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A comparative study of learning outcomes for hearing-impaired foundation phase learners

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Background: Two intervention approaches are implemented in South Africa to alleviate the deleterious consequences of congenital or early onset hearing impairment on language acquisition and subsequent poor learning outcomes.

Aim: This study investigated the learning outcomes of foundation phase learners with severe to profound hearing impairment who received Listening and Spoken Language – South Africa (LSL-SA) (adapted Auditory Verbal Therapy) therapy compared to those who received Traditional Speech-Language Therapy (TSLT).

Setting: The study was conducted at four early intervention (EI) schools for children with hearing impairment across three provinces in South Africa.

Methods: Data were collected through record reviews of their Speech-Language Therapy Outcomes and South African National Department of Basic Education academic report cards. Data were analysed using quantitative statistics.

Results: Findings demonstrated that children with hearing impairment enrolled in LSL-SA outperformed those enrolled in TSLT in achieving age-equivalent language outcomes. A higher percentage of learners enrolled in LSL-SA achieved meritorious to outstanding learning outcomes. While a comparable number of learners progressed to mainstream schooling, children with hearing impairment enrolled in LSL-SA are enrolled for a shorter duration until discharge than those enrolled in TSLT. This is an important finding, particularly in low-middle income countries (LMICs).

Conclusion: Listening and Spoken Language – South Africa graduates achieved superior learning outcomes dependent on language attainment, providing contextually relevant evidence supporting the effectiveness of the LSL-SA EI approach.

Contribution: These context-specific outcomes stress the obligation to upscale and fast-track EI services. Implications for investment in LSL-SA are proposed through collaboration between families, educators, and early interventionists.

Keywords: academic achievement; auditory-verbal therapy; early hearing detection and intervention; early intervention; hearing impairment; listening and spoken language – South Africa; learning outcomes; schooling.

Introduction

The pathways for future academic success are often shaped during early childhood. 'Early childhood is defined as the period from prenatal development to 8 years of age' (World Health Organization [WHO], 2007), as young children learn essential skills that serve as the foundation for the development of later academic skills (Gertler et al. 2014; Hanover Research 2016; Woodhead et al. 2014). Evidence indicates that a hearing impairment denies children access to appropriate stimulation, impacting the development of cognitive abilities, language, and psychosocial skills needed for classroom learning (Black et al. 2017; Feder et al. 2017; Lang-Roth 2014).

Language is the foundation of all communication and influences how we express ourselves, analyse, process, decode, and understand information (Sherred 2021). Language abilities are among several important factors contributing to academic success (Antia et al. 2020; Goldblat & Pinto 2017; Mahmud 2014; Moeller et al. 2007). Auditory input is critical to language development. Consequently, early identification of a child's hearing impairment is important for implementing early amplification and intervention (Korver et al. 2010).

The Joint Committee on Infant Hearing (JCIH) endorses the 1-3-6 principle for Early Hearing Detection and Intervention (EHDI) that prescribes hearing screening be conducted before 1 month of age, confirmation of hearing impairment before 3 months of age for infants that do not pass their hearing screening, and fitting and management of appropriate hearing technology and individualised family centred intervention be implemented by a maximum of 6 months of age (JCIH 2019). Based on contextual factors, the South African adjusted 1-4-8 principle aims to provide children with hearing impairment the opportunity to develop an effective communication system and literacy development on par with children with normal hearing (Health Professions Council of South Africa [HPCSA] 2018; Smith et al. 2017). Despite this, evidence remains limited regarding implementing intervention approaches and related outcomes in sub-Saharan Africa (Casoojee & Khoza-Shangase 2022; Kanji 2016; Khoza-Shangase 2019).

Two intervention approaches are implemented for children with hearing impairment and their families by suitably trained Early Interventionists (i.e., Speech-Language Therapists and/or Audiologists and Teachers of the Deaf) within the public and private healthcare sector in the South African context (Casoojee & Khoza-Shangase 2022). The first approach is the Traditional Speech-Language Therapy (TSLT) approach, ranging from auditory to manual or a combination of these approaches. The second approach, a first-world technique, Auditory Verbal Therapy (AVT), has been adapted to the South African context (i.e., Listening and Spoken Language – South Africa [LSL-SA]). The LSL-SA approach is premised on creating a partnership between educators and parents of children with hearing impairment and teaching the children to use their residual hearing optimally. It is based on the belief that even children with minimal hearing can be taught to listen and learn spoken language with the use of the most current hearing technologies. This, in conjunction with specific therapeutic strategies, fosters listening and spoken conversations through guidance and coaching of the child's parents (Estabrooks, MacIver-Lux & Rhoades 2016). There are limited educational institutions where these Early Intervention (EI) approaches are implemented in South Africa.

A minority of foundation-phase schools in South Africa incorporate a language-enriched learning environment for children with delayed language development and/or hearing impairment (Sewpersad 2014). Unfortunately, there is a significant gap between the evidence base that supports inclusive education resulting in the South African educational system utilising specialised environments to meet the learner's best interests and access to education to maximise their potential (Department of Education [DoE] 2001).

Primary education in South Africa includes mandatory education years, that is, from Grades 0 to Grade 9, which are managed and regulated by the Department of Basic Education (DBE 2021). Primary education is split into three phases: (1) the foundation phase that covers Grades R to three, and includes learners from 6–9 years of age; (2) the junior primary or intermediate phase that covers Grades 4–6; and (3) the senior phase that covers Grades 7–9 (Umalusi 2022). The grading system is on a scale of 1–7. The qualification equivalents of marks on the scale are 1 (0–29: fail); 2 (30–39: elementary); 3 (40–49: moderate); 4 (50–59: adequate); 5 (60–69: substantial), 6 (70–79: meritorious), and 7 (80–100: outstanding).

Academic success is a critical determinant of quality of life for children with hearing impairment (Motasaddi-Zarandy et al. 2009). Multiple studies illustrate that possessing competent spoken language forms the basis of reading and literacy (Burgess 2002 Duff & Tomblin 2018; Reeder & Baxa 2020; Tunick & Pennington 2002). Only a few studies have focussed on learning outcomes among children enrolled in AVT programmes, that is, reading outcomes (Fairgray, Purdy & Smart 2010), writing skills (Yasamsal, Yucel & Sennaroglu 2013), literature grade outcomes (Goldblat & Pinto 2017), language and literacy scores (Geers et al. 2019), and the inclusive education of children with hearing impairment (Eriks-Brophy et al. 2007).

Research suggests that the learning outcomes of children with hearing impairment result from a complex interplay of many factors (Marschark et al. 2015). Factors that may influence the learning outcomes within the South African context include: (1) Linguistic diversity: Mdladlo et al. (2016) indicated that the average Speech-Language Therapist in the South African context is still predominantly an English or Afrikaans-speaking female, not conversant in an African language. Khoza-Shangase and Mophosho (2018) highlighted that only 5% of speech-language therapists and audiologists in South Africa speak an African language as a mother tongue, a significant incongruency to the South African population's linguistic profile; (2) Language of Learning and Teaching (LOLT). Myburgh, Poggenpoel and Van Rensburg et al. (2004) posit that authentic teaching and learning fail to occur when learners do not speak the language of instruction. This, combined with the limited penetration of trained interventionists and the predominance of English in the profession, creates an obstacle in meeting the demands of families while implementing an LSL-SA approach in the context where the majority either do not speak English or speak it as an additional language (EAL) (Mdladlo et al. 2016). Furthermore, the language skills of children with hearing impairment are already below their hearing peers (Hawken et al. 2005); (3) First Additional Language (FAL) is mandatory in South African schools: Lenyai (2011) established that teachers in the foundation phase of schools do not necessarily have the skills to teach literacy in the FAL, failing to produce competent learners; (4) Age at diagnosis of hearing impairment: Diagnosis of permanent congenital or early-onset hearing loss is severely delayed in South Africa, undermining the prospect of positive outcomes through EI (Kuschke et al. 2020); (5) Financial costs of hearing impairment and its effect on EI success: Although AVT is available in

South Africa, it continues to be delivered primarily by the private healthcare sector and often at a significant financial cost to the patient and their family (Maluleke 2022; White & Brennan-Jones 2014). Knowledge of the economic costs associated with a hearing impairment is a powerful tool for policymakers in planning the best use of their healthcare budgets, especially in LMICs (World Health Organization [WHO] 2017).

Children with better oral communication skills perform better academically (Sherred 2021). Fairgray et al. (2010) investigated the effects of AVT on school-aged children with hearing impairment, and their findings support the notion that AVT techniques improve outcomes of children aged 5–17 years old with hearing impairment in receptive language, phonological development, articulation, and listening in noise. In a study examining the effects of the frequency of EI on spoken language and literacy outcomes, Geers et al. (2019) concluded that greater availability of EI services (0–36 months old) yielded higher spoken language and literacy scores at the foundation phase. Furthermore, studies consistently show that children with hearing impairment enrolled in an LSL EI programme attain significantly higher levels of language and learning outcomes relative to age-matched peers than children without EI (Davidson, Osman & Geers 2021). Positive outcomes prevail across auditory verbal centres; however, these data are based on limited empirical evidence (Rhoades 2010). Additionally, all the positive reviews and documented outcomes of AVT globally have emanated from studies conducted in high-income countries (HICs).

The education of learners with hearing impairment is controversial, particularly regarding the type of school placement and, relatedly, the intervention approach adopted (Marschark et al. 2015). There is a dearth of evidence regarding the learning outcomes of children with hearing impairment enrolled in TSLT programmes compared to LSL approaches. In a systematic review by Erbasi, Hickson and Scarinci (2017), findings indicated that communication outcomes in children with hearing impairment were highly variable and evidence regarding the impact of the different EI approaches on learning outcomes was inconclusive. This scarcity of evidence is further influenced by the lack of control and/or comparison groups and the failure in available studies to compare therapeutic intervention approaches (Casoojee, Kanji & Khoza-Shangase 2021; Goldblat & Pinto 2017; White & Brennan-Jones 2014). There is a necessity for research surrounding the use and effectiveness of these different intervention approaches for children with hearing impairment in sub-Saharan Africa (Khoza-Shangase 2019).

This study aimed to contribute towards filling this identified lacuna in the context of research on the effectiveness of an LSL approach for children with hearing impairment, specifically extrapolating the findings to South Africa, a LMIC.

Methods

A quantitative, cross-sectional research approach was adopted to address the study's objectives. This study forms part of a larger study titled 'Speech-language acquisition and learning outcomes of children with hearing impairment following EI in South Africa: A comparative study'. The main aim was to investigate the learning outcomes of foundation phase learners (Grade 3) with hearing impairment who received LSL-SA (LSL-SA group) versus TSLT (TSLT group), with specific objectives being: (1) to determine if any associations exist between selected study variables (i.e., gender, home language, age at diagnosis of hearing impairment, cause of hearing impairment, duration of amplification, type of hearing amplification device, age at start of EI, duration of EI) within the intervention approaches and learning outcomes; (2) to explore the learning outcomes in the LSL-SA group; (3) to describe the learning outcomes in the TSLT group; (4) to compare the learning outcomes between the two groups; (5) to describe the communication functioning at the onset of EI compared to the communication functioning upon discharge from therapy; (6) to determine the association between communication functioning and learning outcomes; and (7) to identify the promotion to mainstream schooling on completion of the foundation phase as an indicator of academic success.

Study sample and demographics

A total of 64 therapy records and academic reports of children with severe to profound hearing impairment, selected through a non-probability purposive sampling technique, were included in the study, and their demographic data were collected (Table 1). This sample size allowed for detecting medium-large effect sizes (w = 0.39) with calculations carried out in G*Power (Faul et al. 2007). The children were enrolled at one of the EI schools in: (1) Johannesburg, Gauteng; (2) Pretoria, Gauteng; (3) Morningside, KwaZulu-Natal; and (4) Cape Town, Western Cape.

Inclusion and exclusion criteria

The records of children: (1) diagnosed with a congenital or early onset, bilateral, severe to profound hearing impairment, (2) enrolled in an EI programme receiving either TSLT or the LSL-SA approach, (3) fitted with hearing aids or cochlear implants, (4) who have completed Grade 3 in the foundation phase of primary schooling, were included in the study. Records of children with hearing impairment who presented with additional comorbidities, such as cognitive impairment, were excluded from the study.

Procedures

Written permission was obtained from all relevant authorities, granting the researcher access to the educational facilities, and to disseminating information to the parents and/or primary caregivers of children with hearing impairment, inviting them to participate in the study. Once access was granted, the researcher compiled a list of potential

participants using non-probability purposive sampling. Parents of all the participants signed an informed consent after indicating their willingness to allow the researcher to access their child's therapy files and Grade 3 academic reports.

Data collection tool

A retrospective data collection tool was developed for this study and was pre-tested at each EI school using a therapy file and academic report. The main study did not include records used in the pilot study. The data collection form comprised three sections: Section A, Child Demographics; Section B, Intervention Outcomes; and Section C, Learning Outcomes. The retrospective record review of written and printed records aimed to gather information regarding: (1) the child's hearing impairment; (2) the age at diagnosis of hearing impairment and age at initiation of EI services; (3) the type of amplification device; and (4) speech-language outcomes in comparison to learning outcomes at the end of Grade 3 at the EI school.

Data analysis

The statistical significance of the categorical variables (i.e., gender, home language, cause of hearing impairment) and its association between the LSL-SA and TSLT approach (i.e., marks for each subject in Grade 3 and communication functioning at discharge from therapy) was determined using the X^2 test. Fisher's exact test was used for 2 × 2 tables or where the requirements for the X^2 test could not be met. The strength of the associations was measured by Cramer's V and the Phi coefficient, respectively.

The association between the intervention approach and the selected continuous study variables and marks for each subject in Grade 3 and communication functioning at discharge from therapy was determined using the independent samples t-test (or one-way analysis of variance [ANOVA] for more than two groups). Where the data did not meet the assumptions of these tests, the corresponding non-parametric tests were used, that is, the Wilcoxon Rank Sum test and the Kruskal–Wallis test. The strength of the associations was measured by Cohen's d for parametric tests and the r-value for the non-parametric tests. Data were analysed using SAS Software, version 9.4 for Windows, Cary, NC, USA: SAS Institute Inc. (2002-2010) (previously Statistical Analysis System) version 9.4 for Windows (SAS 2002–2010).

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of the Witwatersrand, Human Research Ethics Committee (No. H20/06/03).

Results

As depicted in Table 1, of the 64 participants, 29 were male, and 35 were female. The medium of instruction at the participating schools is English and Afrikaans. Children are enrolled in English or Afrikaans based on the language used in intervention sessions. The most spoken languages in the participants' households included 4 of the 11 official languages in South Africa. The records of 15 participants indicate that they do not receive EI in their home language. Table 1 presents a further description of the participants' demographic profiles.

The association between the categorical variables (i.e., age at diagnosis of hearing impairment, duration of amplification, type of hearing amplification device, age at the start of EI, duration of EI) within the intervention approaches (i.e., LSL-SA or TSLT) and learning outcomes are depicted in Table 2.

The average age of diagnosis of hearing impairment in this study was 2.4 years old. When comparing the age of diagnosis of hearing impairment and age of enrolment in an EI programme between the TSLT and LSL-SA groups, the average age of diagnosis and age of enrolment in an EI programme, respectively, for the LSL-SA group was 2.7 years old and 2.9 years old, and for the TSLT group was 2.0 years old and 2.4 years old. The age at diagnosis of hearing impairment and, consequently, the commencement of EI within the TSLT EI approach is earlier in comparison to the LSL-SA EI approach. The percentage of participants between the two EI groups implanted with cochlear implants to those fitted with hearing aids is comparable. The study found that the mean duration of EI until discharge was significantly longer for those who underwent TSLT (7.3 years; standard deviation [s.d.] 1.2 years) compared to those who underwent LSL-SA (5.9 years; s.d. 1.2 years); $p = 0.011$ (moderate effect size; Cohen's d = 0.75), despite those in the TSLT EI group having a longer duration of amplification.

The categorical variable for causes of hearing impairment of the children included in the study is depicted in Table 3. Because of missing data in the children's records, only 38 records could be analysed. Genetic causes were the dominating variable, accounting for 20% of the children with hearing impairment; 6% was attributed to prematurity, 6% to meningitis, 5% to ototoxicity, and 3% each to birth asphyxia, hydrocephalus, and parental substance abuse. Sixteen additional causes were identified, each accounting for 1% of the records analysed.

TABLE 1: Demographic data of children included in the study ($N = 64$).

Demographic profile	*n*
Gender	
Male	29
Female	35
Home language	
English	31
Afrikaans	17
Xhosa	14
Sotho	1
English and Afrikaans	1

TABLE 2: Categorical variables of children included in the study (N = 64).

Characteristic	Overall							TSLT							LSL-SA							p-value for between-group comparison
	n	%	Median	IQR	Mean	s.d.	Range	n	%	Median	IQR	Mean	s.d.	Range	n	%	Median	IQR	Mean	s.d.	Range	
Type of EI	64	-	-	-	-	-	-	23	-	-	-	-	-	-	41	-	-	-	-	-	-	-
Age at diagnosis of hearing impairment	-	-	2.4	1.4–3.6	-	-	0.0–8.0	-	-	2.0	0.8–2.6	-	-	0.1–5.2	-	-	2.7	1.6–4.0	-	-	0.0–8.0	0.098
Type of amplification																						0.78
Hearing Aid	18	28	-	-	-	-	-	7	30	-	-	-	-	-	11	27	-	-	-	-	-	
Cochlear Implant	46	72	-	-	-	-	-	16	70	-	-	-	-	-	30	73	-	-	-	-	-	
Duration of amplification (years from earliest amplification to current age)	-	-	-	-	2.4	3.2	-7.0–8.6	-	-	-	-	3.8	2.2	-0.3–8.6	-	-	-	-	1.6	3.4	-7.0–7.8	0.0060 (d = 0.69)
Age at EI start (years)	-	-	2.8	1.6–4.0	-	-	0.2–8.2	-	-	2.4	1.5–3.0	-	-	0.2–5.4	-	-	2.9	1.6–4.7	-	-	0.2–8.2	0.10
Duration of EI (years)	-	-	-	-	6.4	2.0	0.6–10.9	-	-	-	-	7.3	1.2	5.3–9.4	-	-	-	-	5.9	2.2	0.6–10.9	0.0061 (d = 0.75)

EI, early intervention; IQR, interquartile range; s.d., standard deviation; TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.

Table 4 depicts the learning outcomes found in this study for the LSL-SA group compared to the TSLT group at the end of the foundation phase (N) = 64).

The records indicate that a higher distribution of learners achieve lower grades (0% – 59%) in the TSLT group. In comparison, a significantly higher percentage of learners who received the LSL-SA EI approach achieved a meritorious to outstanding result (70% – 100%) when compared to those who received the TSLT EI approach. This achievement was translated across all subject areas included in the analysis, as depicted in Table 4. These learning outcomes between-group comparisons for learners who achieved 70% and above for Home Language, Life Skills and Mathematics are depicted in Figure 1.

The communication functioning at the onset of the EI approach, depicted in Table 5, compares the communication functioning upon discharge from therapy, depicted in Table 6 for the LSL-SA group and TSLT group, respectively, at the end of the foundation phase.

As indicated in Table 5, for all participants, communication functioning was delayed at the onset of EI for learners who received LSL-SA and those who received TSLT. The records of participants in this study indicate that a comparable number of learners who received TSLT to those who received LSL-SA achieved age-appropriate scores upon discharge from the EI approach at the end of the foundational phase in the areas of speech, receptive language, and cognitive-linguistics (as shown in Table 6). The results obtained in this study further indicate that in the areas of vocabulary, expressive language and audition, a

TABLE 3: Cause of hearing impairment of children included in the study (N = 38).

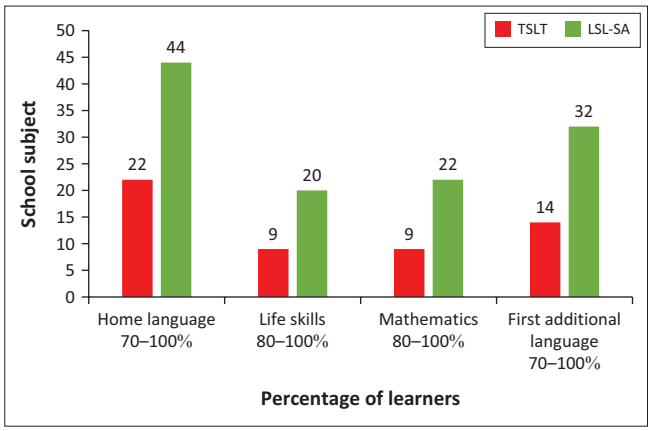
Cause of hearing impairment	n	Percentage (%)
Genetic	13	20
Meningitis	4	6
Prematurity	4	6
Ototoxicity	3	5
Birth asphyxia	2	3
Parental substance abuse	2	3
Hydrocephalus	2	3
Brain swelling	1	2
Placentae Abruptio at birth	1	2
NICU	1	2
Chicken Pox	1	2
Recurrent Otitis Media	1	2
Congenital Rubella	1	2
Cleft palate	1	2
Consanguineous	1	2
Cytomegalovirus	1	2
Septicaemia	1	2
Renal failure	1	2
Jaundice requiring transfusion	1	2
Trauma	1	2
Maternal German Measles	1	2
Parental alcohol abuse	1	2
Enlarged vestibular aqueducts	1	2
Unknown	27	42

NICU, neonatal intensive care unit.

TABLE 4: Learning outcomes between traditional speech-language therapy and listening and spoken language – South Africa at the end of Grade 3 (N = 64).

Subject area	Learning outcome	Overall (N = 64)		TSLT (N = 23)		LSL-SA (N = 41)		p-value for between-group comparison
		n	%	*n*	%	*n*	%	
Home language	0–59	23	36	10	43	13	32	0.22
	60–69 Substantial	18	28	8	35	10	24	-
	70–100	23	36	5	22	18	44	-
Life skills	0–69	29	45	9	39	20	49	0.28
	70–79 Meritorious	25	39	12	52	13	32	-
	80-100 Outstanding	10	16	2	9	8	20	-
Mathematics	Subject not taken	1	2	0	0	0	0	0.066
	0–49	11	17	4	18	7	17	-
	50–59 Adequate	11	17	7	32	4	10	-
	60–69 Substantial	19	30	8	36	11	27	-
	70–79 Meritorious	11	17	1	5	10	24	-
	80–100 Outstanding	11	17	2	9	9	22	-
First Additional Language (FAL)	Subject not taken	1	2	0	0	0	0	0.055
	0–49	19	30	4	18	15	37	-
	50–59 Adequate	18	28	10	45	8	20	-
	60–69 Substantial	10	16	5	23	5	12	-
	70–100	16	25	3	14	13	32	-

TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.



TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.

FIGURE 1: Comparative percentage of learners who achieved 70% and above.

significantly higher number of learners who underwent the LSL-SA EI approach achieved age-appropriate scores compared to those learners who underwent the TSLT EI approach.

The following significant associations between language functioning and academic marks as an outcome of EI were found:

- Home Language marks tended to be higher for those with age-appropriate vocabulary upon therapy discharge (p = 0.020; Cramer's V = 0.35; moderate effect size). There was a similar finding for Receptive Language, Expressive Language, and Cognitive linguistics.
- Life Skills marks tended to be higher for those with age-appropriate Receptive Language upon therapy discharge (p = 0.045; Cramer's V = 0.31; moderate effect size). There was a similar finding for Expressive Language.
- Mathematics marks tended to be higher for those with age-appropriate Receptive Language upon therapy discharge (p = 0.034; Cramer's V = 0.40; moderate effect size).
- First Additional Language marks tended to be higher for those with age-appropriate Receptive Language upon therapy discharge (p = 0.024; Cramer's V = 0.39; moderate effect size). There was a similar finding for Expressive Language.

Consideration of promotion to mainstream schooling on completion of the foundation phase, resultant of EHDI, is a marker of academic success. The type of schooling recommended upon completion of the foundation phase is depicted in Table 7.

Comparing TSLT to LSL-SA, there was no statistical difference in the number of learners who progressed to mainstream schooling upon completing Grade 3. This accounts for two-thirds of the participant sample.

Discussion

A representative sample of 64 records of foundation phase learners with hearing impairment who received LSL-SA or TSLT were used in the analyses of this study. The two EI cohorts were matched for gender and type of amplification device. The typical age of diagnosis of hearing impairment in the study varied between 2.0 and 2.7 years, and the age at the start of EI varied between 2.4– and 2.9 years. The study confirms that the speech-language and learning outcome measures used in the study have validity, as the EI schools in South Africa use the same measures for the assessment of these outcomes.

While attempting to determine if any associations exist between selected study variables (i.e., gender, home language, age at diagnosis of hearing impairment, cause of hearing impairment, duration of amplification, type of hearing amplification device, age at the start of EI, duration of EI) within the intervention approaches (LSL-SA and TSLT) and learning outcomes, current findings indicate that 25% of the participants and their families receive EI in the child's

TABLE 5: Communication functioning at the onset of the early intervention approach (N = 64).

Communication functioning at the onset of therapy	Overall		TSLT		LSL-SA		*p*-value for between-group comparison
	n	%	*n*	%	*n*	%	
Speech							
Delayed	63	98	23	100	40	98	> 0.99
Age appropriate	1	2	0	0	1	2	-
Vocabulary							
Delayed	63	98	23	100	41	100	NA
Age appropriate	0	0	0	0	0	0	-
Unknown	1	2	0	0	0	0	-
Receptive language							
Delayed	63	98	23	100	40	98	> 0.99
Age appropriate	1	2	0	0	1	2	-
Expressive language							
Delayed	64	100	23	100	41	100	NA
Age appropriate	0	0	0	0	0	0	-
Audition							
Delayed	63	98	22	96	41	100	0.36
Age appropriate	1	2	1	4	0	0	-
Cognitive linguistics							
Delayed	61	95	23	100	38	93	0.55
Age appropriate	3	5	0	0	3	7	-

TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.

TABLE 6: Communication functioning upon discharge from the early intervention approach (N = 64).

Communication functioning at discharge of therapy:	Overall		TSLT		LSL-SA		*p*-value for between-group comparison
	n	%	*n*	%	*n*	%	
Speech							
Delayed	26	41	10	43	16	39	0.79
Age appropriate	38	59	13	57	25	61	-
Vocabulary							
Delayed	34	53	14	61	20	49	0.44
Age appropriate	30	47	9	39	21	51	-
Receptive language							
Delayed	34	53	13	57	21	51	0.80
Age appropriate	30	47	10	43	20	49	-
Expressive language							
Delayed	35	55	14	61	21	51	0.60
Age appropriate	29	45	9	39	20	49	-
Audition							
Delayed	28	44	12	52	16	39	0.43
Age appropriate	36	56	11	48	25	61	-
Cognitive linguistics							
Delayed	22	34	9	39	13	32	0.59
Age appropriate	42	66	14	61	28	68	-

TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.

TABLE 7: Type of school recommended upon completing Grade 3 (N = 64).

Type of school recommended after EI	Overall		TSLT		LSL-SA		The *p*-value for between-group comparison
	n	%	*n*	%	*n*	%	
Mainstream	40	63	14	61	26	63	> 0.99
Remedial	24	37	9	39	15	37	-

TSLT, traditional speech-language therapy; LSL-SA, listening and spoken language – South Africa.

second language because of a lack of another common language between the Early Interventionist and the child.

These findings are consistent with gaps identified within the South African context, evidencing a significant linguistic and cultural mismatch between Speech-Language Therapists and/or Audiologists and the population they serve (Gxilishe 2011; Khoza-Shangase & Mophosho 2018, 2021; Mdladlo et al. 2016). In a systematic review by Larson et al. (2020), various studies confirmed that the language of intervention played a role in intervention effectiveness. The findings of this study highlight that LSL-SA interventionists face immense challenges in providing equitable services based on linguistic diversity. This may influence the successful implementation of communication intervention approaches in South Africa. These findings raise implications that breach AVT (and LSLS-SA) principles in providing support services to families of children with hearing impairment, failing to facilitate educational and social inclusion, and creating a challenge in meeting the demands of all families.

Optimal communication and learning outcomes for children with hearing impairment are associated with early diagnosis

and early enrolment in effective EI programmes (Auditory Verbal UK, 2022b). Although the age of diagnosis of hearing impairment (2.0 years) and age at enrolment in an EI programme (2.4 years) is earlier for the TSLT group, findings of this study indicate that even the adjusted 1-4-8 South African guidelines have not been achieved to date (HPCSA 2018). These findings are consistent with the findings of Kuschke et al. (2020), indicating an average age of diagnosis of hearing impairment at 2.6 years, Chan (2018) at 2.58 years, Butler et al. (2015) at 3.01 years and Khoza-Shangase and Michal (2014) at approximately 2.0 years. These findings highlight the delay within the South African context in meeting stipulated guidelines and raise implications for translating policy into practice.

The causes of hearing impairment identified in this study correlate with causes identified by Smith et al. 2023; the American Speech-Language-Hearing Association (2023), and Korver et al. (2017). Congruent with many studies, a definitive cause was unidentified in 38% of the participants (Korver et al. 2017; Mulwafu, Kuper & Ensink 2015). The findings of this study did not find any statistically significant association between the cause of hearing impairment within the intervention approaches (i.e., LSL-SA and TSLT) and learning outcomes, but raised awareness of understanding the risk profile of infants in an LMIC, depending upon the underlying cause. These findings raise implications in planning EHDI services, particularly preventive audiology initiatives.

Despite these confounding variables, this study's findings indicate that children with hearing impairment enrolled in the LSL-SA intervention approach attend therapy for a shorter duration until discharge. This is a positive finding for this LMIC, given the financial stressors imposed by a hearing impairment on resource-constrained African healthcare systems (Hear-It.org 2019). Although the current study does not provide exact financial figures, these findings support the mathematical modelling study by Baltussen and Smith (2012), stating that when available effective interventions are implemented to remediate hearing impairment in sub-Saharan Africa, substantial health gains of up to $32 million Disability-Adjusted Life Years (DALYs) are achieved. These findings raise implications for managing the burden of disease in LMICs.

When exploring the learning outcomes in the LSL-SA group, findings show a positive contribution of LSL-SA to the grades achieved in Home Language, Life Skills, Mathematics and FAL. The findings of this study are consistent with previous studies indicating that children with hearing impairment receiving AVT achieve average to above-average grades on measures of academic achievement (Auditory Verbal UK, 2022a; Eriks-Brophy et al. 2012; Goldblat & Pinto 2017). These findings highlight the dearth of empirical research on learning outcomes, as only one of these studies compared the learning outcomes of children with hearing impairment who received AVT to those not enrolled in an AVT approach (Goldblat & Pinto 2017). Notably, the study by Goldblat and Pinto (2017) included participants with additional special needs. It additionally did not have information on the EI approach that the control group received, resulting in an inability to compare the learning outcomes based on affiliation to a certain rehabilitation approach (Goldblat & Pinto 2017). This study's findings highlight the paucity of well-controlled research in this field and raise the need for further empirical research comparing EI approaches and their impact on learning outcomes in diverse contexts.

As far as the learning outcomes of foundation phase learners with hearing impairment who received TSLT are concerned, learners are exposed to an adapted curriculum in which grade-appropriate core skills are taught and assessed within a small class setting and with therapeutic intervention. These adaptations support how the content is taught and assessed at a grade-appropriate level equivalent to normal hearing learners. While exploring the TSLT group's learning outcomes, findings indicate that more learners achieve lower grades in Home Language, Life Skills, and Mathematics. The findings are consistent with the literature stating that children with hearing impairment are at higher risk of poorer academic achievement (Su et al. 2020). The findings of this study further highlight the inconsistencies among EI approaches for children with hearing impairment as existing research relating to TSLT varies widely in participant characteristics, laterality and degree of hearing loss, and philosophies of EI approaches (Ganek & Cardy 2021). These findings highlight the need for addressing the academic repercussions of childhood hearing impairment by implementing evidence-based speech and language treatment protocols for children, especially in resource-constrained settings such as South Africa.

When the learning outcomes of foundation phase learners between the two groups were compared, this study's findings correlate with the learning outcomes found in Goldblat and Pinto (2017), the only study that compared the learning outcomes of AVT graduates to the learning outcomes of those not enrolled in an AVT approach. Goldblat and Pinto (2017) suggest that AVT graduates outperformed the control group who were not rehabilitated via the AVT approach. The findings of this study indicate that the LSL-SA EI approach yields superior learning outcomes compared to the TSLT approach. It is noteworthy that contributing factors such as degree of hearing loss, language skills pre-EI, age-range, and school grade were controlled for in the study by Goldblat and Pinto (2017).

When comparing the communication functioning at the onset of EI to the communication functioning upon discharge from the EI approach, this study's findings revealed delayed speech, vocabulary, receptive and expressive language, audition, and cognitive-linguistics development prior to receiving EI, as expected. This is congruent with research data that 'the first 3 years of life are critical for developing spoken language through listening' (Auditory Verbal UK 2020). Upon discharge from EI at the end of the foundation phase, this

study's findings demonstrated that children with hearing impairment enrolled in LSL-SA outperformed those enrolled in TSLT by achieving age-equivalent outcomes of vocabulary, expressive language (spoken language) and audition (listening skills). These results are consistent with the findings of research conducted by Auditory Verbal UK, (2022a), Yanbay et al. (2014), Dettman et al. (2013), Motasaddi-Zarandy et al. (2009), Percy-Smith et al. (2017), and Fairgray et al. (2010). Mortazavi and Mortazavi (2017) advocate for the AVT approach as a legitimate communication approach for children with hearing impairment regardless of the type of hearing amplification devices. The findings of this study are congruent with Mortazavi and Mortazavi 2017. as a comparable number of participants enrolled in LSL-SA (70%) and TSLT (73%) are implanted with cochlear implants. These findings highlight the need for Early Interventionists to capitalise on current knowledge and mobilise collective resources to ensure improved developmental outcomes for children with hearing impairment in LMICs.

Many studies agree that possessing competent language forms the basis of reading and literacy (Catts 2003; Tunick & Pennington 2002; Burgess 2002). *When determining the association between communication functioning and learning outcomes,* there was a significant trend linking higher grades to age-appropriate language skills in vocabulary, receptive language, expressive language, and cognitive linguistics across learning outcome measures for languages (i.e., Home Language and FAL) and life skills. Mathematics measures indicate a trend linked to higher marks across all participants of age-appropriate receptive language. This study's results concur with findings that mathematics requires reading comprehension and understanding specific linguistic mathematical terms such as conditionals, comparatives, and inferential statistics (Edwards, Edwards & Langdon 2013; Mukari, Ling & Ghani 2007; Traxler 2000). These trends reflect positive learning outcomes based on enrolment in an EI communication intervention approach, with no differentiation between LSL-SA and TSLT. The findings of this study contrast with a study conducted by Percy-Smith et al. (2017), who researched the impact of (re)habilitation strategies on speech-language outcomes for early cochlear implanted children who received different communication intervention approaches following cochlear implantation, that is, TSLT versus AVT. Children with hearing impairment enrolled in the AVT intervention approach scored age appropriately and outperformed children with hearing impairment enrolled in TSLT on receptive language, expressive language, and productive vocabulary (Percy-Smith et al. 2017).

When identifying the promotion to mainstream schooling on completion of the foundation phase as an indicator of academic success, this study's findings support research data that indicate an EHDI approach (i.e., appropriate hearing amplification, family-centred care and appropriate intervention) will allow children with hearing impairment to achieve linguistic skills at the same level as their hearing peers and contribute to their integration into mainstream schooling (Casoojee et al. 2021; Ching et al. 2017; Fulcher et al. 2015). The findings highlight that EI, in general, is associated with positive language outcomes in children with hearing impairment and while the therapeutic approaches may vary, there is congruence among the strategies suggested to families (Casoojee et al. 2021; Roberts 2019). This study's findings redress the lacuna of research in the South African context, providing results regarding the schooling career of children with hearing impairment upon completion of Grade 3.

Furthermore, this study's findings are noteworthy, as the estimated annual cost of deaf education in a residential school for the deaf in South Africa is $9459.50 per child (Emmet & Francis 2015). A cost analysis conducted by the National Center for Hearing Assessment and Management (NCHAM 2010) indicates that substantial amounts of money would be saved over a child's educational lifetime if, because of early and effective interventions, the most appropriate educational setting for the child is a regular mainstream classroom instead of residential programmes.

Conclusion

The findings of this study emphasise the importance of EHDI, whether TSLT or LSL-SA, as they conclude that learning outcomes depend on language attainment achieved within both approaches. However, a deeper analysis of the results reveals that children with hearing impairment enrolled in LSL-SA outperform those enrolled in TSLT in achieving age-equivalent language outcomes. Children with hearing impairment enrolled in LSL-SA are enrolled for a shorter duration until discharge than those enrolled in a TSLT approach. This finding is important for LMICs with limited resources, such as South Africa. This finding suggests a possible reduction in the global burden of disease caused by hearing impairment. The results suggest that EI services must be adapted to local contexts. Although a comparable number of children with hearing impairment progressed to mainstream schooling, children with hearing impairment enrolled in LSL-SA achieved meritorious to outstanding learning outcomes. The study suggests that new and updated policies and guidelines in South Africa regarding the current EI approaches for children with hearing impairment are needed. Frameworks are required to achieve proper and effective monitoring and evaluation systems that track progress and improve levels of access to and the quality of EI services for infants and young children as stipulated in government policies. The results obtained in this study, at best, attest to the premise of LSL-SA in maximising linguistic competence and literacy development for infants and young children with hearing impairment and, at the very least, stresses the need for further study.

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Competing interests

The authors have declared that no competing interest exists.

Authors' contributions

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Data availability

The data that support the findings of this study are available from the corresponding author, A.C., upon reasonable request.

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