stay. History of seizures was found in 17 subjects (10.5%) overall, with the highest incidence in the secondary group (20.4%) (P=0.012). Screen time >1 hour/day was found in 108 (66.7%) subjects. The majority of primary caregivers were mothers (54.9%). A total of 80 (49.4%) subjects were exposed to bilingualism with significantly greater number in the primary (55.6%) and secondary (59.3%) groups than in the control group (P=0.014). Growth problems were found in 66 (40.7%) subjects. A total of 93 subjects (57.4%) received exclusive breastfeeding. Other than the seizure history and bilingual environment, none of the other prenatal and postnatal factors were significantly different between groups (**Table 3**).

Risk factor analysis was carried out using the multinomial logistic regression (risk of being primary/secondary). Risk factors with P ≤0.025 in bivariate analysis were analyzed to assess the risk of being primary or secondary. In the primary group, the significant risk factors were male gender (OR 5.666; 95%CI 2.128 to 15.088; P=0.001), age 2-<3 years (OR 28.551; 95%CI 3.032 to 268.838; P=0.003), age 3-<4 years (OR 10.417; 95%CI 1.11 to 97.727; P=0.04), and maternal age 19-35 years (OR 3.133; 95%CI 1.132 to 8.67; P=0.028). The analysis revealed that not being bilingual was a protective factor (OR 0.389; 95%CI 0.156 to 0.971; P=0.043). In the secondary group, the significant risk factor was male gender (OR 3.733; 95%CI 1.43 to 9.749; P=0.007). The protective factors were high maternal education (OR 0.165; 95%CI 0.046 to 0.594; P=0.006), not having seizures (OR 0.164; 95%CI 0.029 to 0.928; P=0.041), and not being bilingual (OR 0.383; 95%CI 0.155 to 0.945; P=0.037) (**Table 4**).

Discussion

In this study, we found significantly more males in the primary and secondary groups than in the control group, similar to previous studies.[1,16,17] The largest age

Table 1. Subjects' characteristics

Characteristics	Control (n=54)	Primary (n=54)	Secondary (n= 54)	P value
Gender, n (%)				0.004[a]*
Male	26 (48.1)	42 (77.8)	37 (68.5)	
Female	28 (51.9)	12 (22.2)	17 (31.5)	
Age, n (%)				0.002[a]*
2 -<3 years	15 (27.8)	32 (59.3)	20 (37.0)	
3-<4 years	16 (29.6)	18 (33.3)	16 (29.6)	
4-<5 years	11 (20.4)	3 (5.6)	11 (20.4)	
5-6 years	12 (22.2)	1 (1.9)	7 (13.0)	
Maternal age, n (%)				0.025[a]*
≤18 years	0 (0)	0 (0)	0 (0)	
19-35 years	30 (55.6)	43 (79.6)	38 (70.4)	
≥36 years	24 (44.4)	11 (20.4)	16 (29.6)	
Paternal age, n (%)				0.382
≤18 years	0 (0)	0 (0)	0 (0)	
19-35 years	28 (55.6)	30 (55.6)	23 (42.6)	
≥36 years	26 (44.4)	24 (44.4)	31 (57.4)	
Maternal age at birth, n (%)				0.864
≤18 years	0 (0)	0 (0)	0 (0)	
19-35 years	46 (85.2)	47 (87.0)	45 (83.3)	
≥36 years	8 (14.8)	7 (13.0)	9 (16.7)	
Paternal age at birth, n (%)				0.315
≤18 years	0 (0)	0 (0)	0 (0)	
19-35 years	39 (72.2)	43 (79.6)	36 (66.7)	
≥36 years	15 (27.8)	11 (20.4)	18 (33.3)	
Maternal education, n (%)				0.000[a]*
Low-middle	9 (16.7)	14 (25.9)	31 (57.5)	
High	45 (83.3)	50 (74.1)	23 (42.6)	
Paternal education, n (%)				0.001[a]*
Low-middle	12 (22.3)	13 (24.1)	29 (53.7)	
High	42 (77.8)	41 (75.9)	25 (46.3)	
No. of siblings, n (%)				0.204
0	15 (27.8)	27 (50)	19 (35.2)	
1	26 (48.1)	15 (27.8)	22 (40.7)	
2	8 (14.8)	9 (16.7)	11 (20.4)	
≥3	5 (9.3)	3 (5.6)	2 (3.7)	
Birth order, n (%)				0.271
1	27 (50)	32 (59.3)	24 (44.4)	
2	20 (37)	11 (20.4)	18 (33.3)	
≥3	7 (13)	11 (20.4)	12 (22.2)	

[a]Chi square test; *significant (P<0.05)

Table 2. Characteristics of speech language disorders in the primary and secondary groups

Characteristics	Primary group (n=54)	Secondary group (n=54)
Expressive, n(%)	24 (44.4)	
Mixed expressive and receptive, n(%)	30 (55.6)	
Global developmental delay, n(%)		34 (62.9)
Autism spectrum disorder, n(%)		17 (31.5)
Attention deficit hyperactivity disorder, n(%)		1 (1.9)
Hearing disorders, n(%)		2 (3.7)
Intellectual disability, n(%)		0 (0)

Table 3. Analysis of possible risk factors and types of speech disorders

Characteristics	Control (n=54)	Primary (n= 54)	Secondary (n=54)	P value
Prenatal history, n (%)				
Pregnancy complications				0.961
No	49 (90.7)	48 (88.9)	49 90.7)	
Hypertension	1 (1.9)	3 (5.6)	2 (3.7)	
Pre/eclampsia	2 (3.7)	3 (5.6)	3 (3.7)	
Gestational diabetes	1 (1.9)	0 (0)	1 (1.9)	
TORCH infection	1 (1.9)	0 (0)	0 (0)	
Family history of speech language disorder				0.039a*
No	53 (98.1)	46 (85.2)	51 (94.4)	
Yes	1 (1.9)	8 (14.8)	3 (5.6)	
Perinatal history, n (%)				
Mode of delivery				0.263
Normal	15 (27.8)	18 (33.3)	23 (42.6)	
Cesarean section	39 (72.2)	36 (66.7)	31 (57.4)	
Prematurity				0.739
No	46 (85.2)	45 (83.3)	43 (79.6)	
Yes	8 (14.8)	9 (16.7)	10 (20.4)	
Low birthweight				0.229
No	44 (81.5)	50 (92.6)	46 (85.2)	
Yes	10 (18.5)	4 (7.4)	8 (14.9)	
Jaundice				0.081
No	39 (72.2)	38 (70.4)	47 (87.0)	
Yes	15 (27.8)	16 (29.6)	7 (13.0)	
Asphyxia				0.476
No	48 (88.9)	45 (83.3)	49 (90.7)	
Yes	6 (11.1)	9 (16.7)	5 (9.3)	
Postnatal history, n (%)				
Intensive care				0.644
No	47 (87)	44 (81.5)	47 (87.0)	
Yes	7 (13)	10 (18.5)	7 (13.0)	
Seizure				0.012a*
No	52 (96.4)	50 (92.6)	43 (79.6)	
Yes	2 (3.7)	4 (7.4)	11 (20.4)	
Screen time > 1 hour/day				0.076
No	24 (44.4)	13 (24.1)	17 (31.5)	
Yes	30 (55.6)	41 (75.9)	37 (68.5)	
Exclusive brestfeeding				0.052
Yes	36 (66.7)	33 (61.1)	24 (44.4)	
No	18 (33.3)	21 (38.9)	30 (55.6)	
Growth problems				0.369
No	28 (51.8)	35 (64.8)	33 (61.1)	
Yes	26 (48.2)	19 (35.2)	21 (38.9)	
Bilingualism				0.014a*
No	36 (66.7)	24 (44.4)	22 (40.7)	
Yes	18 (33.3)	30 (55.6)	32 (59.3)	
Primary caregiver				0.087
Mother	28 (51.9)	25 (46.3)	36 (66.7)	
Mother and others	14 (25.9)	18 (33.3)	6 (11.1)	
Others	12 (22.2)	11 (20.4)	12 (22.2)	

[a]Chi square test; *significant (P<0.05)

Table 4. Analysis of possible speech disorder risk factors

Group	Characteristics	OR (95% CI)	P value
Primary	Demographic factor		
	Male gender	5.666 (2.128-15.088)	0.001[b*]
	Age 2-3 years	28.551 (3.032-268.838)	0.003[b*]
	Age 3-4 years	10.417 (1.11-97.727)	0.04b*
	Maternal age 19-35years	3.133 (1.132-8.67)	0.028[b*]
	High maternal education	0.382 (0.092-1.588)	0.186
	High paternal education	1.59 (0.411-6.155)	0.502
	Postnatal history		
	No seizure	0.412 (0.06-2.857)	0.37
	Not bilingual	0.389 (0.156-0.971)	0.043[b*]
Secondary	Demographic factor		
	Male gender	3.733 (1.43-9.749)	0.007[b*]
	Age 2-3 years	2.546 (0.634-10.226)	0.188
	Age 3-4 years	1.234 (0.306-4.975)	0.768
	Maternal age 19-35 years	1.993 (0.753-5.278)	0.165
	High maternal education	0.165 (0.046-0.594)	0.006[b*]
	High paternal education	0.815 (0.241-2.752)	0.741
	Postnatal history		
	No seizure	0.164 (0.029-0.928)	0.041[b*]
	Not bilingual	0.383 (0.155-0.945)	0.037[b*]

[b]multinomial regression test; * significant (P<0.05)

group was 2 to 3-year-old in the primary (59.3%) and secondary (37%) groups, similar to previous studies in Jakarta and the Netherlands.[3,18]

The largest maternal age group was 19-35 years, with 79.6% in the primary group and 70.4% in the secondary group. Data on maternal and paternal age in previous studies of speech-language disorders are limited. A Turkish study reported that the largest maternal age group during pregnancy was 19-35 years (61.8%), but there was no significant relationship found.[19] The most common birth order was firstborn child 83 (51.2%), and 63 subjects had 1 sibling (38.9%); there were no significant differences among the 3 groups. In contrast, study from Turkey which grouped speech-language disorder into intellectual disability, ASD, specific language disorder (SLD), stimulus deficiency, speech sound disorder (SSD), and speech fluency disorder (SFD) noted significant differences in birth order and number of siblings.[19]

The majority subjects' parents had high education (108; 66.7%). Studies comparing parental education, especially paternal education, and types of speech-language disorders have been limited. A previous study in Jakarta reported parents of children with general developmental delays had higher education (68%), but differences were not assessed because there was no control group.[20]

The most common primary speech language disorder in this study was mixed receptive-expressive (55.6%), similar to findings in the Netherlands, with 61% of children having mixed language disorders.[18] Different results were reported in Palembang where the incidence of expressive language disorders was greater. These contrasting results may have been due to differences in methods for determining the type of speech disorder, whereas ELMS-2 was used in our study, and the SLI checklist was used in Palembang, South Sumatera.[21]

The most common diagnosis of subjects in the secondary speech-language disorder group was global developmental delay (GDD) (55.6%), in agreement with a Jakarta study which reported that the most common diagnoses for speech disorders with comorbidities were GDD (30.8%), followed by ASD (15%).[3]

There was only one subject with ADHD (aged 4 years 9 months). This may have been because ADHD diagnosis is generally made in older children. A systematic review of children with ADHD in Europe found a mean age at diagnosis of 6.2-18.1 years.[22] Intellectual disability was not found in our study. In the secondary group, 7 children were aged ≥5 years.

Four children were diagnosed with ASD for whom IQ examination was not yet possible, 2 children had moderate-severe hearing loss but did not yet use hearing aids, and 1 child had an IQ result of 90-99 (lower average).

Significant differences in our study were history of speech problems in the family, history of seizures, and bilingualism, while pregnancy complications, prematurity, LBW, asphyxia, jaundice, intensive care, exclusive breastfeeding, screen time >1 hour/day, growth disorders, and main caregivers were not significantly different among groups. Previous research results have varied.[19,23-27]

Risk factor analysis using the multinomial logistic regression method revealed that the significant risk factors in the primary group were male gender, age 2-<3 years, age 3-<4 years, and maternal age 19-35 years; the protective factor was not bilingual. The significant risk factor in the secondary group was male gender; protective factors were high maternal education, not having seizures, and not being bilingual.

Differences in the level of language development between boys and girls have been widely reported in previous studies.[28] These results were consistently found even though different methods, subjects and geographical locations were used, although statistically they may not be significant.[29] A systematic review reported differences in brain structure in between genders, but these differences do not necessarily lead to differences in speech and language abilities. Gender differences often coincide with other factors such as age and type of task performed. Generally, differences in language-speaking abilities between boys and girls decrease with age.[30] Multiple studies reported significant associations between fetal or early postnatal sex hormone levels and speech and language development. In general, estrogen has been found to correlate with improved social and verbal skills and promote the growth of language centers and related areas in the brain, whereas testosterone has the opposite effect.[31]

The primary group had significantly higher percentage of 2 to 4-year-old than the other two groups. These results may be related to differences in speech-language abilities in different genders that decrease with increasing age. A previous study reported significant differences in language ability scores for 3-year-old girls compared to boys. This difference decreased at the age of 4 years and became non-significant at age 5 years.[32]

Maternal age when the child was born did not differ significantly among the control group, primary, and secondary groups. But, maternal age of 19-35 years at study was a risk factor for primary speech-language disorders. Older maternal age may be a protective factor of SLI because older mothers are more confident and responsive to their children, resulting in better language stimulation. A study in the Netherlands that compared children with SLI to normal children found that children with SLI had mothers who were significantly younger compared to mothers of children in the control group.[24]

In our study, not having seizures was a protective factor in the secondary group, but not in the primary group. This may have been because seizures in the primary group were all febrile seizures, while in the secondary group, apart from febrile seizures, some subjects had seizures due to epilepsy. A history of epilepsy may influence the type of speech disorder. Functional magnetic resonance imaging (fMRI) studies suggest that epilepsy of various underlying etiologies may affect language network consolidation.[33]

Research on multilingualism as a risk factor for speech disorders has obtained mixed results. For children exposed to more than one language, several factors can influence mastery of each language: time exposed to each language, the number of people who interact with the child in only one language, and the number of people in the household who master each language.[34] We found that not being bilingual was a protective factor in the primary and secondary groups. This result may have been due to our failure to differentiate between the number of languages used. These results may also have been influenced by the level of mastery of each language by people in the household or whether the child was exposed to multiple languages simultaneously or sequentially, which we also did not assess.

The limitations of this study were the lack of age and gender matching due to difficulties in obtaining suitable subjects, and parenting style as a factor that can influence the outcome of speech and language problems was not assessed. For further study, we recommend assessing parenting style to complement factors that can influence the outcome of speech-language problems in children. For early detection, we

recommend increasing awareness for speech-language problems in boys and in children aged 2-4 years for primary speech-language problems

In conclusion, male gender, age 2-4 years, and maternal age 19-35 years are risk factors for primary speech disorders. Not being bilingual is a protective factor for primary speech disorders. Male gender is also a risk factor for secondary speech language disorders. High maternal education, not having seizures, as well as not being bilingual are protective factors for secondary speech language disorders.

Conflict of interest

None declared.

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