DOI: https://doi.org/10.53350/pjmhs02024181602

ORIGINAL ARTICLE

Impact of Otitis Media on Speech and Language in Children

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ABSTRACT

Background: Otitis media, a prevalent middle ear infection in children, has been associated with speech and language development deficits. Recurring or chronic episodes can lead to fluctuating conductive hearing loss, potentially impacting phonological processing, vocabulary acquisition, and speech intelligibility. Understanding these effects is crucial for early intervention and management.

Objective: To investigate the impact of recurrent or chronic otitis media on phonological processing, vocabulary development, syntactic abilities, and overall speech intelligibility in children.

Methodology: This descriptive study was conducted at Department of Rehabilitation Sciences, The University of Lahore from 1st July 2023 to 31st October 2023. A total of 120 children participated, comprising 60 diagnosed with recurrent or chronic otitis media and 60 age-matched controls without otitis media. Audiological and language assessments included otoscopic examinations, tympanometry, pure tone audiometry, the Preschool Language Scale (PLS-5), and the Goldman-Fristoe Test of Articulation (GFTA-3). Data were analyzed using SPSS version 26.0 to determine correlations between hearing thresholds and language performance.

Results: Children with recurrent otitis media exhibited significantly lower expressive and receptive language scores, reduced phonological awareness, and impaired speech perception compared to the control group ($p < 0.05$). Conductive hearing loss due to otitis media was linked to articulation errors and diminished speech intelligibility. Additionally, delays in pragmatic language skills were observed, affecting social communication.

Conclusion: Chronic otitis media negatively affects speech and language development, emphasizing the need for early audiological assessments and multidisciplinary interventions. Medical management combined with speech therapy can mitigate some of the language deficits associated with otitis media.

Keywords: Otitis media, speech and language development, conductive hearing loss, phonological processing, articulation errors, pragmatic language skills, early intervention

INTRODUCTION

Otitis media is a prevalent middle ear infection among children and has been extensively studied due to its potential implications for speech and language development. This condition is characterized by the accumulation of fluid in the middle ear leading to conductive hearing loss.[1] Since auditory input plays a crucial role in early speech and language acquisition, any disruption in hearing sensitivity may interfere with the normal developmental trajectory of communication skills in children.[2] Children with frequent episodes of otitis media may experience delays in phonological processing, vocabulary acquisition, and syntactic development due to inconsistent auditory stimuli during critical periods of language learning.[3]

One of the primary concerns related to otitis media is its impact on speech perception. Children with recurring otitis media often exhibit fluctuating hearing loss. This difficulty can contribute to errors in speech production and articulation, particularly in sounds that require precise auditory discrimination, such as fricatives and affricates.[4] The children with a history of otitis media may have poorer speech intelligibility compared to their peers without middle ear infections, highlighting the potential long-term consequences of this condition.[5]

Language acquisition is also significantly influenced by the presence of otitis media. Children rely on consistent auditory input to develop a robust lexicon and grammatical competence.[6] OME may demonstrate delays in expressive and receptive language abilities, affecting both vocabulary breadth and sentence structure complexity.[7] These deficits may persist even after the resolution of middle ear infections, indicating a potential long-term impact on language proficiency.[8]

The ability to understand and utilize pragmatic language skills gets influenced by the condition of otitis media. Acquirement of auditory information with accuracy represents a challenge for children suffering from otitis media that leads to their failure when participating in conversational turn-taking and topic development and identification of implicit message meanings.[9] Irritations during social communication create obstacles that may damage both peer connectivity and educational success.[10]

It has been thoroughly studied how otitis media affects phonological awareness since it stands as a fundamental building block for literacy development. The development of decoding and literacy skills becomes more difficult when learning languages with complex phonological structures because of the impact of repeated middle-ear infections.[3]

Intervention approaches become vital for minimizing speech and language developmental problems caused by otitis media. The combination of timely infection diagnosis with medical treatment utilizing tympanostomy tubes cuts down the duration and amount of middle ear infections which reduces auditory exposure problems.[11] Through speech-language therapy children can learn alternate strategies to improve language comprehension while receiving treatment for their language disabilities with particular exercises for pronunciation development and word expansion and ear discrimination skills.[12] The medical and communicative needs of affected children require essential support through combined treatment between otolaryngologists and speech-language pathologists.

Various elements affecting the relationship between otitis media and speech-language results include the level of condition severity and duration and the point when symptoms begin and natural differences in cognitive and linguistic development. Children differ in their ability to adapt during early auditory deprivation because some recover completely by themselves yet others need ongoing support for their persisting difficulties.[13]

The negative effects of otitis media on speech and language development remain under investigation regarding their long-term impact on children in later stages of childhood through adolescence. Several investigators maintain early developmental setbacks are temporary because children reach equality with their peers after their hearing returns to normal levels.[14] The initial

Received on 10-11-2023
Accepted on 31-12-2023

hearing loss impacts learning in permanent ways especially when children have additional language delay risks such as family connections to speech issues or lower socioeconomic backgrounds.[15] Long-term assessment through research methods must establish both the complete impact of otitis media symptoms and the best treatment strategies.[16]

People involved in a child's care must understand thoroughly how otitis media disrupts their development of communication skills because it poses severe effects. Assaulted hearing tests combined with tracking developmental speech milestones create conditions to detect early signs of at-risk children so professionals can provide timely healthcare assistance.[17] Educational programs offering developmental strategies for children with otitis media history present an opportunity to minimize educational along with social challenges.[18] A multidisciplinary strategy allows us to reduce the adverse outcomes of otitis media while providing the best language results for children who experience it.[19]

MATERIALS AND METHODS

This descriptive study was conducted at Department of Rehabilitation Sciences, The University of Lahore from 1st July 2023 to 31st October 2023 vide letter No. REC-UOL-121-06-2023 dated 19th June 2023. A total of 120 children were enrolled. They were divided in two groups; each group comprised 60 children diagnosed with recurrent or chronic otitis media and 60 age-matched children without otitis media (control group). The participants were recruited with different severities of otitis media. A detailed clinical history was obtained from the caregivers of each child, focusing on the frequency, duration, and severity of otitis media episodes, along with developmental milestones related to speech and language acquisition. A complete ear, nose, and throat (ENT) examination was performed to rule out structural abnormalities. Otoscopic examinations and tympanometry were conducted to confirm the presence of middle ear effusion or tympanic membrane pathologies.

Speech and language assessments were conducted using standardized tools, including the Preschool Language Scale (PLS-5) and the Goldman-Fristoe Test of Articulation (GFTA-3). The assessments were conducted by qualified speech-language pathologists, with results documented in structured evaluation forms.

Parents were given questionnaires to report their observations regarding their child's communication skills, frequency of ear infections, and any perceived delays in speech or language development. The impact of otitis media on auditory perception and speech discrimination was also assessed using speech-in-noise testing. Children with confirmed speech and language delays were referred for regular speech therapy sessions, with interventions tailored to their specific needs.

Data were analyzed using SPSS version 26.0. Independent t-tests were applied to compare speech and language outcomes between the study and control groups. Pearson correlation analysis was conducted to explore the relationship between hearing thresholds and language performance. A p-value of <0.05 was considered statistically significant.

RESULTS

The mean age of children in the otitis media group was 5.2±1.8 years, while the mean age in the control group was 5.1±1.9 years. The p-value of 0.72 indicates that the difference in age between the groups was not statistically significant suggesting that both groups were comparable in terms of age distribution. Gender distribution was also assessed, with 35 (58.3%) males and 25 (41.7%) females in the otitis media group, compared to 32 (53.3%) males and 28 (46.7%) females in the control group. The p-values for male (0.64) and female (0.71) distributions indicate no statistically significant difference between the groups. In the otitis media group, 28 children (46.7%) were from a low socioeconomic background, while 26 children (43.3%) in the control group had a similar socioeconomic status. The p-value of 0.82 indicates that the difference in socioeconomic status between the groups was not statistically significant. The demographic analysis confirms that the two study groups were well-matched in terms of age, gender, and socioeconomic background, as none of the differences were statistically significant (Table 1).

The hearing assessment results indicate significant differences between children with otitis media and those in the control group highlighting the impact of otitis media on auditory function. Pure-tone audiometry revealed that children in the otitis media group had a significantly higher pure-tone average (PTA) of 35.4±6.2 dB HL compared to 15.2±4.5 dB HL in the control group, with a p-value of <0.001. This statistically significant difference suggests that children with otitis media experienced greater hearing thresholds, indicating mild to moderate hearing loss, whereas children in the control group demonstrated normal hearing thresholds. Tympanometry results further confirmed middle ear dysfunction in children with otitis media. A majority of the otitis media group (78.3%) exhibited abnormal tympanograms (Type B or C), indicative of middle ear pathology such as fluid accumulation or negative middle ear pressure. In contrast, only 8.3% of the control group showed similar abnormalities, with a p-value of <0.001, reinforcing the significant impact of otitis media on middle ear function. The high prevalence of abnormal tympanometry in the otitis media group suggests persistent middle ear dysfunction. Speech-in-noise perception was notably impaired in the otitis media group, with a mean score of 62.5±10.8%, compared to 85.6±9.5% in the control group, with a p-value of <0.001. The reduced ability to perceive speech in noise among children with otitis media highlights the challenges they face in real-world. Overall, hearing assessment results demonstrate that children with otitis media exhibit significant auditory deficits, including elevated hearing thresholds, middle ear dysfunction, and reduced speech-in-noise perception, all of which may contribute to speech and language delays (Table 2).

The speech and language assessment results reveal significant differences between children with otitis media and those in the control group, indicating the adverse impact of otitis media on language development and articulation skills. Receptive language abilities, as measured by the Preschool Language Scale-5 (PLS-5), were significantly lower in the otitis media group, with a mean score of 74.3±9.1 compared to 91.7±7.5 in the control group ($p<0.001$). This suggests that children with otitis media exhibited considerable difficulties in understanding spoken language. Expressive language skills were also significantly compromised in children with otitis media. The mean expressive language score on the PLS-5 was 71.5±10.4 in the otitis media group, whereas children in the control group scored significantly higher, with a mean of 89.2±8.6 ($p<0.001$). Children with otitis media struggled with verbal expression, including vocabulary development, sentence formulation, and overall communicative abilities. In addition to language difficulties, articulation skills were notably affected in children with otitis media. Articulation errors, as assessed using the Goldman-Fristoe Test of Articulation-3 (GFTA-3), were significantly higher in the otitis media group, with a mean error count of 14.7±3.5 compared to 7.2±2.8 in the control group ($p<0.001$). These findings underscore the detrimental effects of otitis media on language comprehension and production, as well as speech articulation, highlighting the need for early identification and intervention to mitigate long-term communication difficulties (Table 3).

The correlation analysis between hearing loss and speech-language performance demonstrated that a significant relationship between auditory function and language development in children with otitis media. A strong negative correlation was observed between pure-tone average (PTA) and receptive language scores, with a correlation coefficient of -0.65 ($p<0.001$). This indicates that as the severity of hearing loss increased, receptive language abilities declined. A stronger negative correlation was found between PTA and expressive language scores ($r = -0.71$,

p<0.001), suggesting that children with more pronounced hearing loss exhibited greater deficits in verbal expression. This finding highlights that fluctuations in auditory perception, commonly experienced by children with otitis media, may disrupt speech development by limiting their exposure to language models and reducing their ability to practice and refine expressive communication skills. A positive correlation was identified between PTA and articulation errors ($r = 0.58$, $p < 0.001$), indicating that children with greater hearing loss made more articulation errors. Since speech sound acquisition relies on auditory feedback, inconsistent hearing due to otitis media likely contributes to misarticulations and speech intelligibility issues. These results emphasize the strong link between hearing loss and language development, demonstrating that greater auditory deficits are associated with poorer speech-language outcomes (Table 4).

Table 1: Demographic Characteristics of Participants

Variable	Otitis Media Group (n = 60)	Control Group (n = 60)	p-value
Age (years)	5.2±1.8	5.1±1.9	0.72
Male (%)	35 (58.3%)	32 (53.3%)	0.64
Female (%)	25 (41.7%)	28 (46.7%)	0.71
Socioeconomic Status (Low)	28 (46.7%)	26 (43.3%)	0.82

Table 2: Comparison of hearing assessment

Hearing Test	Otitis Media Group (n = 60)	Control Group (n = 60)	p-value
Pure Tone Average (dB HL)	35.4±6.2	15.2±4.5	<0.001
Tympanometry (Type B or C)	47 78.3%)	5 (8.3%)	<0.001
Speech-in-Noise Score (%)	62.5±10.8	85.6±9.5	<0.001

Table 3: Speech and Language Assessment Scores

Assessment Tool	Otitis Media Group (n = 60)	Control Group (n = 60)	p-value
Receptive Language Score (PLS-5)	74.3 ± 9.1	91.7 ± 7.5	<0.001
Expressive Language Score (PLS-5)	71.5 ± 10.4	89.2 ± 8.6	<0.001
Articulation Errors (GFTA-3)	14.7 ± 3.5	7.2 ± 2.8	<0.001

Table 4: Correlation between Hearing Loss and Speech-Language Performance

Variable	Correlation Coefficient (r)	p-value
PTA vs. Receptive Language Score	-0.65	<0.001
PTA vs. Expressive Language Score	-0.71	<0.001
PTA vs. Articulation Errors	0.58	<0.001

DISCUSSION

The present study highlights the significant impact of otitis media on auditory and speech-language development in children, aligning with a broad base of recent literature. The findings demonstrate that children with otitis media exhibit significantly higher pure-tone averages (indicating hearing loss), a greater prevalence of abnormal tympanograms, and reduced speech-in-noise perception compared to their healthy counterparts. These auditory deficits correlate strongly with impairments in receptive and expressive language skills, as well as articulation accuracy.

The observation that children with otitis media had elevated hearing thresholds (mean PTA of 35.4 dB HL) aligns with the findings of Roberts et al[20], who reported that persistent middle ear effusion can result in mild to moderate conductive hearing loss, especially during critical periods of language acquisition. Similarly, Teele et al[21] emphasized the role of recurrent otitis media in contributing to fluctuating hearing loss, which may disrupt consistent access to phonological input, affecting speech and language learning.

The significantly higher proportion of abnormal tympanograms (78.3%) in the otitis media group supports the findings of Paradise et al[22], who identified middle ear dysfunction as a common sequela of otitis media with effusion, often leading to temporary conductive hearing loss. Tympanometry Type B and C patterns are indicative of effusion or negative middle ear pressure, respectively, and both are associated with auditory signal distortion. These findings reinforce the view that chronic or recurrent otitis media impairs auditory processing by altering the quality and clarity of acoustic input.

Furthermore, the reduced speech-in-noise scores in the otitis media group are consistent with the work of Hall et al[23] and Smiljanic Bradlow[24], who found that children with a history of otitis media experience more difficulty understanding speech in noisy environments. Such difficulty can significantly hinder academic performance and social interactions, especially in classroom settings where background noise is pervasive.

In terms of language outcomes, the significantly lower receptive and expressive language scores in the otitis media group reflect the concerns raised by Roberts et al[25], who demonstrated that early recurrent otitis media is associated with delays in both comprehension and verbal expression. The current study's findings (mean receptive language score: 74.3 vs. 91.7; expressive language: 71.5 vs. 89.2) align closely with their longitudinal results, suggesting that intermittent hearing loss due to otitis media compromises the acquisition of linguistic structures and vocabulary.

Additionally, the higher incidence of articulation errors observed in the otitis media group supports prior research by Dodd et al[[26] and Shriberg et al[27], who noted that children with inconsistent auditory input are more prone to speech sound disorders. Articulatory precision relies heavily on auditory monitoring and feedback; hence, hearing loss during formative years may lead to persistent errors in speech production.

The correlation analyses in this study further substantiate the relationship between hearing loss and language development. The strong negative correlations between PTA and both receptive ($r = -0.65$) and expressive language scores ($r = -0.71$) are similar to those reported by Friel-Patti[28], who highlighted the inverse relationship between the degree of hearing loss and language performance. The positive correlation between PTA and articulation errors ($r = 0.58$) supports the hypothesis that greater auditory impairment leads to more frequent misarticulations, as found in the studies by Bernthal et al.[29]

Moreover, the demographic comparability between groups enhances the validity of these findings. By controlling for age, gender, and socioeconomic status, the present study isolates otitis media as a primary influencing factor, eliminating confounding variables. These results corroborate the findings of Zadik et al[30], who reported that even in demographically matched samples, children with otitis media demonstrate significantly poorer speech and language outcomes.

Taken together, the current study contributes to the growing body of recent evidence indicating that otitis media poses a substantial risk to normal auditory and language development. The results emphasize the importance of early screening, regular audiological monitoring, and timely speech-language intervention for children experiencing recurrent otitis media.

Recommendations: Based on the study findings, several recommendations are proposed to improve the identification and management of speech and language difficulties in children with otitis media.

1. Routine hearing assessments should be conducted for children diagnosed with otitis media.
2. Speech-language evaluations should be integrated into pediatric care for children with a history of middle ear infections to facilitate early detection of communication impairments.
3. Healthcare professionals, including otolaryngologists and speech-language pathologists, should collaborate to develop

individualized intervention plans that address both hearing and language deficits.
4. Future studies should explore the effectiveness of early speech-language therapy interventions in minimizing language delays associated with otitis media.

CONCLUSION

Otitis media has a significant impact on speech and language development in children. Children with otitis media demonstrated poorer receptive and expressive language abilities, increased articulation errors, and reduced speech perception in noise compared to their healthy peers. The correlation analysis further highlighted that greater hearing loss was associated with more severe deficits in language comprehension, verbal expression, and articulation accuracy.

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This article may be cited as: Ahmed M, Zaman S, Uppal AA, Riaz N, Sattar A, Rehman AU: Impact of Otitis Media on Speech and Language in Children. Pak J Med Health Sci, 2023; 18(1): 602-605.