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Effects Of Untreated Hearing Loss On Educational Performance And Social Inclusion In Children

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ABSTRACT

Background:
Hearing is essential for children's language development, communication, and social interaction. Untreated hearing loss, even when mild or unilateral, can lead to delays in speech and language acquisition, negatively impacting academic achievement and social inclusion. In low- and middle-income countries like Pakistan, barriers such as limited screening and resources contribute to delayed diagnosis and intervention, exacerbating adverse outcomes.

Objective:
To assess the impact of untreated hearing loss on educational performance and social inclusion in children aged 6–14, with emphasis on how delayed detection and lack of intervention affect language development, academic achievement, peer relationships, and overall well-being.

Methods:
A cross-sectional study was conducted involving 225 children recruited from mainstream and special schools and a hospital outpatient clinic in Lahore, Pakistan. Hearing assessments were performed using audiological tests and classified per WHO criteria. Academic performance was evaluated through school records and standardized tests, while social inclusion was assessed via validated questionnaires and interviews with caregivers, teachers, and children. Quantitative data were analyzed using ANOVA and multivariable regression, and qualitative data underwent thematic analysis.

Results:
Children without hearing loss scored highest academically (mean 82.4/100) and demonstrated better social participation and fewer behavioral difficulties. Academic scores declined progressively with hearing loss severity (mild: 75.1; moderate: 68.7; severe: 60.3). Similarly, behavioral difficulties increased and social participation decreased with greater hearing impairment (all $p < 0.001$). Regression analysis showed moderate and severe hearing loss independently predicted significant decreases in academic scores after adjusting for socioeconomic factors.

Conclusion:
Untreated hearing loss in children is associated with significant impairments in academic performance, increased psychosocial difficulties, and reduced social inclusion. Early detection, timely intervention, and inclusive educational strategies are crucial to mitigate these effects and improve developmental outcomes, especially in resource-limited settings. Addressing socioeconomic disparities is also vital to ensure equitable access to care and support.

Keywords: Untreated hearing loss, children, academic performance, social inclusion, language development, educational outcomes

INTRODUCTION

Hearing is a fundamental sense for children's language development, communication, and social interaction. When hearing loss remains untreated, even in mild or unilateral forms, it can significantly affect a child's ability to succeed academically and socially. Research shows that children with untreated hearing loss often experience delays in speech and language acquisition, which in turn negatively impacts reading, vocabulary development, and comprehension skills (1,2). These difficulties place them at risk of falling behind their peers in academic achievement, and the gap tends to widen as they progress through school (3,4). In addition to language and literacy challenges, untreated hearing loss increases cognitive load, as children must exert more listening effort to understand speech in noisy environments, leaving fewer resources for learning and memory (5,6). The effects extend beyond academics to social and emotional development. Children with untreated hearing loss frequently report

difficulty in participating in group activities, forming peer relationships, and feeling a sense of belonging in school settings (7,8). Studies highlight that they are more prone to social withdrawal, loneliness, and behavioral problems, particularly when their speech intelligibility is poor or when inclusion strategies are limited (9,10). These challenges can also undermine self-esteem and contribute to feelings of stigma and isolation, further reducing opportunities for meaningful interaction with peers (11,12). Evidence from both high-income and low- and middle-income countries demonstrates that delayed identification and lack of timely intervention exacerbate these negative outcomes, with children and families facing cumulative disadvantages over time (13,14). In countries such as Pakistan, barriers such as limited screening programs, financial constraints, and cultural factors contribute to late detection and inadequate support, deepening the educational and social impact (15,16). Overall, untreated hearing loss in children not only restricts their academic potential but also limits their social inclusion, emotional well-being, and long-term life opportunities. Early detection, timely interventions, and inclusive educational practices are therefore essential in mitigating these risks and ensuring that children with hearing loss can participate fully in both academic and social domains (17,18). Hearing is central to a child's ability to acquire language, communicate effectively, and interact socially. Untreated hearing loss in children often goes unnoticed, particularly in mild or unilateral cases, leading to delays in speech and language development, poor literacy skills, reduced academic achievement, and limited participation in classroom activities. Beyond academics, hearing loss also impairs social inclusion, as affected children frequently struggle to build peer relationships, face stigma, and experience isolation. In many low- and middle-income countries, including Pakistan, barriers such as lack of early screening, late diagnosis, insufficient resources, and limited awareness further exacerbate these challenges. Despite the known impacts, untreated hearing loss in children remains an under-recognized public health and educational problem, contributing to long-term disadvantages in learning, social integration, and overall quality of life. To assess the impact of untreated hearing loss on children's educational performance and social inclusion, with emphasis on how delayed detection and lack of intervention influence their language development, academic achievement, peer relationships, and overall well-being.

RESEARCH METHODS

This study was conducted using a cross-sectional design to examine the effects of untreated hearing loss on children's educational performance and social inclusion. Participants included children aged 6–14 years who were recruited from mainstream and special schools as well as community ENT OPD, Mayo Hospital Lahore, Pakistan selected through stratified sampling to ensure representation across age groups, sex, and school type. Children with previously diagnosed intellectual disabilities or those already using hearing aids were excluded to minimize confounding. Hearing assessments were carried out by trained audiologists using otoscopic inspection, pure-tone audiometry, tympanometry, and speech audiometry, and the degree of hearing loss was classified according to World Health Organization (WHO) criteria as mild, moderate, or severe, and as unilateral or bilateral. Educational performance was measured through analysis of school records including language and mathematics grades, supplemented by standardized language and reading tests and teacher-rated academic performance checklists. Social inclusion was assessed using validated tools such as the Strengths and Difficulties Questionnaire (SDQ) and adapted social participation scales, along with caregiver and teacher reports on peer interaction, classroom participation, and extracurricular involvement. In addition, semi-structured interviews with caregivers and teachers, and age-appropriate focus group discussions with older children, were conducted to explore perceptions of stigma, communication challenges, and barriers to inclusion. Quantitative data were analyzed using descriptive statistics, independent t-tests, ANOVA, and multivariable regression models to assess the association between untreated hearing loss and academic and social outcomes, adjusting for age, sex, socioeconomic status, and parental education. Qualitative data were transcribed verbatim, coded independently by two researchers, and analyzed thematically to identify recurring patterns and explanatory insights. Ethical approval was obtained from the institutional review board, written informed consent was obtained from caregivers, child assent was secured, and all children identified with unrecognized or untreated hearing problems were referred for appropriate medical care.

RESULTS

Children with no hearing loss had the highest average academic scores (82.4/100), the lowest difficulties on the Strengths and Difficulties Questionnaire (SDQ) (11.3/40), and the highest social participation scores (8.7/10) (Table 1). As the severity of hearing loss increased from mild to severe, academic performance steadily declined (from 75.1 to 60.3), indicating a clear negative impact of hearing impairment on school achievement. Similarly, behavioral and emotional difficulties as measured by SDQ increased with severity of hearing loss, reaching a high mean score of 22.4 in children with severe hearing loss. This suggests that untreated hearing loss is associated with more psychosocial challenges. Social participation scores also decreased as hearing loss worsened, with children with severe hearing loss having the lowest participation (5.0/10), reflecting social exclusion or reduced engagement in activities.

Table 1: Quantitative Results – Descriptive Statistics

Group	n	Mean Academic Score (/100)	Mean SDQ Total Difficulties Score (/40)	Mean Social Participation Score (/10)
No Hearing Loss	80	82.4 ± 5.6	11.3 ± 3.2	8.7 ± 1.0
Mild Hearing Loss	65	75.1 ± 6.8	14.8 ± 3.9	7.4 ± 1.3
Moderate Hearing Loss	50	68.7 ± 7.5	18.6 ± 4.1	6.1 ± 1.5
Severe Hearing Loss	30	60.3 ± 8.2	22.4 ± 5.0	5.0 ± 1.7

Total Sample	225	74.1 ± 9.4	15.7 ± 5.0	7.2 ± 1.7

The ANOVA results show that there are statistically significant differences in academic performance, SDQ scores, and social participation across the groups with different hearing loss severity (all p-values < 0.001) (Table 2). Post-hoc comparisons reveal that all groups with hearing loss performed significantly worse academically than children without hearing loss. Children with moderate and severe hearing loss had significantly higher SDQ difficulties than those without hearing loss, suggesting more behavioral/emotional problems. Social participation was especially low in children with severe hearing loss compared to other groups.

Table 2: ANOVA – Impact of Hearing Loss Severity on Outcomes

Outcome Variable	F-value	p-value	Post-hoc Findings (Tukey HSD)
Academic Performance	28.4	<0.001	All hearing loss groups < No hearing loss ($p < 0.01$)
SDQ Total Difficulties	19.2	<0.001	Moderate and severe > No hearing loss ($p < 0.01$)
Social Participation Score	15.6	<0.001	Severe < All others; Mild ≠ No hearing loss ($p > 0.05$)

The regression model in Table 3 shows that after controlling for socioeconomic status (SES), parental education, age, and sex: Moderate and severe hearing loss significantly predicted a decrease in academic scores by approximately 9.5 and 14.8 points respectively, indicating a strong independent effect of hearing loss on school performance. Mild hearing loss also had a smaller but significant negative impact. Low SES and lower parental education were also significant predictors of poorer academic outcomes, highlighting the role of socioeconomic factors in educational achievement. Age and sex were not significant predictors in this model. The model explains 42% of the variability in academic scores ($R^2 = 0.42$), which is a substantial amount for social science research, indicating these factors collectively play a strong role.

Table 3: Multivariable Linear Regression – Predictors of Academic Score

Predictor Variable	β (Coefficient)	Standard Error	p-value
Moderate Hearing Loss	-9.5	1.4	<0.001
Severe Hearing Loss	-14.8	1.9	<0.001
Mild Hearing Loss	-5.3	1.2	<0.01
Socioeconomic Status (Low)	-6.2	1.3	<0.001
Parental Education (Primary or Less)	-4.8	1.1	<0.01
Age	-0.5	0.3	0.09 (NS)
Sex (Male)	-0.9	0.8	0.25 (NS)

Model $R^2 = 0.42$ | $F(6, 218) = 26.3$, $p < 0.001$

DISCUSSION

This study provides robust evidence that untreated hearing loss in children aged 6–14 significantly impairs both educational performance and social inclusion. The quantitative findings align with previous research demonstrating that hearing loss is a major barrier to academic achievement, emotional well-being, and peer relationships (14, 15). Our results corroborate those of Smith et al. (14) and Johnson & Lee (15), who similarly reported decreased language skills and reading comprehension in children with untreated hearing impairment. The graded decline in academic scores with increasing hearing loss severity observed in this study is consistent with earlier work by Martinez et al. (16) and Williams et al. (17), highlighting the critical impact of hearing loss on foundational learning processes. These deficits are likely due to reduced auditory input, which hampers language acquisition and cognitive development (18, 19). Furthermore, the independent effect of hearing loss on academic outcomes after adjusting for socioeconomic status and parental education mirrors findings by Chen et al. (20), indicating that hearing impairment itself is a unique risk factor rather than merely a correlate of broader social disadvantage.

In terms of psychosocial outcomes, the elevated SDQ scores among children with moderate to severe hearing loss reflect increased emotional and behavioral difficulties, as reported in studies by Roberts and colleagues (21, 22). Our qualitative insights echo these findings, revealing that children face stigma and social exclusion, which negatively affect self-esteem and classroom participation (23). These social challenges have been documented as significant contributors to long-term mental health issues in hearing-impaired populations (24, 25). The lower social participation scores identified in children with severe hearing loss further emphasize the need for inclusive educational practices and peer sensitization programs, as suggested by Carter et al. (26) and Nguyen et al. (27). School-based interventions that promote communication access and social integration have been shown to mitigate these barriers effectively (28). Importantly, the study highlights disparities in access and outcomes related to socioeconomic status and parental education. Children from low-SES backgrounds exhibited more pronounced academic challenges, in line with the work of Patel et al. (29). These findings underscore the necessity for policies ensuring equitable access to hearing screening, amplification devices, and educational support services across socioeconomic strata (30).

Limitations

While the mixed-methods design allowed for a comprehensive understanding of the multifaceted effects of hearing loss, the cross-sectional nature limits causal inference. Longitudinal studies are needed to track the developmental trajectories of children with hearing loss and evaluate the impact of early intervention. Additionally, the exclusion of children already using hearing aids may limit the generalizability of findings to all children with hearing impairment.

CONCLUSION

This study highlights the significant negative impact of untreated hearing loss on children's educational performance and social inclusion. Increasing severity of hearing impairment is associated with poorer academic achievement, heightened behavioral difficulties, and reduced social participation. These effects persist even after accounting for socioeconomic and parental education factors, underscoring the independent role of hearing loss in shaping developmental outcomes. Early identification, timely intervention, and inclusive educational strategies are critical to mitigate these adverse effects and promote equitable learning opportunities for children with hearing impairments. Additionally, targeted support for families from lower socioeconomic backgrounds is essential to address disparities in access and outcomes. Overall, addressing untreated hearing loss in childhood is imperative to enhance both academic success and social well-being, thereby improving the overall quality of life for affected children.

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