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Analysing Story Grammar in Tamil-Speaking Child Cochlear Implant Users

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Abstract

Objective: This cross-sectional comparative study aimed to analyse and compare the story-grammar components in Tamil-speaking children with and without hearing impairments narratives.

Design: The study utilised a cross-sectional, comparative design to assess and compare narrative structures.

Setting: Data was collected at the Sri Ramachandra Institute of Higher Education and Research (SRIHER) in Chennai, India.

Participants: Thirty children participated in the study, including fifteen children with severe to profound hearing loss who used cochlear implants and fifteen with normal hearing. The participants were language-age-matched three- and five-year-olds proficient in Tamil.

Interventions: No specific interventions were implemented in this study.

Main Outcome Measures: The primary outcome measures focused on story grammar components, including settings, characters, initiating events, internal plans, attempts, outcomes, and resolution. These components were evaluated through narrative retellings by the children.

Results: Analysis of the narratives revealed significant differences between the two groups. Children with normal hearing demonstrated a higher representation of story-grammar elements than children with hearing impairments. Specific numerical data on the differences in story-grammar components can be provided.

Conclusions: The findings suggest that children with normal hearing exhibit a more proficient understanding and utilisation of story structure in their storytelling than children with hearing impairments. This study highlights the importance of narrative analysis in language assessment, particularly for children with hearing impairments. Tailored interventions incorporating appropriate language stimulation techniques are needed to enhance children's narrative skills with hearing impairments. Further research in this area is warranted.

Keywords: narratives, macrostructure analysis, story grammar, hearing impairment, story retelling, memory.

What is already known on this topic: No previous studies have reported on story grammar analysis of narratives in the context of Tamil-speaking child cochlear implant users.

What this study adds: This study provides unique insights by examining narrative abilities in Tamil-speaking children with hearing impairments. It reveals differences in story-grammar components and highlights the need for tailored interventions. The findings emphasise the importance of story grammar interventions in facilitating narrative language development and addressing the narrative difficulties of the hearing-impaired population.

How this study might affect research, practice, or policy: The findings underscore the significance of narrative analysis in language assessment, advocate for targeted interventions, and inform early identification and intervention strategies for Tamil-speaking children with hearing impairments.

Introduction

Several studies have examined the impact of cochlear implants on children with severe to profound hearing loss, emphasising the importance of early intervention and personalised rehabilitation approaches. For instance, Geers conducted a longitudinal study on children who underwent early cochlear implantation, demonstrating significant improvements in speech perception, production, and language development (1). Similarly, Rubinstein presented the advantages of cochlear implants for individuals with severe to profound hearing loss, highlighting the importance of early intervention, ongoing support, and personalised rehabilitation strategies. The study emphasised enhancing speech perception, production, and language abilities through cochlear implants. Moreover, the study recognised the challenges associated with pediatric cochlear implantation and underscored the need for comprehensive assessments and tailored intervention strategies to meet each child's unique needs(2).

Sharma et al. evaluated how various parameters affect the outcomes of cochlear implants in pediatric patients. The findings highlighted that the age of implantation and the duration of device use play crucial roles in determining the effects of cochlear implantation. The study revealed that early implantation and a more extended period of device use contribute to better speech

perception, language development, and overall functional performance. The authors emphasised the significance of auditory rehabilitation in maximising the benefits of cochlear implants. They stressed the need for consistent and structured rehabilitation programs to support children in optimising their hearing skills (3).

Ganek et al. investigated the language outcomes of individuals who underwent cochlear implantation. The study emphasised that cochlear implantation positively impacts language development in individuals with profound hearing loss. They identified influential factors such as age at implantation, duration of implant use, residual hearing, and additional disabilities. The article also acknowledged potential challenges individuals face with cochlear implants and stressed the importance of individualised approaches to address language delays or difficulties in specific areas (4). Worsfold, Mahon, Yuen and Kennedy reported that children who received early confirmation of hearing impairment experienced substantial delays in their narrative skills compared to typically developing peers. Identifying and intervening early to support the development of narrative abilities is crucial (5)

Research has shown that hearing-impaired children may encounter difficulties organising and structuring their narratives, resulting in less cohesive and coherent storytelling(6). Reuterskiöld, Ibertsson, and Sahlén highlighted the narrative production difficulties children with hearing loss faced, particularly regarding story structure and coherence. Assessing and providing support for the narrative abilities of children with HI is vital for enhancing their communication skills (7)

Weiss and Johnson investigated the relationship between narrative skills and syntactic abilities in children with hearing impairment. Their study revealed that hearing-impaired children demonstrated lower levels of narrative and syntactic skills than their typically developing peers. The researchers also found a strong correlation between narrative and syntactic competencies in both groups. The authors concluded that hearing impairment has a negative impact on the development of narrative and syntactic skills in school-aged children. They stressed the significance of addressing these difficulties through educational interventions and offering appropriate support to foster language development (8). Yoshinago-Itano and Snyder examined the structural elements of narratives in deaf children. They found that the narratives of deaf children lacked cohesion devices, such as conjunctions and pronouns (9). Although major story grammar structures were present in the narratives of hearing-impaired students, their recall of the story's events was only about half compared to their hearing peers (10)

Kirk et al. examined the effects of age at cochlear implantation and communication mode on the narrative performance of young children. They found that earlier implantation and the use of spoken language were associated with improved narrative structure and cohesion performance. The study highlights the importance of considering the mode of communication, as children using spoken language exhibited different narrative patterns than those using sign language (11)

Soares, Goulart, and Chiari found that children with HI have lower levels of narrative competence. This results from difficulties in organising and structuring their narratives, resulting in less cohesive and cohesive storytelling. The study emphasises the significance of resolving and bolstering narrative skills in hearing-impaired children to improve their communication skills (5)

Reuterskiöld, Ibertsson, and Sahlén examined hearing-impaired children's narrative skills, exploring their abilities beyond the sentence level. The findings indicate that children with hearing loss face challenges in narrative production, particularly in story structure and coherence. The study emphasises the importance of assessing and supporting narrative abilities in children with hearing loss(7)

Amemiya, Goulart, and Chiari conducted a comparative analysis of nouns and verbs in the oral narratives of children with hearing impairments (HI) and typically developing children with normal hearing. The findings revealed that children with HI demonstrated a lower frequency of nouns and verbs than their peers with normal hearing and that children with normal hearing used a wider variety of verbs in their narratives. This study highlights the importance of considering these specific linguistic components when assessing and supporting the language development of children with HI. It also underscores the need for targeted interventions to support expressive language skills in individuals with HI (12)

Griffith and Ripich conducted a study comparing the ability of children with hearing loss and learning disabilities to recall story structures with that of nondisabled children. The findings indicated that while children with hearing loss and learning disabilities faced challenges in organising and remembering the overall story structure, their comprehension of individual story elements was similar to that of nondisabled children. These results suggest that interventions that improve story structure recall may benefit these children and enhance their narrative comprehension abilities (13)

Language interventions and targeted support have proven effective in enhancing narrative abilities in children with language disorders and hearing impairments. Interventions involving repeated retellings of model narratives and the creation of personal narratives have shown immediate positive effects on language characteristics (14). Understanding the relationship between narrative and syntactic competencies informs intervention strategies to promote language development in children with hearing impairments (8). Previous studies have reported on story grammar-enhanced narrative interventions for children with hearing impairments, suggesting their effectiveness in facilitating the acquisition of narrative skills (15–17).

Narratives of hearing impaired children in Tamil speaking context

Research on narratives in Tamil-speaking children has primarily focused on typically developing children. Two notable studies by Priyadarshini and Venkatraman & Valluvan have examined story grammar development in preschool and school-aged children, using different story stimuli and contexts. Venkatraman and Thiruvalluvan studied the developmental progression of story grammar components in typically developing Tamil-speaking children aged three to six years and 11 months. The results revealed a developmental trajectory in acquiring and expressing story grammar components, with the character element being the most frequently expressed. There was an increase in these elements initiating events, internal plans, attempts, and outcome elements as age increased. The resolution element also exhibited a gradual increase over time. These findings provide normative data for assessing narrative abilities in the Tamil-speaking population and offer valuable insights for designing interventions targeting children with language disorders (18)

Abinayaa et al. implemented the Multilingual Assessment Instrument for Narratives (MAIN) in Tamil to study story grammar analysis in children with HI. The process entailed the alteration of English sentences to adopt more superficial structures that would facilitate the natural formation of sentences in Tamil. Furthermore, the order of events in the sentences was modified accordingly. The bilingual population proficient in Tamil and English often borrows words from one language to convey negative emotions. The study aimed to assess the narrative proficiency of children aged 5 to 8 years using a modified assessment tool (19)

Priyadarshini examined the development of story grammar in Tamil-speaking children aged 5-8 years by analysing their retold narratives using videos without narration. The story "Frog- where are you?" elicited the narratives. Different age groups were compared, and the performance varied across age groups. The study explored story grammar elements such as characters, settings, goals or problems, episodes, and resolution. Findings showed that older children expressed story grammar units more frequently. However,

limited research exists on narratives of hearing-impaired children (20). A study by Jayaseelan et al. compared narratives' micro and macro structures in children with and without HI aged 4 to 8 years. The study employed a picture description task and found significant differences between the two groups' narrative macro and microstructure parameters. Jayaseelan et al. reported challenges in several macrostructural domains for children with HI, including topic maintenance, event sequencing, and explicitness. Children with HI faced difficulty maintaining narrative coherence, organising events logically, and providing a clear resolution to the story. Additionally, they exhibited deficits in explicitness, lacking informativeness, elaboration, and completeness in their narratives. The study concluded that early intervention strategies should target narrative coherence, event organisation, and explicitness, including informativeness, elaboration, and completeness (21)

However, a methodological gap existed as the study used a one-time picture description context, which may not fully capture the complexities of narrative tasks such as story retelling or personal narratives. The current study examines the story grammar components of narratives in Tamil-speaking child cochlear implant users, intending to fill the methodological voids in this area. Through a specific focus on this particular subgroup, the study can conduct a more precise examination of their narrative capabilities.

Given the existing research on narrative development in typically developing children and the observed differences in narratives of children with HI, there is a clear need to conduct a study explicitly focusing on story grammar analysis in children with HI. Such a study can provide insights into these children's challenges and difficulties constructing narratives. The knowledge gained can inform targeted intervention strategies to improve narrative skills and promote overall language development in this population.

Method

Participants

Patients or members of the general public WERE NOT involved in the conception, execution, reporting, or dissemination of our study. In this study, we utilised a sample size of 30 children to estimate the effect magnitude and variability, which will inform the design of future larger trials. This choice of sample size complies with recommendations and serves to reduce the overall trial sample size in subsequent research (22). Two groups of children participated in the study: 15 with severe to profound hearing loss who were receiving cochlear implants and 15 with normal hearing. The demographic information of the participants is presented in Table 1. Prior to the study, the research was approved by the Institutional Ethics Committee (IEC), and parental consent forms were signed by the parents of the participating children. The research was conducted at the Sri Ramachandra Faculty of Audiology and Speech-Language Pathology under the Project No. CSP/22/DEC/119/595. The inclusion and exclusion criteria for children with normal hearing

were as follows: children whose native language and primary mode of communication is Tamil, without any risk of hearing loss or history of middle ear infections, who completed an informal hearing test, and who had no history of late speech onset or speech and language delay milestones. For children with hearing impairments, the inclusion and exclusion criteria were as follows: children diagnosed with prelingual deafness before the age of 3 and who received cochlear implants to improve their hearing, with their native language and primary mode of communication being Tamil, language assessment using the Assessment of Language Development (ALD) indicating a language age above the receptive and expressive language age, ranging from three to five years, and exclusion of children with hearing impairments and multiple disabilities from the study.

Table 1

Participants' Description for Narrative Comparison

Groups	**Number of Participants** (M/F)	**Mean age**	**Lan-guage** Age	**Mean Duration of Rehabilitation**	**Mean Age of Im-plantation**
Normal hearing Children	15(7/8)	4.5	4.5	-	-
Children with hearing impairment	15 (7/8)	9.4	4.3	4.2	2.4

Materials and Stimulus

The study utilised a story titled "My Fish, No Fish," which had been translated into Tamil. The story was obtained from storyweavers.org, a digital story repository. Before the study, the story underwent a pilot test for familiarity among Tamil-speaking children between the ages of 3 and 6, as conducted in Venkatraman and Thiruvalluvan's (18) study.

Procedure

Prior to the task of retelling a story, the researcher established a rapport with every child participant. During the story's narration, the children were instructed to concentrate on the vibrant illustrations and the Tamil language. During the storytelling, the narrator employed suitable nonverbal communication, such as gestures and cues. If a child failed to grasp the narrative during the initial exposure, it was reiterated until a complete understanding was attained. After that, the children were instructed to recount their recently heard narrative. After the storyteller's narration, the children were given a 1-2 minute break.

During the narration, the investigator used neutral transitional terms such as "then," "next," and "after that" to encourage the children to continue retelling the story whenever they paused. The children were rewarded with candy upon completing the task as reinforcement. An Olympus camera recorded audio and video of the investigator's narrative and the children's story retelling. The duration of the audio-visual recording ranged from three to five minutes.

Analysis and Transcription

Verbatim transcription was performed on the obtained samples. The researcher's neutral prompts, repetitive utterances, false starts, and the children's mazes were excluded from the analysis. The macrostructure of participant utterances was then analysed. The story grammar (SG) components, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event, were examined according to Stein and Glenn's framework (23). This study utilised the qualitative rating reported by Venkatraman and Valluvan for story grammar analysis (18). The investigator prompts, and mazes were removed before calculating the presence of each story grammar element. The narrative samples of the story retelling were divided into utterances for detailed examination. A rating system from 0 to 3 was used for scoring, with 3 indicating an accomplished or detailed description of the component, 2 representing the main content of the element being described, 1 denoting a relevant attempt to describe the component, and 0 indicating the absence of any attempt to describe the component.

Statistical Analysis

The macrostructure parameters obtained from both groups were recorded in an MS Excel file, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event. The data were analysed using SPSS software. The means of the macrostructure measures for the retold narratives of the hearing-impaired children were compared with the established means of normally hearing children using the Mann-Whitney U test. A coefficient of approximately 0.947% was derived after testing the inter-rate reliability of all coded samples using Cohen's Kappa. The results indicate the inter-rate consistency between the two rates is exceptionally high. A high Cohen's Kappa score denotes better agreement between the independent raters.

Results

The following are the statistical analysis results comparing typically developing children to children with hearing impairments (HI) regarding various story grammar variables (Table 2). Significant differences were found between typically developing children and children with HI in the use of characters ($U = 25.000$, $p < .001$, $r = -.877$), setting ($U = 14.000$, $p < .001$, $r = -.913$), initiating events ($U = 7.000$, $p < .001$, $r = -0.945$), internal plans ($U = 30.000$, $p < .001$, $r = -.848$), attempts ($U = 22.000$, $p < .001$, $r = -.877$), outcomes

(U = 23.000, p < .001, r = -.877), and resolutions (U = 12,500, p < .001, r = -0.931). These findings demonstrate significant differences in story grammar components between typically developing children and those with hearing impairments. The results highlight a substantial reduction in story grammar elements during the narrative retelling task for children with hearing impairments.

Table 2 Comparison Of Narrative Macrostructure In Children With And Without Hearing Impairment

Story grammar Variables	Group	Mann-Whitney U	Wilcoxon W	Z	p-Value
Characters	Children with and without HI	25.00	145.00	-3.974	.000*
Settings	Children with and without HI	14.00	134.00	4.570	.000*
Initiating event	Children with and without HI	7.00	127.00	-4.570	.000*
Internal plan	Children with and without HI	30.00	150.00	-3.572	.000*
Attempt	Children with and without HI	22.00	142.00	-3.962	.000*
Outcome	Children with and without HI	23.00	143.00	-3.969	.000*
Resolution	Children with and without HI	12.50	132.00	-4.332	.000*

Note. Grouping Variable: Group. *p < .001 (2-tailed).

Discussion

The present study investigated the story grammar analysis of narratives in children with and without HI, focusing on the complexity of story grammar components. In order to understand the unique narrative abilities of children with HI, it is essential to discuss the richness of these story grammar elements in typical development and the specific challenges children with HI face in effectively utilising them.

Characters, setting, initiating events, internal plan, attempt, outcome, and resolution are fundamental story grammar elements that contribute to narrative coherence and organisation (18,20). These elements reflect the ability to understand and convey mental states, establish context, depict motivations, and demonstrate logical progression within a story.

Children with typical development exhibit well-developed skills in utilising these story grammar elements, showcasing their ability to construct narratives with depth and complexity (18). However, children with hearing impairments may face challenges fully utilising these elements. Each story grammar component and its presentation in the elicited narratives of children with and without HI are discussed below.

Characters

Children without HI had higher mean character development ranks than those with HI. This finding suggests that children with hearing impairments may demonstrate a restricted use of nouns and pronouns, possibly due to differences in the quantity and diversity of language exposure and the input and rehabilitation methods, compared to children with normal hearing (24)

Setting

Significant differences were observed in establishing the setting element, with typically developing children outperforming children with hearing impairments. This finding highlights the difficulties that children with hearing impairments may experience in acquiring a wide range of vocabulary words, which can impede their ability to describe and establish the setting of a story (24)

Initiating Event

The results demonstrated significant differences in the initiating event element, with typically developing children achieving higher mean ranks. Children with HI exhibit difficulty stringing together a series of actions due to their limited vocabulary and poor syntactic skills to effectively use the PNG markers to generate seamless narration (25)

Internal Plan

Significant differences were found in the internal plan element, with typically developing children exhibiting higher mean ranks. This finding aligns with the theory of mind framework, as internal plans involve characters' thoughts and intentions. This finding suggests that children with hearing impairments may face challenges in understanding and expressing the mental states of story characters, potentially due to limited access to spoken language and delays in linguistic development (26)

Attempt

The findings revealed significant differences in the attempt element, with typically developing children outperforming children with hearing impairments. This result can be attributed to the theory of mind perspective, as understanding characters' actions and strategies requires understanding their mental states. Children with hearing impairments may face challenges in comprehending and expressing these mental states, impacting their ability to construct narratives with well-developed attempts (27)

Outcome

Significant differences were observed in the outcome element, with typically developing children achieving higher mean ranks. This finding can be attributed to the theory of mind framework, as accurately comprehending and expressing the outcomes of story events relies on understanding characters' mental states. Predicting outcome also depends on the inherent ability to provide closure to the stimulus used for storytelling. Children with hearing impairments may encounter difficulties comprehending and expressing these outcomes, impacting their narratives' coherence and organisation (26)

Resolution

The results indicated significant differences in the resolution element, with typically developing children exhibiting higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development (18,20). This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the storytelling higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development (18,20) This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the story. This finding suggests that children with hearing impairments may face challenges in comprehending and expressing the intentions and motivations of story characters, which are crucial for effectively depicting initiating events (26,27). This finding relates to the theory of mind framework, as constructing a coherent and well-organised resolution requires understanding the characters' mental states and the overall story structure.

Notably, although the story grammar elements in question may present difficulties for children with hearing impairments, certain constituents may also prove intricate for children with typical development, as per Venkatraman. The general trend of diminished performance in these components among children with

hearing impairments indicates a necessity for focused interventions and assistance to augment their narrative proficiencies. Studies conducted by Uzuner, Kircaali-Iftar, and Karasu (17) Spencers et al. (15) and Zamani et al.(16) reinforce that the story grammar-based narrative intervention is effective for children with hearing impairments.

Conclusion

The complexity of story grammar components in typical development highlights the richness and depth of narratives typically developing children construct. However, children with hearing impairments face challenges in effectively utilising these elements, potentially due to limited access to spoken language, delays in linguistic development, and difficulties in the theory of mind understanding. Comprehending these barriers can provide direction for creating custom-tailored interventions and strategies aimed at promoting the narrative proficiency of children with hearing impairments, thereby enhancing their linguistic abilities and overall communicative ability. Analysing narratives regarding story grammar components would provide a picture of the individual's ability to construct narratives and shed light on the narrative organisation and coherence inadequacies. An intervention plan based on the story grammar components can facilitate the qualitative richness and appropriateness of narrative skills acquired by children with hearing impairments.

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Footnotes

- **Contributors**: Ms.Latika and Ms. Jenithaa collected data acquisition and analyzed. Ms. Jenithaa and Dr. Krupa Venkatraman wrote the manuscript and contributed substantially to the conception and design of the study, data interpretation, drafting of the manuscript, corrections and revisions.
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- **Patient consent for publication** Not required.
- **Ethics approval** This study was approved by the Institutional Review Board.
- **Provenance and peer review** Not commissioned; externally peer reviewed.
- **Data availability statement** Data are available upon reasonable request.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-6
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*9*
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10

		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Comparative Analysis of Story Grammar Development in Tamil-Speaking Child Cochlear Implant Users and Hearing Peers: A Cross-Sectional Study

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Comparative Analysis of Story Grammar Development in Tamil-Speaking Child Cochlear Implant Users and Hearing Peers: A Cross-Sectional Study

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Abstract

Objective: This cross-sectional comparative study aimed to analyse and compare the story-grammar components in Tamil-speaking children with and without hearing impairments narratives.

Design: The study utilised a cross-sectional, comparative design to assess and compare narrative structures.

Setting: Data was collected at the Sri Ramachandra Institute of Higher Education and Research (SRIHER) in Chennai, India.

Participants: Thirty children participated in the study, including fifteen children with severe to profound hearing loss who used cochlear implants and fifteen with normal hearing. The participants were language-age-matched three- and five-year-olds proficient in Tamil.

Interventions: No specific interventions were implemented in this study.

Main Outcome Measures: The primary outcome measures focused on story grammar components, including settings, characters, initiating events, internal plans, attempts, outcomes, and resolution. These components were evaluated through narrative retellings by the children.

Results: Analysis of the narratives revealed significant differences between the two groups. Children with normal hearing demonstrated a higher representation of story-grammar elements than children with hearing impairments. Specific numerical data on the differences in story-grammar components can be provided.

Conclusions: The findings suggest that children with normal hearing exhibit a more proficient understanding and utilisation of story structure in their storytelling than children with hearing impairments. This study highlights the importance of narrative analysis in language assessment, particularly for children with hearing impairments. Tailored interventions incorporating appropriate language stimulation techniques are needed to enhance children's narrative skills with hearing impairments. Further research in this area is warranted.

Keywords: narratives, macrostructure analysis, story grammar, hearing impairment, story retelling, memory.

Strengths and Limitations of This Study

- Carefully selected and language-age-matched participants and detailed narrative outcome measure that reveal significant differences.
- Significance in highlighting the importance of narrative analysis for children with hearing impairments.
- Highlights the need for specific language intervention strategies for enhancing narrative skills.
- The scope of the study is specific to a particular age group and language levels.
- Sample size considerations may affect the scope of findings.

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Introduction

Several studies have examined the impact of cochlear implants on children with severe to profound hearing loss, emphasising the importance of early intervention and personalised rehabilitation approaches. For instance, Geers conducted a longitudinal study on children who underwent early cochlear implantation, demonstrating significant improvements in speech perception, production, and language development [1]. Similarly, Rubinstein presented the advantages of cochlear implants for individuals with severe to profound hearing loss, highlighting the importance of early intervention, ongoing support, and personalised rehabilitation strategies. The study emphasised enhancing speech perception, production, and language abilities through cochlear implants. Moreover, the study recognised the challenges associated with pediatric cochlear implantation and underscored the need for comprehensive assessments and tailored intervention strategies to meet each child's unique needs [2].

Sharma et al. evaluated how various parameters affect the outcomes of cochlear implants in pediatric patients. The findings highlighted that the age of implantation and the duration of device use play crucial roles in determining the effects of cochlear implantation. The study revealed that early implantation and a more extended period of device use contribute to better speech perception, language development, and overall functional performance. The authors emphasised the significance of auditory rehabilitation in maximising the benefits of cochlear implants. They stressed the need for consistent and structured rehabilitation programs to support children in optimising their hearing skills [3].

Ganek et al. investigated the language outcomes of individuals who underwent cochlear implantation. The study emphasised that cochlear implantation positively impacts language development in individuals with profound hearing loss. They identified influential factors such as age at implantation, duration of implant use, residual hearing, and additional disabilities. The article also acknowledged potential challenges individuals face with cochlear implants and stressed the importance of individualised approaches to address language delays or difficulties in specific areas [4]. Worsfold, Mahon, Yuen and Kennedy reported

that children who received early confirmation of hearing impairment experienced substantial delays in their narrative skills compared to typically developing peers. Identifying and intervening early to support the development of narrative abilities is crucial [5].

Research has shown that hearing-impaired children may encounter difficulties in organising and structuring their narratives, resulting in less cohesive and coherent storytelling[6]. Reuterskiöld, Ibertsson, and Sahlén highlighted the narrative production difficulties children with hearing loss faced, particularly regarding story structure and coherence. Assessing and providing support for the narrative abilities of children with HI is vital for enhancing their communication skills [7].

Weiss and Johnson investigated the relationship between narrative skills and syntactic abilities in children with hearing impairment. Their study revealed that hearing-impaired children demonstrated lower levels of narrative and syntactic skills than their typically developing peers. The researchers also found a strong correlation between narrative and syntactic competencies in both groups. The authors concluded that hearing impairment has a negative impact on the development of narrative and syntactic skills in school-aged children. They stressed the significance of addressing these difficulties through educational interventions and offering appropriate support to foster language development [8]. Yoshinago-Itano and Snyder examined the structural elements of narratives in deaf children. They found that the narratives of deaf children lacked tools for generating cohesive narratives, such as conjunctions and pronouns [9]. Although major story grammar structures were present in the narratives of hearing-impaired students, their recall of the story's events was only about half compared to their hearing peers[10]

Kirk et al. examined the effects of age at cochlear implantation and communication mode on the narrative performance of young children. They found that earlier implantation and the use of spoken language were associated with improved narrative structure and cohesion performance. The study highlights the importance of considering the mode of communication, as children using spoken language exhibited different narrative patterns than those using sign language [11].

Soares et al. found that children with HI have lower levels of narrative competence. This results from difficulties in organising and structuring their narratives, resulting in less cohesive and cohesive storytelling. The study emphasises the significance of resolving and bolstering narrative skills in hearing-impaired children to improve their communication skills [5].

Reuterskiöld et al.examined hearing-impaired children's narrative skills, exploring their abilities beyond the sentence level. The findings indicate that children with hearing loss face challenges in narrative production, particularly in story structure and coherence. The study emphasises the importance of assessing and supporting narrative abilities in children with hearing loss [7].

Amemiya et al. compared nouns and verbs in the oral narratives of children with hearing impairments (HI) and typically developing children with normal hearing. The findings revealed that children with HI

demonstrated a lower frequency of nouns and verbs than their peers with normal hearing and that children with normal hearing used a wider variety of verbs in their narratives. This study highlights the importance of considering these specific linguistic components when assessing and supporting the language development of children with HI. It also underscores the need for targeted interventions to support expressive language skills in individuals with HI [12].

Griffith and Ripich conducted a study comparing the ability of children with hearing loss and learning disabilities to recall story structures with that of non-disabled children. The findings indicated that while children with hearing loss and learning disabilities faced challenges in organising and remembering the overall story structure, their comprehension of individual story elements was similar to that of non-disabled children. These results suggest that interventions that improve story structure recall benefit these children and enhance their narrative comprehension abilities [13].

Language interventions and targeted support have proven effective in enhancing narrative abilities in children with language disorders and hearing impairments. Interventions involving repeated retellings of model narratives and the creation of personal narratives have shown immediate positive effects on language characteristics [14]. Understanding the relationship between narrative and syntactic competencies informs intervention strategies to promote language development in children with hearing impairments [8]. Previous studies have reported on story grammar-enhanced narrative interventions for children with hearing impairments, suggesting their effectiveness in facilitating the acquisition of narrative skills [15–17].

Narratives of hearing-impaired Children in Tamil Speaking Context

Research on narratives in Tamil-speaking children has primarily focused on typically developing children. Two notable studies by Priyadarshini and Venkatraman & Valluvan have examined story grammar development in preschool and school-aged children, using different story stimuli and contexts. Venkatraman and Thiruvalluvan studied the developmental progression of story grammar components in typically developing Tamil-speaking children aged three to six years and 11 months. The results revealed a developmental trajectory in acquiring and expressing story grammar components, with the character element being the most frequently described. There was an increase in these elements initiating events, internal plans, attempts, and outcome elements as age increased. The resolution element also exhibited a gradual increase over time. These findings provide normative data for assessing narrative abilities in the Tamil-speaking population and offer valuable insights for designing interventions targeting children with language disorders [18].

Abinayaa et al. implemented the Multilingual Assessment Instrument for Narratives (MAIN) in Tamil to study story grammar analysis in children with HI. The process entailed the alteration of English sentences to adopt more superficial structures that would facilitate the natural formation of sentences in Tamil. Furthermore, the order of events in the sentences was modified accordingly. The bilingual population proficient in Tamil and English often borrows words from one language to convey negative emotions. The study aimed to assess the narrative proficiency of children aged 5 to 8 years using a modified assessment tool [19].

Priyadarshini examined the development of story grammar in Tamil-speaking children aged 5-8 years by analysing their retold narratives using videos without narration. The story "Frog- where are you?" elicited the narratives. Different age groups were compared, and the performance varied across age groups. The study explored story grammar elements such as characters, settings, goals or problems, episodes, and resolution. Findings showed that older children expressed story grammar units more frequently. However, limited research exists on narratives of hearing-impaired children [20]. A study by Jayaseelan et al. compared narratives' micro and macro structures in children with and without HI aged 4 to 8 years. The study employed a picture description task and found significant differences between the two groups' narrative macro and microstructure parameters. Jayaseelan et al. reported challenges in several macrostructural domains for children with HI, including topic maintenance, event sequencing, and explicitness. Children with HI faced difficulty maintaining narrative coherence, organising events logically, and providing a clear resolution to the story. Additionally, they exhibited deficits in explicitness, lacking informativeness, elaboration, and completeness in their narratives. The study concluded that early intervention strategies should target narrative coherence, event organisation, and explicitness, including informativeness, elaboration, and completeness [21].

However, a methodological gap existed as the study used a one-time picture description context, which may not fully capture the complexities of narrative tasks such as story retelling or personal narratives. The current study examines the story grammar components of narratives in Tamil-speaking child cochlear implant users, intending to fill the methodological voids in this area. Through a specific focus on this particular subgroup, the study can conduct a more precise examination of their narrative capabilities.

Given the existing research on narrative development in typically developing children and the observed differences in narratives of children with HI, there is a clear need to conduct a study explicitly focusing on story grammar analysis in children with HI. Such a study can provide insights into these children's challenges and difficulties in constructing narratives. The knowledge gained can inform targeted intervention strategies to improve narrative skills and promote overall language development in this population.

Method

Patient and Public Involvement

The Institutional Ethics Committee (IEC) approved the study and allocated project No.CSP/22/DEC/119/595 following a thorough review conducted at the Sri Ramachandra Institute of Higher Education and Research (SRIHER). The children with hearing loss who participated in the study underwent cochlear implant surgery and received aural rehabilitation services at Sri Ramachandra Faculty of Audiology and Speech-Language Pathology. The parents of the children recruited completed a consent form compiled in Tamil and English outlining the study's purpose, data collection procedures, data confidentiality, and the scientific use of the acquired data.

Participants

The research involved the enrollment of 30 children who were subsequently segregated into two distinct groups. The initial cohort consisted of 15 children diagnosed with severe to profound hearing impairment and receiving cochlear implants. The second group included 15 children with normal hearing. Table 1 provides demographic information for the participants. A group-wise comparison was made by recruiting five children representing both groups within three specific language age groups: 3 to 3 years and 11 months old, 4 to 4 years and 11 months old, and 5 to 5 years and 11 months old. This division was carried out to maintain equal representation within each language-age group.

The inclusion and exclusion criteria for children with normal hearing were as follows: children whose native language and primary mode of communication is Tamil, without any risk of hearing loss or history of middle ear infections, who completed an informal hearing test, and who had no history of late speech onset or speech and language delay milestones. For children with hearing impairments, the inclusion and exclusion criteria were as follows: children diagnosed with prelingual deafness before the age of 3 and who received cochlear implants to improve their hearing, with their native language and primary mode of communication being Tamil, language assessment using the Assessment of Language Development (ALD) indicating a language age above the receptive and expressive language age, ranging from three to five years, and exclusion of children with hearing impairments and multiple disabilities from the study.

Table 1 Participants' Description for Narrative Comparison

Groups	**Number of Participants** (M/F)	**Mean- age**	**Mean Language Level**	**Duration of Rehabilitation**	**Age of Implantation**

Normal hearing Children	15(7/8)	4.5	4.5	-	-
Children with hearing impairment	15 (7/8)	9.4	4.3	4.2	2.4

Materials and Stimulus

The study utilised a story titled "My Fish, No Fish," which had been translated into Tamil. The story was obtained from storyweavers.org, a digital story repository. Before the study, the story underwent a pilot test for familiarity among Tamil-speaking children between the ages of 3 and 6, as conducted in Venkatraman and Thiruvalluvan's study [18].

Procedure

Before retelling a story, the researcher established a rapport with every child participant. During the story's narration, the children were instructed to concentrate on the vibrant illustrations and the Tamil language. During the storytelling, the narrator employed suitable nonverbal communication, such as gestures and cues. If a child failed to grasp the narrative during the initial exposure, it was reiterated until a complete understanding was attained. After that, the children were instructed to recount their recently heard narrative. After the storyteller's narration, the children were given a 1–2-minute break.

During the narration, the investigator used neutral transitional terms such as "then," "next," and "after that" to encourage the children to continue retelling the story whenever they paused. The children were rewarded with candy upon completing the task as reinforcement. An Olympus camera recorded audio and video of the investigator's narrative and the children's story retelling. The duration of the audio-visual recording ranged from three to five minutes.

Analysis and Transcription

Verbatim transcription was performed on the obtained samples. The researcher's neutral prompts, repetitive utterances, false starts, and the children's mazes were excluded from the analysis. The macrostructure of participant utterances was then analysed. The story grammar (SG) components, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event, were examined according to Stein and Glenn's framework [22]. This study utilised the qualitative rating reported by Venkatraman and Valluvan for story grammar analysis [18]. The investigator prompts and mazes were removed before calculating the presence of each story grammar element. The narrative samples of the story retelling were divided into utterances for detailed examination. A rating system from

0 to 3 was used for scoring, with 3 indicating an accomplished or detailed description of the component, 2 representing the main content of the element being described, 1 denoting a relevant attempt to describe the component, and 0 indicating the absence of any attempt to describe the component.

Statistical Analysis

The macrostructure parameters obtained from both groups were recorded in an MS Excel file, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event. The data were analysed using SPSS software. The means of the macrostructure measures for the retold narratives of the hearing-impaired children were compared with the established means of normally hearing children using the Mann-Whitney U test. A coefficient of approximately 0.947% was derived after testing the inter-rate reliability of all coded samples using Cohen's Kappa. The results indicate the inter-rate consistency between the two rates is exceptionally high. A high Cohen's Kappa score denotes better agreement between the independent raters.

Results

The following are the statistical analysis results comparing typically developing children to children with hearing impairments (HI) regarding various story grammar variables (Table 2). Significant differences were found between typically developing children and children with HI in the use of characters ($U = 25.000$, $p < .001$, $r = -.877$), setting ($U = 14.000$, $p < .001$, $r = -.913$), initiating events ($U = 7.000$, $p < .001$, $r = -0.945$), internal plans ($U = 30.000$, $p < .001$, $r = -.848$), attempts ($U = 22.000$, $p < .001$, $r = -.877$), outcomes ($U = 23.000$, $p < .001$, $r = -.877$), and resolutions ($U = 12{,}500$, $p < .001$, $r = -0.931$). These findings demonstrate significant differences in story grammar components between typically developing children and those with hearing impairments. The results highlight a substantial reduction in story grammar elements during the narrative retelling task for children with hearing impairments.

Table 2 Comparison of Narrative Macrostructure in Children with And Without Hearing Impairment

Story grammar Variables	Group	Mann-Whitney U	Wilcoxon W	Z	p-Value
Characters	Children with and without HI	25.00	145.00	-3.974	.000*
Settings	Children with and without HI	14.00	134.00	4.570	.000*
Initiating event	Children with and without HI	7.00	127.00	-4.570	.000*
Internal plan	Children with and without HI	30.00	150.00	-3.572	.000*
Attempt	Children with and without HI	22.00	142.00	-3.962	.000*
Outcome	Children with and without HI	23.00	143.00	-3.969	.000*
Resolution	Children with and without HI	12.50	132.00	-4.332	.000*

Note. Grouping Variable: Group. *p < .001 (2-tailed).

Discussion

The present study investigated the story grammar analysis of narratives in children with and without HI, focusing on the complexity of story grammar components. A deliberate matching strategy was employed in this study to effectively address potential age-related biases, ensuring that our group comparisons were

both meaningful and reliable. To understand the unique narrative abilities of children with HI, it is essential to discuss the richness of these story grammar elements in typical development and the specific challenges children with HI face in effectively utilising them.

Characters, setting, initiating events, internal plan, attempt, outcome, and resolution are fundamental story grammar elements that contribute to narrative coherence and organisation [18, 20]. These elements reflect the ability to understand and convey mental states, establish context, depict motivations, and demonstrate logical progression within a story.

Children with typical development exhibit well-developed skills in utilising these story grammar elements, showcasing their ability to construct narratives with depth and complexity [18]. However, children with hearing impairments may face challenges fully utilising these elements. Each story grammar component and its presentation in the elicited narratives of children with and without HI are discussed below.

Characters

Children without HI had higher mean character development ranks than those with HI. This finding suggests that children with hearing impairments may demonstrate a restricted use of nouns and pronouns, possibly due to differences in the quantity and diversity of language exposure and the input and rehabilitation methods compared to children with normal hearing [23].

Setting

Significant differences were observed in establishing the setting element, with typically developing children outperforming children with hearing impairments. This finding highlights the difficulties that children with hearing impairments may experience in acquiring a wide range of vocabulary words, which can impede their ability to describe and establish the setting of a story [23].

Initiating Event

The results demonstrated significant differences in the initiating event element, with typically developing children achieving higher mean ranks. Children with HI exhibit difficulty stringing together a series of actions due to their limited vocabulary and poor syntactic skills to effectively use the PNG markers to generate seamless narration [24].

Internal Plan

Significant differences were found in the internal plan element, with typically developing children exhibiting higher mean ranks. This finding aligns with the theory of mind framework, as internal plans involve characters' thoughts and intentions. This finding suggests that children with hearing impairments may face challenges in understanding and expressing the mental states of story characters, potentially due to limited access to spoken language and delays in linguistic development [24].

Attempt

The findings revealed significant differences in the attempt element, with typically developing children outperforming children with hearing impairments. This result can be attributed to the theory of mind perspective, as understanding characters' actions and strategies requires understanding their mental states. Children with hearing impairments may face challenges in comprehending and expressing these mental states, impacting their ability to construct narratives with well-developed attempts [23].

Outcome

Significant differences were observed in the outcome element, with typically developing children achieving higher mean ranks. This finding can be attributed to the theory of mind framework, as accurately comprehending and expressing the outcomes of story events relies on understanding characters' mental states. Predicting outcomes also depends on the inherent ability to provide closure to the stimulus used for storytelling. Children with hearing impairments may encounter difficulties comprehending and expressing these outcomes, impacting their narratives' coherence and organisation [24].

Resolution

The results indicated significant differences in the resolution element, with typically developing children exhibiting higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development [18,20]. This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the storytelling higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development [18,20]. This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the story. This finding suggests that children with hearing impairments may face challenges in comprehending and expressing the intentions and motivations of story characters, which are crucial for effectively depicting initiating events [23,24]. This finding relates to the theory of mind framework, as constructing a coherent and well-organised resolution requires understanding the characters' mental states and the overall story structure.

Notably, although the story grammar elements in question may present difficulties for children with hearing impairments, certain constituents may also prove intricate for children with typical development, as per Venkatraman. Although children's language ages were matched using a standardised test tool, the quantity of communication did not reflect its quality. This study on child cochlear implant users' narrative skills highlights qualitative differences and challenges faced in higher-level language tasks. Although limited in sample size, the findings provide valuable insights and encourage further exploration in this vital area. The general trend of diminished performance in these components among children with hearing impairments indicates a necessity for focused interventions and assistance to augment their narrative proficiencies.

Studies by Uzuner, Kircaali-Iftar et al., Spencers et al. and Zamani et al. reinforce that the story grammar-based narrative intervention is effective for children with hearing impairments [15–17].

Conclusion

The complexity of story grammar components in typical development highlights the richness and depth of narratives typically developing children construct. However, children with hearing impairments face challenges in effectively utilising these elements, potentially due to limited access to spoken language, delays in linguistic development, and difficulties in the theory of mind understanding. Comprehending these barriers can provide direction for creating custom-tailored interventions and strategies to promote the narrative proficiency of children with hearing impairments, thereby enhancing their linguistic and communicative abilities. Analysing narratives regarding story grammar components would provide a picture of the individual's ability to construct narratives and shed light on the narrative organisation and coherence inadequacies. An intervention plan based on the story grammar components can facilitate the qualitative richness and appropriateness of narrative skills acquired by children with hearing impairments.

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Contributorship statement

1. Drafting and critical revision: Ms. Jenithaa drafted the manuscript and incorporated feedback from co-authors and reviewers.

2. Conception and design: Dr. Krupa Venkatraman contributed to the study's design and methodology and gave final approval for publication.

3. Data acquisition and analysis: Ms. Jenita and Ms. Latika collected and analysed data, offering valuable insights.

Competing interests

No, there are no competing interests for any author

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Data sharing statement

Data are available upon reasonable request.

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Comparative Analysis of Story Grammar Development: A Cross-Sectional Study of Tamil-Speaking Child Cochlear Implant Users and Hearing Peers in Tamil Nadu, India

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Abstract

Objective: This cross-sectional comparative study aimed to analyse and compare the story-grammar components in Tamil-speaking children with and without hearing impairments narratives.

Design: The study utilised a cross-sectional, comparative design to assess and compare narrative structures.

Setting: Data was collected at the Sri Ramachandra Institute of Higher Education and Research (SRIHER) in Chennai, India.

Participants: Thirty children participated in the study, including fifteen children with severe to profound hearing loss who used cochlear implants and fifteen with normal hearing. The participants were language-age-matched three- and five-year-olds proficient in Tamil.

Interventions: No specific interventions were implemented in this study.

Main Outcome Measures: The primary outcome measures focused on story grammar components, including settings, characters, initiating events, internal plans, attempts, outcomes, and resolution. These components were evaluated through narrative retellings by the children.

Results: Analysis of the narratives revealed significant differences between the two groups. Children with normal hearing demonstrated a higher representation of story-grammar elements than children with hearing impairments. Specific numerical data on the differences in story-grammar components can be provided.

Conclusions: The findings suggest that children with normal hearing exhibit a more proficient understanding and utilisation of story structure in their storytelling than children with hearing impairments. This study highlights the importance of narrative analysis in language assessment, particularly for children with hearing impairments. Tailored interventions incorporating appropriate language stimulation techniques are needed to enhance children's narrative skills with hearing impairments. Further research in this area is warranted.

Keywords: narratives, macrostructure analysis, story grammar, hearing impairment, story retelling, memory.

Strengths and Limitations of This Study

- Pioneering the initial exploration of story grammar analysis in Tamil-speaking children with hearing impairment, filling a critical gap in the existing research landscape.
- Participant selection is restricted to cochlear implant users with a language age of three to six years.
- The scope of the study is specific to a particular age group and language level.
- Sample size considerations may affect the scope of findings.

Introduction

Several studies have examined the impact of cochlear implants on children with severe to profound hearing loss, emphasising the importance of early intervention and personalised rehabilitation approaches. For instance, Geers conducted a longitudinal study on children who underwent early cochlear implantation, demonstrating significant improvements in speech perception, production, and language development [1]. Similarly, Rubinstein presented the advantages of cochlear implants for individuals with severe to profound hearing loss, highlighting the importance of early intervention, ongoing support, and personalised rehabilitation strategies. The study emphasised enhancing speech perception, production, and language abilities through cochlear implants. Moreover, the study recognised the challenges associated with pediatric cochlear implantation and underscored the need for comprehensive assessments and tailored intervention strategies to meet each child's unique needs [2].

Sharma et al. evaluated how various parameters affect the outcomes of cochlear implants in pediatric patients. The findings highlighted that the age of implantation and the duration of device use play crucial roles in determining the effects of cochlear implantation. The study revealed that early implantation and a more extended period of device use contribute to better speech perception, language development, and overall functional performance. The authors emphasised the significance of auditory rehabilitation in maximising the benefits of cochlear implants. They stressed the need for consistent and structured rehabilitation programs to support children in optimising their hearing skills [3].

Ganek et al. investigated the language outcomes of individuals who underwent cochlear implantation. The study emphasised that cochlear implantation positively impacts language development in individuals with profound hearing loss. They identified influential factors such as age at implantation, duration of implant use, residual hearing, and additional disabilities. The article also acknowledged potential challenges individuals face with cochlear implants and stressed the importance of individualised approaches to address language delays or difficulties in specific areas [4]. Worsfold, Mahon, Yuen and Kennedy reported that children who received early confirmation of hearing impairment experienced substantial delays in their narrative skills compared to typically developing peers. Identifying and intervening early to support

the development of narrative abilities is crucial [5].

Research has shown that hearing-impaired children may encounter difficulties in organising and structuring their narratives, resulting in less cohesive and coherent storytelling[6]. Reuterskiöld, Ibertsson, and Sahlén highlighted the narrative production difficulties children with hearing loss faced, particularly regarding story structure and coherence. Assessing and providing support for the narrative abilities of children with HI is vital for enhancing their communication skills [7].

Weiss and Johnson investigated the relationship between narrative skills and syntactic abilities in children with hearing impairment. Their study revealed that hearing-impaired children demonstrated lower levels of narrative and syntactic skills than their typically developing peers. The researchers also found a strong correlation between narrative and syntactic competencies in both groups. The authors concluded that hearing impairment has a negative impact on the development of narrative and syntactic skills in school-aged children. They stressed the significance of addressing these difficulties through educational interventions and offering appropriate support to foster language development [8]. Yoshinago-Itano and Snyder examined the structural elements of narratives in deaf children. They found that the narratives of deaf children lacked tools for generating cohesive narratives, such as conjunctions and pronouns [9]. Although major story grammar structures were present in the narratives of hearing-impaired students, their recall of the story's events was only about half compared to their hearing peers[10]

Kirk et al. examined the effects of age at cochlear implantation and communication mode on the narrative performance of young children. They found that earlier implantation and the use of spoken language were associated with improved narrative structure and cohesion performance. The study highlights the importance of considering the mode of communication, as children using spoken language exhibited different narrative patterns than those using sign language [11].

Soares et al. found that children with HI have lower levels of narrative competence. This results from difficulties in organising and structuring their narratives, resulting in less cohesive and cohesive storytelling. The study emphasises the significance of resolving and bolstering narrative skills in hearing-impaired children to improve their communication skills [5].

Reuterskiöld et al.examined hearing-impaired children's narrative skills, exploring their abilities beyond the sentence level. The findings indicate that children with hearing loss face challenges in narrative production, particularly in story structure and coherence. The study emphasises the importance of assessing and supporting narrative abilities in children with hearing loss [7].

Amemiya et al. compared nouns and verbs in the oral narratives of children with hearing impairments (HI) and typically developing children with normal hearing. The findings revealed that children with HI demonstrated a lower frequency of nouns and verbs than their peers with normal hearing and that children with normal hearing used a wider variety of verbs in their narratives. This study highlights the importance

of considering these specific linguistic components when assessing and supporting the language development of children with HI. It also underscores the need for targeted interventions to support expressive language skills in individuals with HI [12].

Griffith and Ripich conducted a study comparing the ability of children with hearing loss and learning disabilities to recall story structures with that of non-disabled children. The findings indicated that while children with hearing loss and learning disabilities faced challenges in organising and remembering the overall story structure, their comprehension of individual story elements was similar to that of non-disabled children. These results suggest that interventions that improve story structure recall benefit these children and enhance their narrative comprehension abilities [13].

Language interventions and targeted support have proven effective in enhancing narrative abilities in children with language disorders and hearing impairments. Interventions involving repeated retellings of model narratives and the creation of personal narratives have shown immediate positive effects on language characteristics [14]. Understanding the relationship between narrative and syntactic competencies informs intervention strategies to promote language development in children with hearing impairments [8]. Previous studies have reported on story grammar-enhanced narrative interventions for children with hearing impairments, suggesting their effectiveness in facilitating the acquisition of narrative skills [15–17].

Narratives of hearing-impaired Children in Tamil Speaking Context

Research on narratives in Tamil-speaking children has primarily focused on typically developing children. Two notable studies by Priyadarshini and Venkatraman & Valluvan have examined story grammar development in preschool and school-aged children, using different story stimuli and contexts. Venkatraman and Thiruvalluvan studied the developmental progression of story grammar components in typically developing Tamil-speaking children aged three to six years and 11 months. The results revealed a developmental trajectory in acquiring and expressing story grammar components, with the character element being the most frequently described. There was an increase in these elements initiating events, internal plans, attempts, and outcome elements as age increased. The resolution element also exhibited a gradual increase over time. These findings provide normative data for assessing narrative abilities in the Tamil-speaking population and offer valuable insights for designing interventions targeting children with language disorders [18].

Abinayaa et al. implemented the Multilingual Assessment Instrument for Narratives (MAIN) in Tamil to study story grammar analysis in children with HI. The process entailed the alteration of English sentences to adopt more superficial structures that would facilitate the natural formation of sentences in Tamil.

Furthermore, the order of events in the sentences was modified accordingly. The bilingual population proficient in Tamil and English often borrows words from one language to convey negative emotions. The study aimed to assess the narrative proficiency of children aged 5 to 8 years using a modified assessment tool [19].

Priyadarshini examined the development of story grammar in Tamil-speaking children aged 5-8 years by analysing their retold narratives using videos without narration. The story "Frog- where are you?" elicited the narratives. Different age groups were compared, and the performance varied across age groups. The study explored story grammar elements such as characters, settings, goals or problems, episodes, and resolution. Findings showed that older children expressed story grammar units more frequently. However, limited research exists on narratives of hearing-impaired children [20]. A study by Jayaseelan et al. compared narratives' micro and macro structures in children with and without HI aged 4 to 8 years. The study employed a picture description task and found significant differences between the two groups' narrative macro and microstructure parameters. Jayaseelan et al. reported challenges in several macrostructural domains for children with HI, including topic maintenance, event sequencing, and explicitness. Children with HI faced difficulty maintaining narrative coherence, organising events logically, and providing a clear resolution to the story. Additionally, they exhibited deficits in explicitness, lacking informativeness, elaboration, and completeness in their narratives. The study concluded that early intervention strategies should target narrative coherence, event organisation, and explicitness, including informativeness, elaboration, and completeness [21].

However, a methodological gap existed as the study used a one-time picture description context, which may not fully capture the complexities of narrative tasks such as story retelling or personal narratives. The current study examines the story grammar components of narratives in Tamil-speaking child cochlear implant users, intending to fill the methodological voids in this area. Through a specific focus on this particular subgroup, the study can conduct a more precise examination of their narrative capabilities.

Given the existing research on narrative development in typically developing children and the observed differences in narratives of children with HI, there is a clear need to conduct a study explicitly focusing on story grammar analysis in children with HI. Such a study can provide insights into these children's challenges and difficulties in constructing narratives. The knowledge gained can inform targeted intervention strategies to improve narrative skills and promote overall language development in this population.

Method

Patient and Public Involvement

The Institutional Ethics Committee (IEC) approved the study and allocated project No.CSP/22/DEC/119/595 following a thorough review conducted at the Sri Ramachandra Institute of Higher Education and Research (SRIHER). The children with hearing loss who participated in the study underwent cochlear implant surgery and received aural rehabilitation services at Sri Ramachandra Faculty of Audiology and Speech-Language Pathology. The parents of the children recruited completed a consent form compiled in Tamil and English outlining the study's purpose, data collection procedures, data confidentiality, and the scientific use of the acquired data.

Participants

The research involved the enrollment of 30 children who were subsequently segregated into two distinct groups. The initial cohort consisted of 15 children diagnosed with severe to profound hearing impairment and receiving cochlear implants. The second group included 15 children with normal hearing. Table 1 provides demographic information for the participants. A group-wise comparison was made by recruiting five children representing both groups within three specific language age groups: 3 to 3 years and 11 months old, 4 to 4 years and 11 months old, and 5 to 5 years and 11 months old. This division was carried out to maintain equal representation within each language-age group.

The inclusion and exclusion criteria for children with normal hearing were as follows: children whose native language and primary mode of communication is Tamil, without any risk of hearing loss or history of middle ear infections, who completed an informal hearing test, and who had no history of late speech onset or speech and language delay milestones. For children with hearing impairments, the inclusion and exclusion criteria were as follows: children diagnosed with prelingual deafness before the age of 3 and who received cochlear implants to improve their hearing, with their native language and primary mode of communication being Tamil, language assessment using the Assessment of Language Development (ALD) indicating a language age above the receptive and expressive language age, ranging from three to five years, and exclusion of children with hearing impairments and multiple disabilities from the study.

Table 1 Participants' Description for Narrative Comparison

Groups	**Number of Participants** (M/F)	**Mean- age**	**Mean Language Level**	**Duration of Rehabilitation**	**Age of Implantation**
Normal hearing Children	15(7/8)	4.5	4.5	-	-

Children with hearing impairment	15 (7/8)	9.4	4.3	4.2	2.4

Materials and Stimulus

The study utilised a story titled "My Fish, No Fish," which had been translated into Tamil. The story was obtained from storyweavers.org, a digital story repository. Before the study, the story underwent a pilot test for familiarity among Tamil-speaking children between the ages of 3 and 6, as conducted in Venkatraman and Thiruvalluvan's study [18].

Procedure

Before retelling a story, the researcher established a rapport with every child participant. During the story's narration, the children were instructed to concentrate on the vibrant illustrations and the Tamil language. During the storytelling, the narrator employed suitable nonverbal communication, such as gestures and cues. If a child failed to grasp the narrative during the initial exposure, it was reiterated until a complete understanding was attained. After that, the children were instructed to recount their recently heard narrative. After the storyteller's narration, the children were given a 1–2-minute break.

During the narration, the investigator used neutral transitional terms such as "then," "next," and "after that" to encourage the children to continue retelling the story whenever they paused. The children were rewarded with candy upon completing the task as reinforcement. An Olympus camera recorded audio and video of the investigator's narrative and the children's story retelling. The duration of the audio-visual recording ranged from three to five minutes.

Analysis and Transcription

Verbatim transcription was performed on the obtained samples. The researcher's neutral prompts, repetitive utterances, false starts, and the children's mazes were excluded from the analysis. The macrostructure of participant utterances was then analysed. The story grammar (SG) components, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event, were examined according to Stein and Glenn's framework [22]. This study utilised the qualitative rating reported by Venkatraman and Valluvan for story grammar analysis [18]. The investigator prompts and mazes were removed before calculating the presence of each story grammar element. The narrative samples of the story retelling were divided into utterances for detailed examination. A rating system from 0 to 3 was used for scoring, with 3 indicating an accomplished or detailed description of the component, 2 representing the main content of the element being described, 1 denoting a relevant attempt to describe the component, and 0 indicating the absence of any attempt to describe the component.

Statistical Analysis

The macrostructure parameters obtained from both groups were recorded in an MS Excel file, including the setting (S), characters (C), initiating event (IE), internal plan (IP), attempt (A), outcome (O), and resolution (R) of the event. The data were analysed using SPSS software. The means of the macrostructure measures for the retold narratives of the hearing-impaired children were compared with the established means of normally hearing children using the Mann-Whitney U test. A coefficient of approximately 0.947% was derived after testing the inter-rate reliability of all coded samples using Cohen's Kappa. The results indicate the inter-rate consistency between the two rates is exceptionally high. A high Cohen's Kappa score denotes better agreement between the independent raters.

Results

The following are the statistical analysis results comparing typically developing children to children with hearing impairments (HI) regarding various story grammar variables (Table 2). Significant differences were found between typically developing children and children with HI in the use of characters ($U = 25.000$, $p < .001$, $r = -.877$), setting ($U = 14.000$, $p < .001$, $r = -.913$), initiating events ($U = 7.000$, $p < .001$, $r = -0.945$), internal plans ($U = 30.000$, $p < .001$, $r = -.848$), attempts ($U = 22.000$, $p < .001$, $r = -.877$), outcomes ($U = 23.000$, $p < .001$, $r = -.877$), and resolutions ($U = 12{,}500$, $p < .001$, $r = -0.931$). These findings demonstrate significant differences in story grammar components between typically developing children and those with hearing impairments. The results highlight a substantial reduction in story grammar elements during the narrative retelling task for children with hearing impairments.

Table 2 Comparison of Narrative Macrostructure in Children with And Without Hearing Impairment

Story grammar Variables	Group	Mann-Whitney U	Wilcoxon W	Z	p-Value
Characters	Children with and without HI	25.00	145.00	-3.974	.000*
Settings	Children with and without HI	14.00	134.00	4.570	.000*
Initiating event	Children with and without HI	7.00	127.00	-4.570	.000*
Internal plan	Children with and without HI	30.00	150.00	-3.572	.000*
Attempt	Children with and without HI	22.00	142.00	-3.962	.000*
Outcome	Children with and without HI	23.00	143.00	-3.969	.000*
Resolution	Children with and without HI	12.50	132.00	-4.332	.000*

Note. Grouping Variable: Group. *p < .001 (2-tailed).

Discussion

The present study investigated the story grammar analysis of narratives in children with and without HI, focusing on the complexity of story grammar components. A deliberate matching strategy was employed in this study to effectively address potential age-related biases, ensuring that our group comparisons were

both meaningful and reliable. To understand the unique narrative abilities of children with HI, it is essential to discuss the richness of these story grammar elements in typical development and the specific challenges children with HI face in effectively utilising them.

Characters, setting, initiating events, internal plan, attempt, outcome, and resolution are fundamental story grammar elements that contribute to narrative coherence and organisation [18, 20]. These elements reflect the ability to understand and convey mental states, establish context, depict motivations, and demonstrate logical progression within a story.

Children with typical development exhibit well-developed skills in utilising these story grammar elements, showcasing their ability to construct narratives with depth and complexity [18]. However, children with hearing impairments may face challenges fully utilising these elements. Each story grammar component and its presentation in the elicited narratives of children with and without HI are discussed below.

Characters

Children without HI had higher mean character development ranks than those with HI. This finding suggests that children with hearing impairments may demonstrate a restricted use of nouns and pronouns, possibly due to differences in the quantity and diversity of language exposure and the input and rehabilitation methods compared to children with normal hearing [23].

Setting

Significant differences were observed in establishing the setting element, with typically developing children outperforming children with hearing impairments. This finding highlights the difficulties that children with hearing impairments may experience in acquiring a wide range of vocabulary words, which can impede their ability to describe and establish the setting of a story [23].

Initiating Event

The results demonstrated significant differences in the initiating event element, with typically developing children achieving higher mean ranks. Children with HI exhibit difficulty stringing together a series of actions due to their limited vocabulary and poor syntactic skills to effectively use the PNG markers to generate seamless narration [24].

Internal Plan

Significant differences were found in the internal plan element, with typically developing children exhibiting higher mean ranks. This finding aligns with the theory of mind framework, as internal plans involve characters' thoughts and intentions. This finding suggests that children with hearing impairments may face challenges in understanding and expressing the mental states of story characters, potentially due to limited access to spoken language and delays in linguistic development [24].

Attempt

The findings revealed significant differences in the attempt element, with typically developing children outperforming children with hearing impairments. This result can be attributed to the theory of mind perspective, as understanding characters' actions and strategies requires understanding their mental states. Children with hearing impairments may face challenges in comprehending and expressing these mental states, impacting their ability to construct narratives with well-developed attempts [23].

Outcome

Significant differences were observed in the outcome element, with typically developing children achieving higher mean ranks. This finding can be attributed to the theory of mind framework, as accurately comprehending and expressing the outcomes of story events relies on understanding characters' mental states. Predicting outcomes also depends on the inherent ability to provide closure to the stimulus used for storytelling. Children with hearing impairments may encounter difficulties comprehending and expressing these outcomes, impacting their narratives' coherence and organisation [24].

Resolution

The results indicated significant differences in the resolution element, with typically developing children exhibiting higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development [18,20]. This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the storytelling higher mean ranks. As reported in earlier literature, this story-grammar parameter was frequently sparse for children with typical development [18,20]. This story grammar component requires a complex understanding of a coordinated sequence of events to give closure to the story. This finding suggests that children with hearing impairments may face challenges in comprehending and expressing the intentions and motivations of story characters, which are crucial for effectively depicting initiating events [23,24]. This finding relates to the theory of mind framework, as constructing a coherent and well-organised resolution requires understanding the characters' mental states and the overall story structure.

Notably, although the story grammar elements in question may present difficulties for children with hearing impairments, certain constituents may also prove intricate for children with typical development, as per Venkatraman. Although children's language ages were matched using a standardised test tool, the quantity of communication did not reflect its quality. This study on child cochlear implant users' narrative skills highlights qualitative differences and challenges faced in higher-level language tasks. Although limited in sample size, the findings provide valuable insights and encourage further exploration in this vital area. The general trend of diminished performance in these components among children with hearing impairments indicates a necessity for focused interventions and assistance to augment their narrative proficiencies.

Studies by Uzuner, Kircaali-Iftar et al., Spencers et al. and Zamani et al. reinforce that the story grammar-based narrative intervention is effective for children with hearing impairments [15–17]. While this study undoubtedly offers substantial contributions to the narrative analysis of children with hearing impairment, it is crucial to note that it exclusively assessed the story-retelling task. Nevertheless, it remains paramount to encompass a more comprehensive array of narrative skills, including personal narratives and story generation, in order to gain a more comprehensive understanding of these children's overall narrative performance.

Conclusion

The complexity of story grammar components in typical development highlights the richness and depth of narratives typically developing children construct. However, children with hearing impairments face challenges in effectively utilising these elements, potentially due to limited access to spoken language, delays in linguistic development, and difficulties in the theory of mind understanding. Comprehending these barriers can provide direction for creating custom-tailored interventions and strategies to promote the narrative proficiency of children with hearing impairments, thereby enhancing their linguistic and communicative abilities. Analysing narratives regarding story grammar components would provide a picture of the individual's ability to construct narratives and shed light on the narrative organisation and coherence inadequacies. An intervention plan based on the story grammar components can facilitate the qualitative richness and appropriateness of narrative skills acquired by children with hearing impairments.

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Contributorship statement

1. Drafting and critical revision: Ms. Jenithaa drafted the manuscript and incorporated feedback from co-authors and reviewers.

2. Conception and design: Dr. Krupa Venkatraman contributed to the study's design and methodology and gave final approval for publication.

3. Data acquisition and analysis: Ms. Jenita and Ms. Latika collected and analysed data, offering valuable insights.

Competing interests

No, there are no competing interests for any author

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Data sharing statement

Data are available upon reasonable request.

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