ACADEMIA International Journal for Social Sciences
Volume 4, Issue 3, 2025 ISSN-L (Online): 3006-6638

Traffic Awareness and Safety Education among Children with Hearing Impairment

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Received: 09-04-2025 **Revised:** 10-05-2025 **Accepted:** 15-06-2025 **Published:** 01-07-2025

ABSTRACT

The current study investigated the perception of children with hearing impairment in perceiving visible information in the traffic, paying attention to their knowledge of road signals, the difficulties of this area, and the adequacy of education in improving traffic awareness level. With a cross-sectional sample of 100 children (studying in both the government and private schools), the study was able to determine that, most of the respondents were well introduced regarding the comprehension of traffic signs and signals, but lacked in the comprehension of speed and distance of vehicles, rendering them more susceptible, on the road. Failure to hear important sounds such as horn and sirens caused a sense of insecurity and inconvenience particularly during crossing roads. In spite of this segment of children receiving help with the aid of assistive devices and safety training, the availability of such ranged and numerous of them indicated they needed more specialized aid. It was found by statistical analysis that gender and the extent of hearing impairment did not have significant impact on awareness of the traffic, however, the students of a private school and the students who use visual aids have a higher degree of awareness. The study puts a particular emphasis on the necessity to increase the visual support system, extend access to assistive technology, and offer specific safety education in order to ensure safer mobility and independence of children with HI.

Keywords: *Assistive technology, Disability and safety, Hearing impairment, Road safety education, Traffic awareness, Visual learning*

INTRODUCTION

Hearing loss is a sensory disability that impairs one's perception of sound, from mild hearing loss to profound deafness. It is a common condition worldwide with considerable developmental and social consequences, especially in children. The acquisition of speech, language and cognitive behavior relies on the factor of hearing because it allows the child to interpret the sounds, conceptualize language, and learn; thus, a severe hearing problem has a far reaching effect in child's both in terms of language and cognitive development. Early intervention programs have been instrumental in minimizing the long-term consequences of HI; however, there are still challenges in different areas in life, such as road safety and traffic awareness (Fageeh et al., 2023).

The etiology of hearing impairment in children may include genetic, infection, trauma, or environmental noise exposure. It is the most prevalent sensory impairment in the world, and prevalence is different in various regions. For example, in the US, permanent child hearing loss is identified in about 1.1 per 1,000 infants screened (Marriage et al., 2017). The impact of the HI on development is serious; it affects how the speech and language are developed, the academic achievement, communicative process with each other, and emotional control. HI children are likely to have delays in the expressive and receptive language, which lead to social withdrawal and low self-esteem (Lieu et al., 2020). These symptoms suggest the need for intervention in the form of their individual needs in various areas of their lives.

Traffic awareness is a useful skill to promote safety in city life today. For the hearing-impaired children, crossing traffic is more risky since they have fewer opportunities to hear warning noises like horns or alarms. This disadvantage leaves them at increased risk as cyclists or pedestrians. Evidence indicates that conventional traffic signs such as "Deaf Child Area" do impart some kind of awareness but do not become useful in changing drivers' behavior to a significant extent (Sauerburger et al., 2012).

Further, HI children might have difficulties in having spatial awareness and assessing the direction of oncoming cars, thereby adding to their opportunities for accidents further. The originality of this research stems from its concentration on a fairly underrated topic: traffic awareness in children with hearing impairment. Although extensive work has appeared on the pedagogical and social issues in children with HI, not very much has been written regarding the safety of HI children in road environments. Road accidents are also indeed worrying as they constitute one of the most prevalent causes of destruction and loss of life among children around the globe.

Through traffic awareness among deaf children, this current study looks to offer meaningful data as per their special vulnerabilities and needs. Policymakers, educators, and caregivers will be informed based on the data regarding effective measures to be implemented towards road safety education for the group. Second, the current study is an input towards greater initiatives involved in developing the autonomy and integration of sensory disabled children.

Finally, the realization of the overlap between traffic awareness and hearing impairment is crucial to safer environments for children with HI. This research not only fills a critical gap in research that has previously been conducted but also seeks to enhance a global movement towards inclusivity and accessibility for the disabled.

Objectives of the Study

The study was conducted to achieve the following objectives:

1. To determine the extent of general traffic knowledge among children with hearing impairment considered to the ability of the students to recognize traffic signs and signals and visual cues at the road settings.
2. To determine what challenges children having hearing impairment have towards understanding and applying the traffic rules.
3. To evaluate the availability and effectiveness of safety education and training delivered to the children with the hearing impairment

LITERATURE REVIEW

Traffic awareness among hearing-impaired children (HI) is a high and relatively unexplored area of road safety, especially since such children are particularly hindered by sound-based scenarios. The most common form of any form of sensory impairment globally, hearing loss, strongly influences the manner in which people perceive environmental information, such as traffic noises like car horns, sirens, or oncoming vehicles (Musiek et al., 2021).

For children with HI, auditory deprivation or alteration of input can impair detection of threat, crossing the road at intersections, or interpretation of auditory warning, thus exposing roads to threats (Stevenson et al., 2017; Alosufe et al., 2018). Previous studies cite that HI subjects usually suffer from cognitive and attentional loads due to compensatory visual attention, impacting situational awareness and decision-making within dynamic environments (Musiek et al., 2021; Amiour et al., 2022).

For instance, studies of adult HI driving behavior show that auditory deprivation can lead to visual compensation strategy use, but cognitive fatigue and reduced working memory capacity may impede the best reaction to unanticipated changes in traffic (Stevenson et al., 2017). But the direct implications for children, still learning traffic safety skills, remain poorly understood, particularly in settings where auditory information is prominent in pedestrian education (Alosufe et al., 2018; Amiour et al., 2022).

Inequalities in education worsen such concerns further. HI children placed in special schools are defined by research highlighting weakness within the systems, e.g., reduced coverage to tailored safety teaching and disability devices (Kanwal et al., 2023; Alosufe et al., 2018). For example, theoretical and practical loopholes identified from research on car crash prevention amongst deaf children identified severe needs in intervening with regard to such customized demands. Furthermore, environmental conditions like substandard infrastructure (e.g., absence of visual traffic signals) and social stigmatization increase the risk, especially in low-resource environments with no specialized care (Alosufe et al., 2018).

Despite that some research recommends tactile or multimodal warnings as compensatory assistants for HI drivers, equivalent solutions for children—e.g., visual-based road education programs—are underdeveloped (Musiek et al., 2021; Alosufe et al., 2018; Amiour et al., 2022). This is particularly important since models of traffic safety tend to naturally emphasize sound signals, unknowingly leaving children with HI behind.

By the coming together of findings from the fields of audiology, cognitive psychology, and road safety research, the literature review tries to determine the convergence point of hearing loss, development potential, and road safety education and recommends inclusive methods that take into account the special needs of the group (Musiek et al., 2021; Alosufe et al., 2018; Amiour et al., 2022).

It reduces detection of crucial auditory signals, including engine noise, horns, and sirens necessary for situational awareness (Dow et al., 2022). Directional hearing deficits also make identifying sound sources even more difficult, heightening risk at road crossings (Cavallari et al., 2019). Although vision fills in some auditory gaps, challenging situations (e.g., high traffic density) cause increased vulnerabilities due to cognitive overload (Davis et al., 2023).

Research on older drivers with hearing impairment shows compensatory actions like night avoidance or high-speed road avoidance (DiGuiseppi et al., 2022). Although less studied in children, similar difficulties

are likely to be present, especially within dynamic city environments where decisions must be made in a split second (Peat & Higgins, 2023).

Personalized road safety programs are necessary. Road Safety and Me spent effort on SEN-friendly learning through participatory approaches such as using wearable cameras to detect hazards in the environment (O'Toole et al., 2022). Australia's NRMA program also restructured content for the hearing-impaired child, incorporating visual signals and interactive learning (McLinden et al., 2022).

The primary strategies are Multisensory training like using visual, touch, and sound stimuli to reinforce safety concepts (Iqbal et al., 2024). Environmental changes like clear signs, vibrating warning pedestrian signals, and lowered traffic areas around schools (Wang et al., 2021). Parent and caregiver participation, like shared systems to support safety routines at home (Alonso et al., 2020; Broadley, 2020).

Safety issues usually constrain independent travel by limiting social participation (Alonso et al., 2018). Cognitive-psychological findings report that combining hearing loss and poor executive functioning (e.g., attention, decision-making) increases the likelihood of accidents (Cao, 2021). For instance, hearing-impaired children may not be able to prioritize several stimuli (e.g., traffic lights, pedestrian activities) (Kourmousi et al., 2024).

Though more knowledge is present in relation to the problems involving hearing-impaired children in traffic contexts, still substantial gaps in knowledge exist within literature available (Williams et al., 2002). Much research deals with hearing-impaired adults, specifically in traffic-oriented disciplines like driving and occupational dangers (Thorslund, 2014), Thus providing an enormous gap in knowledge with respect to the manner in which hearing-impaired children perceive traffic conditions themselves (Alosoufe et al., 2018). Studies conducted on children are generally narrow in scope and do not examine the interaction between loss of senses, cognitive maturation, and environmental factors that influence their traffic perception (Williams et al., 2002).

For instance, whereas some research accounts for visual dependency in deaf children (Hughes et al., 2023), there is much that is unknown regarding multisensory real-world traffic cue interpretation with conflicting stimuli (Hughes et al., 2023). In addition, there is no standard measure or method to assess traffic awareness and safety abilities in this population. Current tests are based on general road safety information or simulations with little real connection to actual driving situations (Alosoufe et al., 2018). Cultural and environmental variables like differences in urban and rural traffic environments or pedestrian infrastructure differences are not taken into account at all, restricting generalizability across settings (Khabiri et al., 2025).

Another major gap involves the design and assessment of learning interventions for children who are specifically hearing-impaired (Berg, 1973). Although there are some such programs that have been successful, they mainly provide general road safety education and are not designed with multisensory instruction or assistive technologies specifically aimed at addressing auditory impairments (Alosoufe et al., 2018). Additionally, there are hardly any studies conducted on the long-term effectiveness of these interventions as well as on their transferability across various systems of education.

Policy dimensions also remain poorly studied. While visual pedestrian signals or tactile paving have been utilized in some nations under accessibility programs, little can be shown of their effectiveness. Little also is the collaboration between city planners, teachers, and audiologists to create universally accessible

settings that often encompass the special requirements of this portion of society (World Health Organization, 2023; Williams et al., 2002).

To deal with these loopholes, future research would require a multidisciplinary approach incorporating data from audiology, cognitive psychology, education, and urban planning. Longitudinal observations of hearing-disabled children learning traffic awareness would allow for the learning of an understanding of developmental milestones of sensory compensation and their impact on safety behaviors (Williams et al., 2002). Observations in real-world settings with tools such as wearable technology or eye-tracking devices might offer useful observations about how such children visually scan their surroundings when moving through traffic (Hughes et al., 2023).

Moreover, employment of assistive devices like vibrating wristbands linked to pedestrian signals or augmented reality glasses can be useful in enhancing situational awareness in hearing-impaired children in real traffic conditions (Bubar, 2023). Secondly, the culturally grounded interventions must be tailored to meet the needs of specific environmental contexts; for example, traffic safety programs for busy cities may differ from those for rural areas that are lightly trafficked and lack pedestrian infrastructure (Khabiri et al., 2025).

Parent and caregiver engagement is another topic to be explored. Research must investigate the potential of home-based training sessions to facilitate caregivers in modeling safe behavior and to improve traffic safety attitudes within the home environment (Alosoufe et al., 2018). Public campaigning at a policy level must be conducted to guarantee that the requirement of the hearing-impaired pedestrians has to be given priority in urban planning policy. This can involve obligatory deployment of visual pedestrian signs along special needs schools for children or incentives to schools to implement adaptive road safety education curricula. Cooperative collaboration across disciplines by educators, urban planners, audiologists, and policymakers will be key to developing comprehensive solutions to address individual as well as systemic traffic safety barriers (Machingaidze, 2021; Williams et al., 2002; Alosoufe et al., 2018).

In general, hearing-impaired children present special difficulties in coping with traffic situations because they rely on visual cues and the limited provision of auditory information about situational awareness. Although previous research has existed that has reported some findings concerning compensatory behaviors and intervention strategies, there is still much to be discovered about how such children perceive and react to actual traffic danger in the natural environment.

The gaps must be closed through concerted research merging technological developments with education programs targeted to this population. Through the combined efforts of caregivers, educators, policymakers, and city planners, society can come up with more accessible spaces with improved mobility and safety for deaf children. These programs will not only make such children aware of how to safely walk on the roads but also provide them with equal access to public places and overall well-being along with social inclusion.

METHODOLOGY

Research study

The cross-sectional design of a survey provided an analysis of traffic awareness among HI. This strategy allowed the capturing of data at one point in time; focusing the awareness of traffic rules among the children, the problems encountered by the children on traffic situations including the usage of assistive

devices and the safety education and training experience that the children had. The quantitative approach gave an insight of the exact challenges encountered by these children and the importance of the specific safety education and supportive strategies to safer mobility.

Population

The population of study in the research was the children, either male or female in different age brackets, with hearing impairment. The participants chosen, to represent various schooling environments, were formed of both private and government school representatives. The research involved different durations of hearing loss and its occurrence. It was also gathered information on their usage of visual aids and whether they were taught safety concerning traffic or not. This strategy was used to make sure that the sample embraced various experiences and backgrounds of the hearing- impaired community, which fit the research constructs of the study.

Sampling & Sample

Random sampling was used to enroll participants in the study. Participants were randomly chosen from the population, irrespective of characteristics such as being a learner, having been diagnosed with hearing challenges, or being of a certain age group. Such an approach guarantees that each individual of the population would have an equal probability of being chosen, which helped limit selection bias and enhance the generalizability of findings. Sample size was determined based on the number of accessible and statistically preferable subjects.

Research Tool Development

Google Form were used to develop an online questionnaire with the aim of collecting traffic awareness information for deaf students. The questionnaire assessed understanding of traffic regulation, traffic signs, and identification of traffic dangers among respondents. Statement questions were kept concise and simple for ease of use and readability. Visual assistance such as photos of road signs and road surfaces, was incorporated into the form to ensure better understanding of deaf participants. The online version was convenient to distribute and complete, giving an easily accessible platform the intended audience.

Research Tool Validity and Reliability

To verify the validity of the questionnaire, content validity was confirmed through the related literature. Construct validity was also built upon the available evidence from relevant literature and measurement statistics. To ascertain reliability, measures like test-test reliability or Internal consistency of the questionnaire was tested with Cronbach's alpha.

Cronbach's Alpha	No of frequency	No. of Item
0.912	100	30

Data Analysis and Interpretation

Data was collected through Google Form, and results could be analyzed by the SPSS software. The results were interpreted using a statistical tool such as mean, median, mode, ANOVA, t-test and frequency distribution.

Table 1: Demographic information

Variable	Respondents	Frequency	Percentage
Age Group			
	10-12 years	25	25%
	13-15 years	29	29%
	16-18 years	29	29%
	19 years or above	17	17%
Gender			
	Male	78	78%
	Gender	22	22%
Type of School			
	Private	21	21%
	Government	79	79%
Hearing Impairment			
	Since birth	96	96%
	Less than 5 years	2	2%
	5-10 years	2	2%
Use of Visual Aids			
	Yes	67	67%
	No	33	33%
Safety Education Provided			
	Yes	62	62%
	No	33	33%
	Unsure	5	5%

Table 1 summarizes the demographic information of the 100 children with impaired hearing who took part in the research. The sample was complied of the children in four age groups of which 25 percent

were 10-12 years, 29 percent were 13-15 years, 29 percent were 16-18 years, and 17 percent were 19 years and above. Out of them, 78 percent were male and 22 percent were female basing on gender. Most of the respondents who are 79 percent attended government schools and 21 percent attended privately schools. Most of them (96%) were born with hearing impairment, and there were only 2% of those whose hearing impairment was acquired in less than 5 years or 5-10 years ago. As far as the safety education is concerned, 67% of the sample stated that they got it, and 33% did not; the same question regarding education in road safety was discovered as 62% said yes, 33 said no, and 5% were unsure. This population sample is mostly heterogeneous with specific age, type of school, and length of hearing deficiency with good representation of the students of government school and the children born deaf.

Table 2: General Traffic Awareness and Visual Cues in Traffic.

Sr.no	Statement	Mean	S.D.
1	I am able to identify common traffic signs and their meanings.	3.83	0.570
2	I pay attention to traffic lights and understand their signals.	4.03	0.540
3	I recognize when vehicles are about to stop or move based on their visual cues.	3.97	0.594
4	I can judge the speed and distance of moving vehicles by watching them.	3.89	0.751
5	I notice pedestrians and other road users around me while crossing the street.	4.00	0.667
6	I use visual cues such as vehicle brake lights or turn signals to stay safe.	3.92	0.800
7	I am aware of the safest places to cross the road.	4.00	0.725
8	I feel confident in interpreting the traffic environment using my vision.	4.00	0.765

Table 2 showed that children with hearing difficulties have had a great skill of identifying and deciphering visual signs in the traffic, e.g., traffic lights (mean =4.03, SD = 0.54), and they felt comfortable in using visual information to address the traffic (mean = 4.00, SD = 0.765). They could also identify typical traffic signs (mean = 3.83, SD = 0.57) or recognize visual cues i.e., brake light or turn signals (mean = 3.92, SD = 0.80). Yet, the ability to estimate the speed of passing vehicles and their distances was rated more weakly (mean = 3.89, SD = 0.751), which suggesting the area of improvement. In general, the data indicate that there is a high dependency of visual clues on safe mobility among the children's.

Table 3: Challenges in Traffic Situations and Use of Assistive Tools.

Sr.no	Statement	Mean	S.D.
1	I find it difficult to hear important sounds like car horns or emergency vehicle sirens.	4.02	0.568
2	I sometimes feel unsafe because I cannot hear what is	4.05	0.557

	happening around me in traffic.		
3	I use assistive tools (such as visual alerts, apps, or devices) to help me navigate traffic safely.	3.55	1.077
4	The assistive tools I use help me to better understand traffic situations.	3.73	0.863
5	I face challenges when crossing busy streets because of my hearing impairment.	4.03	0.688
6	I rely more on visual information than on sounds to stay safe in traffic.	4.17	0.514
7	I have experienced confusion or difficulty in traffic situations due to lack of sound cues.	3.90	0.759
8	I would benefit from more assistive tools designed for hearing-impaired pedestrians.	4.09	0.637

The table 3 examines the problematic traffic situations conditions and the use of assistive items. Great difficulties were also reported by the children since they are unable to hear such important noises as sounds of car horn or emergency vehicle sirens (mean = 4.02, SD = 0.568), and most of them feel unsafe in the traffic situations (mean = 4.05, SD = 0.557). The preference of visual information, as compared to auditory one, was evident (mean = 4.17, SD = 0.514), yet a part of children mentioned using the assistive tools, such as visual signals or applications (mean = 3.55, SD = 1.077). Nonetheless, the average shows that not everybody used assistive devices or could do it as there were variations among the kids. Another factor that stands out in the responses is the desire to have more Assistive tools that have been specially designed to help the hearing-impaired among pedestrians (mean = 4.09, SD = 0.637) and this would indicate that the current system of support is wanting with this.

Table 4: Safety Education and Training

Sr.no	Statement	Mean	S.D.
1	I have received training on how to stay safe in traffic environments.	3.30	1.202
2	The safety education I received was easy to understand and relevant to my needs.	3.47	1.049
3	I feel more confident in traffic after attending road safety training.	3.70	0.905
4	My school provides regular road safety education for students with hearing impairments.	3.74	0.906
5	I have learned specific strategies to compensate for my hearing impairment in traffic.	3.87	0.787

6	Safety education has taught me how to use visual cues effectively.	3.92	0.761
7	I would like to receive more training focused on traffic safety for hearing-impaired children.	4.18	0.593
8	Safety education has helped me avoid accidents or dangerous situations in traffic.	4.12	0.656

Table 4 is devoted to safety education and training. According to findings, a middle value of this item was obtained as not all the children had been taught on how to remain safe in traffic situations (mean = 3.30, SD = 1.202). People who had attended safety training considered that information to be clear and practical (mean=3.47, SD=1.049) and believed that their confidence had improved (mean=3.70, SD=0.905). The training was useful in instructing on ways of overcoming hearing impairment (mean = 3.87, SD =0.787) and encouraging use of visual clues (mean = 3.92, SD =0.761). Notably, the desire to get more specific safety training, was quite high (mean = 4.18, SD = 0.593) and a substantial proportion of children felt that they were not involved in a potentially dangerous situation or accident (mean = 4.12, SD = 0.656).

Table 5: Gender Differences in Traffic Awareness (Independent t-test)

Gender	N	Mean	SD	df	t	Sig.
Male	78	92.8333	12.10819	98	-1.038	.302
Female	22	95.7727	10.25360			

*P > .05 Level of Significance

The table examines that there is no significant difference between male and female hearing-impaired children. The p-value is more than 0.05 (.302 > 0.05), meaning that gender will not affect traffic awareness.

Table 6: School Type Differences in Traffic Awareness (Independent t-test)

Type of School	N	Mean	SD	Df	t	Sig.
Private	21	99.2857	10.76170	98	2.624	.010
Government	79	91.9367	11.56514			

*P < .05 Level of Significance

The table shows that Private school students are significantly more traffic aware than their government school peers. The result is statistically significant (p=0.010 < 0.05), showing the effect of school type.

Table 7: Impact of Visual Aids on Traffic Awareness (Independent t-test)

Use of Visual aids	N	Mean	SD	df	t	Sig.
Yes	67	96.4328	10.76220	98	-1.196	.000
No	33	87.4848	11.49761			

*P < .05 Level of Significance

The table represents that Children using visual aids are more aware of traffic than those who do not use any visual aid. The difference is highly significant (p=0.000 < 0.05), confirming the value of visual aids.

Table 8: Age Group Differences in Traffic Awareness (One-Way ANOVA)

Age	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3402.748	3	1134.249	10.631	.000
Within Groups	10242.212	96	106.690		
Total	13644.960	99			

*P < .05 Level of Significance

The table suggests that statistically significant age differences exist between the four groups. The Significance level of p = .000, which is far less than the .05 threshold. The result attests that at least one of the groups significantly varies in age from the others.

Table 9: Traffic Awareness by Level of Hearing Impairment (One-Way ANOVA)

Hearing Impairment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.470	2	1.235	.009	.991
Within Groups	13642.490	97	140.644		
Total	13644.960	99			

*P > .05 Level of Significance

This table shows that the significance value is 0.991, which is higher than 0.05. No significant difference exists regarding traffic awareness on the basis of the level of hearing impairment.

Table 10: Impact of Safety Education on Traffic Awareness (One-Way ANOVA)

Safety Education	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3034.510	2	1517.255	13.871	.000
Within Groups	10610.450	97	109.386		
Total	13644.960	99			

*P < .05 Level of Significance

The significance value is 0.000, which is below 0.05. This shows a significant difference, and safety education has a positive impact on traffic awareness among children with hearing impairment.

FINDINGS

Hearing impaired children are found to have strong reliance on the visual information such as road signs, lights, and vehicles movement to navigate the traffic environment. Having the general ability to notice visual cues, they have more difficulties with estimating incoming vehicle speed and distance thus, increasing higher risk on the road. The disability to hear sounds such as the sound of a horn or a siren instills a feeling of insecurity and poses great difficulties, especially when crossing busy streets. Despite the fact that some children improved their safety through the assistive tools, the availability and utilization is not permanent, and there is an evident necessity in more specific Assistive devices.

The effect of safety education is positive, and the individuals who gained the targeted training state high confidence and better usage of visual strategies. Nevertheless, not every child has been taught proper safety, and it is highly required to have more specific and available training courses. Statistical analysis indicated that the level of hearing impairment and gender do not have significant influence in the level of traffic awareness and students at private schools and using visual aids were more aware. There is also awareness difference based on age because older children tend to be better understanding.

In general, the results should become an indication of the necessity of assistive aids enhancement, increased availability of assistive technologies, and specialized education on safety in traffic situations.

DISCUSSION

Children with hearing impairment can only interpret the traffic signs through use of vision inputs accounting mostly on usage of traffic lights, signs as well as parking of motor vehicles to orientate to the environment since they are unable to hear the sound signals. This reliance on the visual information is substantially explored and supported by past research, indicating that auditory deprivation results in compensatory visually attention, which might respectively increase cognitive overburden and fatigue, influence situational perception, and decision-making in demanding conditions (Musiek et al., 2021; Stevenson et al., 2017).

These children will always have problems estimating speed and distance of vehicles in traffic whereas they are strong enough to read traffic signs. The children are hence more at risk in the traffic. Lack of access to critical sounds, such as horns and sirens, is an additional factor in the feeling of insecurity and challenge, in particular, when moving across the busy streets (Dow et al., 2022; Cavallari et al., 2019). Although kids with special needs may utilize assistive devices, like visual alerts or smartphone apps, access is still limited, and there are not many of them; therefore, more focused and widely devices are necessary (Bubar et al., 2023).

Traffic awareness and confidence is in a positive effect when safety education is administered to the hearing-impaired children. The road safety target training enhances their visual strategies awareness and application, which is supported by the literature (Alosoufe et al., 2018; Iqbal et al., 2024). Nevertheless, not every child has been properly trained in safety, and it is highly wanted that training should be more focused.

According to statistical analysis, gender and the degree of hearing impairment do not have a significant impact on traffic awareness consistent with the previous results showing that demographic factors have a small impact on safety outcomes (Alosoufe et al., 2018). However, in terms of heightened traffic awareness, students in the private schools and those with visual aids prove to be more aware in traffic and the need to use this type of knowledge (Kanwal et al., 2023). There is also an age difference which is significant whereby older children tend to be more aware which in this case matches the developmental aspects of cognitive and perceptual skills.

Taken as a whole, these results emphasize the necessity of better visual aids support, wider introduction of the assistive technologies, and increased safety educational training of children with hearing loss that should be more focused on cases of impairment. It is vital to address these needs to facilitate safety, mobility, and enhanced independence in the given population (World Health Organization, 2023; Williams et al., 2002).

CONCLUSION

To conclude that hearing impaired children demonstrates strong dependence on visual information to become traffic aware as well as safe, yet they do encounter some difficulties in trying to gauge the speed and distance of vehicles, and this can make them all the more vulnerable on the road. Although their awareness and confidence are developed because of safety education and visual aids, they lack certain avenues in terms of access to assistive devices and specialized training. To improve the situation with road safety among these children, these results emphasize the need to create even more inclusive road safety practices and support systems to fit the specific needs of the children with HI.

RECOMMENDATIONS

Following are some suggestions for the future research based on the gaps and findings:

- Further studies should develop to and test multisensory and technological interventions like tactile or visual alert system to determine whether they will enhance traffic safety in children with impairment of hearing.
- There is need to design and test special road safety education programs which are structured for hearing impaired children with a view of making them more interactive, visual and participatory to enhance more engaging with the program and more knowledge is gained.

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