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Securing Human Capital Towards Equity: Social Determinants and Protective Factors of Speech-Language Delay in Malaysia

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ABSTRACT:
Speech and language delay (SLD) is a critical public health concern that threatens long-term human capital and social equity. This study investigates the significant gap in localised clinical evidence regarding the socio-structural determinants and protective factors of SLD in diverse, multilingual settings. Utilising a cross-sectional methodology, the research analysed multisource secondary data from 320 paediatric clinical records at a major Malaysian referral centre. Data collected included sociodemographic characteristics, language exposure, medical history, and healthcare-related barriers. Results indicate a high clinical prevalence of SLD at 51.9%, significantly exceeding national estimates. Multilingual backgrounds (AOR = 2.13) and parental barriers to follow-up care (AOR = 3.02) were associated with significantly higher odds of SLD. Conversely, older age and the presence of an underlying diagnosed condition were identified as significant protective factors. These findings imply that securing human capital requires an equitable approach to healthcare through culturally sensitive screening and the removal of logistical barriers. Aligning with sustainable development goals, this study advocates for integrated public health strategies to ensure inclusive developmental outcomes for all children.

Keywords: Language Development Disorders, Health Services Accessibility, Health Equity, Bilingualism, Social Determinants of Health, Early Intervention

1. Introduction

Speech and language development is a key indicator of child health and development, reflecting cognitive, social, and communication functioning. Speech and Language Delay (SLD) occur when expected speech and language milestones are not achieved within the typical developmental timeframe (American Academy of Family Physicians, 2023; McLaughlin, 2011). Globally, SLD prevalence ranges from 2.7% to 20%, influenced by differences in diagnostic criteria, assessment methods, and population characteristics (Sunderajan, 2019; Hill et al., 2023; Mondal et al., 2016). The National Health and Morbidity Survey (NHMS 2022) Malaysia reported an increase in overall

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developmental delays from 2.8% in 2016 to 7.4% in 2022, with speech and language delay rising from 1.7% to 2.7%.

Beyond its clinical significance, speech and language development is fundamental to educational attainment, social participation, and future human capital development. Untreated SLD may persist into adolescence and adulthood, affecting academic performance, psychosocial well-being, and long-term opportunities (Langbecker et al., 2020). Commonly reported risk factors include biological, socioeconomic, and environmental influences, such as family history, parental education, prematurity, screen exposure, and caregiver-child interaction (Mondal, 2016; Sunderajan, 2019). Access to timely intervention remains a major challenge. Barriers such as limited service availability, financial constraints, and poor therapy adherence can delay treatment and worsen developmental outcomes (Hobson et al., 2022). These challenges may contribute to inequities in child development, particularly among families with reduced access to specialised services.

Despite increasing national concern, local clinical evidence on SLD in Malaysia remains limited. Population-based surveys provide important prevalence estimates but offer limited understanding of the social, environmental, and healthcare-related factors influencing SLD. Hospital Melaka, a major speech therapy referral centre with more than 1,400 new referrals in 2023, provides an important setting for examining these determinants in a real-world clinical population. Understanding the factors associated with SLD is essential for strengthening inclusive child development services and reducing developmental inequities. Therefore, this study aimed to determine the prevalence and associated factors of SLD among children aged 1–12 years attending Hospital Melaka's Speech Therapy Clinic in 2023. The findings provide evidence to support equitable access to developmental services, culturally responsive screening approaches, and early intervention strategies that promote positive developmental outcomes and long-term human capital development.

2. Research Methodology

2.1 Study Design, Population and Sampling

A cross-sectional study was conducted at the Hospital Melaka's Speech Therapy Clinic from 1 January to 31 December 2023. The clinic serves as a major referral centre for Melaka and neighbouring states, making it suitable for examining SLD in a clinical population. Children aged 1–12 years who attended during the study period were included. Children with incomplete records or duplicate records or records with more than 20 percent missing critical data were excluded. The study followed STROBE guidelines. Sample size was calculated using OpenEPI based on a 27% estimated prevalence (Nivedita, 2016), 5% significance level, and 80% power, yielding a minimum of 306 participants after 20% adjustment for missing data. A total of 320 children were selected using simple random sampling from the clinic attendance database.

2.2 Data Source

The study utilised multisource secondary clinical data, including referral letters, speech therapy notes, and assessment reports. Additional data were obtained from hospital

electronic systems covering demographic, attendance, care plans, and clinical records. This approach allowed comprehensive assessment of sociodemographic, environmental, and healthcare-related determinants of SLD.

2.3 Study Variables

The dependent variable was Speech and Language Delay (SLD), diagnosed by registered speech therapists using the Ministry of Health Malaysia *SLT-Borang Penilaian dan Kemajuan Kemahiran Bahasa Pediatrik Unit Pemulihan Pertuturan-Bahasa,* an official clinical assessment form used in routine Ministry of Health practice in the Standard Operating Procedure for the Management of Pediatric Patients with Language Disorders MOH Malaysia 2023 (Ministry of Health Malaysia, 2023). The assessment evaluates receptive and expressive language according to age-specific developmental milestones. SLD was defined as the presence of at least one age-inappropriate item recorded as "Not Yet Acquired" in either language domain, consistent with the clinical interpretation of the assessment form and routine Ministry of Health clinical practice. Independent variables included sociodemographic factors (e.g., ethnicity, parental education, income, bilingualism/multilingualism), environmental and healthcare access factors (e.g., playschool attendance, screen time, stimulation, follow-up compliance, barriers to care), and biological factors (e.g., age, sex, medical conditions, hearing status, birth complications, and family history). Variables were guided by a social determinant of health framework.

2.4 Data Management

Data were extracted from multiple hospital sources using the 2023 Speech Therapy Clinic attendance list to identify eligible patients, who were selected via simple random sampling using Excel-generated random numbers. Data linkage across systems was performed using each child's identification number (IC) as a unique identifier. Information was obtained from Client Data Information System (SMRP), the Hospital Patient Management System, Daily Statistics, and outpatient clinical records, including the Paediatric Case History Form and SLT assessment forms. A standardised proforma was used to extract sociodemographic, environmental, healthcare-related, and biological variables. All records were de-identified and assigned unique study IDs.

Data were entered into Microsoft Excel and analysed using SPSS version 29.0. Data management included verification, cleaning, and consistency checks, with records containing >20% missing data excluded. Complete-case analysis was applied for multivariable logistic regression. Missingness was evaluated using logistic regression against a binary indicator of missing versus observed values to explore the missing-data mechanism (Alzahrani L D, et al, 2023). Confidentiality was maintained by replacing identifiable information with study IDs, restricting access to raw data only for researchers and securing all files with password protection.

2.5 Statistical Analysis

Participant characteristics were summarised using descriptive statistics, with categorical variables presented as frequencies and percentages. The prevalence of SLD was

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estimated with 95% confidence intervals (CI). Confidence intervals for proportions were calculated using the Wilson score method to provide more reliable estimates, particularly for categories with small sample sizes. Associations between independent variables and SLD were initially examined using simple logistic regression to estimate crude odds ratios (CORs) and 95% CIs. Variables with $p < 0.25$ in the univariable analysis or considered clinically relevant were entered into a multivariable binary logistic regression model using the backward Likelihood Ratio (LR) method to estimate adjusted odds ratios (AORs). The extent of missing data was assessed for all study variables, and complete case analysis was performed, whereby only records with complete data for variables included in the final model were analysed. Model assumptions, including linearity of the logit, absence of multicollinearity, influential observations (Cook's Distance), and goodness-of-fit (Hosmer–Lemeshow test), were assessed. Potential interaction terms between clinically relevant variables were examined, and no statistically significant interactions were identified. Sensitivity analyses were not performed because the study employed a complete-case approach and the primary objective was exploratory identification of associated factors. Statistical significance was set at $p < 0.05$.

3. Results

A total of 320 patient records were analysed. The overall prevalence of speech and language delay (SLD) was 51.9% (95% CI: 46.4–57.4). SLD was most common among children aged 2–3 years (82%), with 62.9% of diagnoses classified as severe. Table 1 presents the sociodemographic characteristics of the study population and the distribution of SLD. Most children were Malay (95.6%), Muslim (95.3%), urban residents (81.9%), and from nuclear families (90.0%). Most households belonged to the middle- or high-income groups (77.8%), and parents were the primary caregivers for most children (80.6%). Differences in SLD prevalence were observed across several sociodemographic characteristics. Higher prevalence was found among Malay children (52.6% vs. 35.7% among non-Malay), children from extended families (62.5% vs. 50.7% in nuclear families), and bilingual/multilingual children (65.1% vs. 47.2% among monolingual children). Children whose fathers were non-professional or unemployed also demonstrated higher SLD prevalence (58.5%).

Table 1: Sociodemographic Characteristics of Children in Speech Therapy Clinic Hospital Melaka and SLD Prevalence, Year 2023 (N = 320)

Characteristics	Frequency (n)	Percentage (%)	SLD, n(%)	95% CI
DEMOGRAPHIC				
Race				
Malay	306	95.6	161 (52.6)	47.0, 58.2
Non-Malay	14	4.4	5 (35.7)	7.0, 64.4
Religion				95% CI (Wilson)
Buddhism	9	2.8	2 (22.2)	6.3–54.7
Christianity	3	0.9	1 (33.3)	6.1–79.2
Hinduism	3	0.9	2 (66.7)	20.8–93.9
Islam	305	95.3	161 (52.8)	47.2–58.4
Place of Residence				

Urban	262	81.9	136 (51.9)	45.8, 58.0
Rural	58	18.1	30 (51.7)	38.5, 65.0
Type of Family				
Nuclear	288	90.0	146 (50.7)	44.9, 56.5
Extended/Joint	32	10.0	20 (62.5)	44.8,80.2
Size of Family				
≤ 4 Persons	227	70.9	118 (52.0)	45.4, 58.5
> 4 Persons	93	29.1	48 (51.6)	41.3, 62.0
Father's Occupation (n=141)				
Professional	88	27.5	43 (48.9)	38.2,59.5
Non-professional/Unemployed	53	16.6	31 (58.5)	44.8, 72.2
Mother's Occupation (n=175)				
Professional	58	33.1	30 (51.7)	38.5, 65.0
Non-professional/Unemployed	117	66.9	54 (46.2)	37.0, 55.3
Father's Education Level (n=173)				95% CI (Wilson)
Tertiary	169	52.8	96 (56.8)	49.3, 64.3
Secondary or Lower	4	1.3	2 (50.0)	38.6–54.3
Mother's Education Level (n=165)				95% CI (Wilson)
Tertiary	157	95.2	84 (53.5)	45.6, 61.4
Secondary or lower	8	4.9	5 (62.5)	30.6–86.3
Household Income Status (n=257)				
M40, T20 (middle to high)	200	77.8	106 (53.0)	46.0, 60.0
B40 (low income)	57	22.2	30 (52.6)	39.3, 66.0
Parents' Marital Status				95% CI (Wilson)
Married	314	98.1	163 (51.9)	46.4,57.5
Not Married	3	0.9	1 (33.3)	6.1–79.2
Divorced	3	0.9	2 (66.7)	20.8–93.9
Primary Caretaker				95% CI (Wilson)
Parents	258	80.6	130 (50.2)	44.0, 56.3
Grandparent	27	8.4	17 (63.0)	43.5, 82.4
Babysitter	30	9.4	16 (53.3)	34.4, 72.3
Relatives	4	1.2	2 (50.0)	15.0–85.0
Welfare Home	1	0.3	1 (0.6)	20.7–100.0
Bilingualism/Multilingualism				
No	237	74.1	112 (47.2)	40.9, 53.7
Yes	83	25.9	54 (65.1)	54.6, 75.5

SLD= speech and language delay, CI= confidence interval

Tables 2 and 3 present the environmental, healthcare-access, and biological characteristics of the study population. Lower SLD prevalence was observed among children attending kindergarten (48.9% vs. 54.1%), those whose parents complied with follow-up appointments (51.4% vs. 55.0%), and those without barriers to follow-up (50.8% vs. 64.0%). Higher SLD prevalence was observed among children with daily media exposure exceeding two hours (64.3%), limited parental interaction (60.0%), and inadequate stimulation (58.3%). Biologically, higher prevalence was observed among

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younger children aged 1–6 years (54.6%), males (53.9%), children with a family history of SLD (61.7%), and those without a diagnosed underlying condition (64.3% vs. 42.2%). Underlying conditions include hearing impairment, cleft lip, learning disability, thalassemia, autism spectrum disorder, and other congenital or developmental conditions.

Table 2: Environmental Characteristics of Children in Speech Therapy Clinic Hospital Melaka and SLD Prevalence, Year 2023 (N=320)

Characteristics	Frequency (n)	Percentage (%)	SLD, n (%)	95% CI
Environmental				
i) Individual Characteristic				
Psychosocial Factor				
No	315	98.4	164 (52.1)	46.5, 57.6
Yes	5	1.6	2 (40.0)	11.8–76.9
Attending Playschool				
Yes	139	43.4	68 (48.9)	40.5, 57.3
No	181	56.6	98(54.1)	46.8,61.5
Inadequate Stimulation				
No	308	96.3	159 (51.6)	46.0, 57.2
Yes	12	3.8	7 (58.3)	25.6, 91.1
Parental Interaction				95% CI (Wilson)
Yes	315	98.4	163 (51.7)	46.2,57.3
No	5	1.6	3 (60.0)	23.1–88.2
Feeding Practice (n=74)				
Exclusive Breastfeeding	39	52.7	(48.7)	32.3, 65.1
'ormula Milk/Mixed Feeding	35	47.3	(45.7)	28.4, 63.1
Vaccination Status				95% CI (Wilson)
Up to Age	319	99.7	165 (51.7)	46.2, 57.2
Delayed	1	0.3	1 (0.6)	20.7–100.0
Media Parenting Practice				
< 2 Hours	306	95.6	157 (51.3)	45.7, 56.9
> 2 Hours	14	4.4	9 (64.3)	35.6, 93.0
ii) Healthcare Aspect				
Availability of Therapist				95% CI (Wilson)

Yes	317	99.1	165 (52.1)	46.5, 57.6
No	3	0.9	1 (33.3)	6.1–79.2
Parents Compliance For Follow-up				
Yes	280	87.5	144 (51.4)	45.5, 57.3
No	40	12.5	22 (55.0)	38.9, 71.1
Barriers to Follow-up				
No	295	92.2	150 (50.8)	45.1, 56.6
Yes	25	7.8	16 (64)	43.8,84.2

SLD= speech and language delay, CI= confidence interval

Table 3: Biological Characteristics of Children in Speech Therapy Clinic Hospital Melaka and SLD Prevalence, Year 2023 (N = 320)

Characteristics	**Frequency (N = 320)**	**Percentage (%)**	**SLD, n (%)**	**95% CI**
Biological				
i) Children				
Age (years)				
1-6 Years	291	90.9	54.6	48.9, 60.3
7-12 Years	29	9.1	24.1	7.6, 40.7
Birth Order				
Only/First/Second	246	76.9	51.2	44.9, 57.5
Third/More	74	23.1	54.1	42.4, 65.7
Gender				
Male	232	72.5	125 (53.9)	47.4, 60.3
Female	88	27.5	41 (46.6)	36, 57.2
Hearing Impairment				
No	299	93.4	159 (53.2)	47.5, 58.9
Yes	21	6.6	7 (33.3)	11.3, 55.3
Birth Complication				
No	267	83.4	141 (52.8)	46.8, 58.8
Yes	53	16.6	25 (47.2)	33.3, 61.1
Oral-Motor Skills				95% CI (Wilson)
Normal	300	93.8	160 (53.3)	47.7, 59.0
Abnormal	20	6.3	6 (30.0)	14.5–51.9
Underlying Condition Diagnosed				
No	140	43.8	90 (64.3)	56.3, 72.3
Yes	180	56.3	76 (42.2)	34.9, 49.5
ii) Parental History				

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Antenatal Disorder				
No	266	83.1	142 (53.4)	47.4, 59.4
Yes	54	16.9	24 (44.4)	30.8, 58.1
Intrapartum Complication				
No	299	93.4	154 (51.5)	45.8, 57.2
Yes	21	6.6	12 (57.1)	34.1, 80.2
Postnatal Factor				
No	202	63.1	113 (55.9)	49.0, 62.8
Yes	118	36.9	53 (44.9)	35.8, 54
Family History of SLD				
No	273	85.3	137 (50.2)	44.2, 56.2
Yes	47	14.7	29 (61.7)	47.3, 76.1

SLD= speech and language delay, CI= confidence interval

Multivariable analysis identified bilingualism/multilingualism, healthcare-access barriers, and Muslim religion as factors associated with higher odds of SLD, while older age and the presence of an underlying medical condition were associated with lower odds (Table 4). Religion was statistically associated with SLD in the multivariable model. However, the estimate should be interpreted cautiously because of the small number of non-Muslim participants. All regression assumptions were met, including linearity of the logit, absence of multicollinearity, adequate model fit (Hosmer–Lemeshow test), and no influential outliers based on Cook's Distance. Potential interaction terms were assessed, and no statistically significant interactions were identified. Assessment of missing data using logistic regression against a binary missingness indicator showed that missingness in mother's occupation, household income, father's education, and mother's education was associated with other observed variables, suggesting a Missing at Random (MAR) mechanism. In contrast, missingness in feeding practices and father's occupation was not associated with the observed variables assessed; however, the underlying missing-data mechanism could not be determined conclusively. Complete-case analysis was therefore applied in multivariable logistic regression.

Table 4: Univariate and Multivariable Analysis of Risk Factors of SLD Among Children in Speech Therapy Clinic Hospital Melaka, 2023, Using Logistic Regressions

Variable	Category	Univariate Logistic Regression			Multivariable Binary Logistic Regression		
		COR	**95% CI**	***p*-value**	***AOR**	**95% CI**	***p*-value**
DEMOGRAPHIC							
Religion	Buddhism	ref					
	Islam	3.913	0.80, 19.14	0.092*	5.37	1.02, 28.17	**0.047***
	Hinduism	7	0.40, 123.35	0.184*	7.75	0.39, 152.97	**0.179**
	Christianity	1.75	0.10, 30.84	0.702	1.06	0.05, 21.35	**0.969**
Race	Malay	ref					
	Others	0.5	0.16 1.53	0.224*			**0.604**

Place of Residence	Rural	ref					
	Urban	1.01	0.57, 1.78	0.98			
Type of Family	Nuclear	ref					
	Extended/ joint	1.62	0.76, 3.44	0.208*	0.72	0.30, 1.71	**0.454**
Size of Family	< 4 Person	ref					
	> 4 Person	0.99	0.61, 1.60	0.952			
Father's Education (n = 173)	Lower Level	ref					
	Tertiary Level	1.53	0.98, 2.38	0.062*	1.55	0.93, 2.59	**0.096**
Mother's Education (n = 165)	Lower Level	ref					
	Tertiary Level	1.45	0.34, 6.27	0.62			
Father's Occupation (n = 141)	Professional	ref					
	Not professional/ Unemployed	1.33	0.72, 2.48	0.697			
Mother's Occupation (n = 175)	Professional	ref					
	Not professional/ Unemployed	0.80	0.43, 1.50	0.488			
Household Income (n=257)	Others (T20/M40)	ref					
	B40 (Low Income)	0.99	0.55, 1.78	0.961			
Parents' Marital Status	Married	ref					
	Not Married/ Divorced	0.93	0.18, 4.66	0.926			
Primary Caretaker	Parents	ref					
	Others	1.36	0.78, 2.39	0.278			
ENVIRONMENTAL							
Attending Playschool/ Kindergarten	Yes	ref					
	No	1.23	0.79, 1.92	0.354			
Bilingualism/ Multilingualism	Yes	2.08	1.24, 3.49	0.006*	2.13	1.21, 3.75	**0.009***
	No	ref					
Psychosocial Factors	Yes	0.61	0.10, 3.72	0.596			
	No	ref					
Inadequate Stimulation	Yes	ref					
	No	0.76	0.24, 2.45	0.649			
Parental Interaction	Yes	ref					
	No	1.40	0.23, 8.49	0.715			
Feeding Practice (n = 74)	Fully BF 6 Months	ref					
	Not Fully BF	0.89	0.36, 2.20	0.796			

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Media Parenting Practice	> 2 Hours Per Day	ref					
	< 2 Hours Per Day	0.59	0.19, 1.79	0.347			
Parents Compliance For Follow-up	Yes	ref					
	No	1.15	0.59, 2.25	0.673			
Availability of Therapist	Yes	ref					
	No	0.46	0.04, 5.13	0.528			
Barriers Faced by Parents for Follow-up	No	ref					
	Yes	1.72	0.73, 4.01	0.211*	3.02	1.14, 7.97	**0.026***
BIOLOGICAL							
Age	1-6 Years	ref					
	7-12 Years	0.26	0.11, 0.64	0.003*	0.29	0.12, 0.74	**0.009***
Gender	Male	1.34	0.82, 2.19	0.245*	1.66	0.97, 2.85	**0.064**
	Female	ref					
Birth Order	First/Second Born	ref					
	Third/More	1.12	0.67, 1.89	0.669			
Hearing Impairments	No	ref					
	Yes	0.44	0.17, 1.12	0.086*	0.56	0.20, 1.59	**0.278**
Birth Complications	No	ref					
	Yes	0.80	0.42, 1.44	0.453			
Oral-motor Skills	Normal	ref					
	Abnormal	0.38	0.14, 1.00	0.05*	2.15	0.74, 6.23	**0.160**
Underlying Condition Diagnosed	No	ref					
	Yes	0.41	0.26, 0.64	<0.001*	0.4	0.24, 0.65	**<0.001***
Antenatal Disorder (including substance use/ alcohol/smoke/ vape)	No	ref					
	Yes	1.4	0.8, 2.6	0.232*	0.72	0.37, 1.39	**0.328**
Intrapartum Complication of Fetal Distress	Yes	ref					
	No	0.80	0.33, 1.95	0.618			
Postnatal Factors- (HIE)/Neonatal Seizures of Other Causes	Yes	0.64	0.41, 1.01	0.057*	0.86	0.50, 1.48	**0.588**
	No	ref					
Family History of SLD	Yes	1.60	0.85, 3.02	0.147*	1.80	0.90, 3.59	**0.098**
	No	ref					

Ref= reference group, COR= crude odds ratio, CI= confidence interval , Adj OR= adjusted odds ratio. Method: Simple Logistic Regression significance set at $p < 0.25$. Multiple binary logistic regression using stepwise backward elimination (likelihood ratio).* Level of significance: $p < 0.05$. The model fits well, Hosmer- Lemeshow Test $p = 0.833$ with no multicollinearity or influential outlier. Logistic regression assumptions were met.

4. Discussion

The prevalence of SLD among children aged 1–12 years attending the Hospital Melaka's Speech Therapy Clinic was 51.9% (95% CI: 46.4–57.4), substantially higher than the 2.7% national prevalence reported by NHMS 2022. This difference is expected given the referral-based clinical setting of the study, which captures children with greater developmental needs. The prevalence was also higher than estimates reported internationally, including 27% among Saudi Arabian children (Alzahrani et al., 2023) and the global range of 3–20% (Hill et al., 2023). Variations in study populations, diagnostic criteria, healthcare accessibility, and screening practices may explain these differences. The high burden observed highlights the importance of early identification and intervention, as untreated SLD may adversely affect educational participation, social inclusion, and long-term human capital development.

Bilingualism/multilingualism was significantly associated with SLD, with bilingual/multilingual children having more than twice the odds of SLD than monolingual children. In this study, 65.1% of bilingual/multilingual children exhibited SLD compared with 47.2% of monolingual children. This finding is consistent with evidence that bilingual/multilingual language development is influenced by the quality and quantity of language input, exposure balance, and assessment context rather than multilingual exposure alone (Bialystok et al., 2020; Paradis & Grüter, 2021). Importantly, bilingualism/multilingualism should not be interpreted as inherently pathological or as a direct cause of language disorder. A language difference resulting from bilingual/multilingual exposure is distinct from a true language disorder, and bilingual children may follow different developmental trajectories while achieving typical long-term language outcomes. Therefore, the observed association may partly reflect differences in language exposure, parental language practices, and assessment challenges. Although SLD diagnoses were made by registered speech therapists using the Ministry of Health Malaysia *SLT-Borang Penilaian dan Kemajuan Kemahiran Bahasa Pediatrik Unit Pemulihan Pertuturan-Bahasa*, an official clinical assessment form based on recognised clinical standards, formal validation across Malaysia's multilingual population has not been reported. Further evaluation of its performance in culturally and linguistically diverse populations would strengthen confidence in distinguishing language difference from language disorder. These findings highlight the importance of cultural and linguistically responsive assessment approaches to minimise diagnostic bias and promote equitable developmental services.

Religious affiliation was statistically associated with SLD. However, this finding should be interpreted with caution. Although Muslim children had higher odds of SLD than Buddhist children (AOR = 5.37, 95% CI: 1.02–28.17, $p = 0.047$), the estimate was imprecise, as reflected by the wide confidence interval, and likely influenced by the very small number of non-Muslim participants. Consequently, the observed association is unlikely to represent religion as an independent determinant of SLD but may instead reflect residual confounding by correlated sociodemographic, cultural, or linguistic factors. In this study, most Muslim families were Malay, suggesting that shared language practices, cultural norms, or socioeconomic characteristics may have contributed to the observed association. Similar findings were not reported by Alzahrani et al. (2023), while Hill et al. (2023)

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emphasised the greater influence of social and educational environments on language development than religious affiliation. Therefore, religion should not be interpreted as a causal risk factor, and future studies involving more diverse populations are needed to explore the underlying contextual determinants of SLD.

Children whose parents experienced barriers to follow-up had three times higher odds of SLD than those without barriers (AOR = 3.02, 95% CI: 1.144–7.969, $p = 0.026$). Financial constraints, time limitations, and logistical challenges are recognised barriers to therapy access and adherence (Alzahrani et al., 2023). These findings highlight how healthcare accessibility and family circumstances can influence developmental outcomes. Addressing such barriers requires accessible, family-centred models of care, including telehealth services, community-based interventions, and parental support programmes that improve continuity of care and early intervention uptake.

Contrary to previous studies, screen exposure and media parenting practices were not significantly associated with SLD in this study. Previous research has shown that excessive screen use is associated with poorer language development, particularly when caregiver–child interaction is limited (See et al., 2022). However, this relationship was not observed in the present study. The lack of association may reflect the homogeneity of this clinical population and limitations of secondary data, which did not capture factors such as screen duration, content quality, age of first exposure, or co-viewing practices. Nevertheless, screen use remains an important developmental consideration. Promoting healthy media parenting practices and responsive caregiver-child interaction should remain part of early childhood development and health promotion efforts.

Older children had significantly lower odds of SLD than those aged 1–6 years (AOR = 0.293, 95% CI: 0.117–0.735, $p = 0.009$). This finding is consistent with established developmental milestones and previous studies (Alzahrani et al., 2023; Hill et al., 2023), suggesting that some children with mild delays may improve over time through maturation and exposure to language-rich environments. Given the rapid language development that occurs during early childhood, these findings highlight the importance of developmental surveillance, early screening, and timely intervention to prevent long-term educational and social consequences (McLaughlin, 2011).

Interestingly, children with diagnosed underlying conditions had lower odds of SLD than those without diagnosed conditions. This finding contrasts with previous studies reporting increased risk of language delay among children with neurological, genetic, or developmental disorders (Hill et al., 2023). One possible explanation is that children with recognised medical conditions may undergo earlier developmental surveillance, receive more frequent multidisciplinary follow-up, and access intervention services sooner than children without established diagnoses. In addition, the underlying-conditions group in this study comprised a heterogeneous mix of neurological, developmental, congenital, and medical disorders with differing developmental trajectories, referral pathways, and treatment histories. Selection bias inherent to this referral-based clinical population, together with variation in clinical coding and subgroup composition, may also have influenced the observed association. As this cross-sectional study cannot establish temporal or causal relationships, further longitudinal studies stratifying specific underlying

conditions are needed to determine whether earlier surveillance and intervention account for this finding.

5. Study Limitation and Recommendations

This study has several limitations. The cross-sectional design precludes causal inference, while the absence of a control group limits comparisons with children without SLD. The use of secondary clinical data resulted in incomplete information for some variables, including feeding practices and socioeconomic characteristics, and the clinic-based sample may limit generalisability. Future studies should employ longitudinal designs, prospective data collection, larger and more representative samples, and population-based approaches using confirmed diagnoses by registered speech therapists. Standardised electronic health records may also improve data quality and efficiency. To enhance developmental outcomes, culturally sensitive multilingual screening tools, expanded access to therapy services, telehealth initiatives, and public education on developmental milestones and therapy adherence should be strengthened. Multisectoral collaboration between healthcare, education, and community stakeholders remains essential to support early identification, equitable access to intervention, and long-term human capital development.

6. Conclusion

In conclusion, this study revealed a high prevalence of SLD among children at the major speech therapy referral centre in Malaysia. Multilingual exposure was associated with significant findings, as was the presence of barriers to follow-up therapy, younger age, and the presence of underlying diagnosed conditions; however, some findings must be interpreted with some reservation due to the referral-based study design and the potential for residual confounding. The results highlight the need for developmental surveillance, access to assessment and intervention, and culturally and linguistically responsive clinical practice in similar healthcare contexts to promote child development. These can be further strengthened to support Sustainable Development Goals: child health and well-being (SDG 3), readiness for learning (SDG 4), and reducing inequities in access to developmental services (SDG 10). Further longitudinal and population-based research with representative samples, validated multilingual assessment instruments and detailed measures of language exposure, intervention history, and developmental outcomes is warranted to validate these results and inform evidence-based practices.

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