

**Relationship between Aided Audiological Abilities and Academic Achievement  
of Children with Hearing Impairment**

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**This dissertation is submitted as part fulfilment of  
Master's Degree in Special Education (Hearing Impairment) – M.S.Ed.(HI)**

**University of Mysore**

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**May 2015**

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## **CERTIFICATE**

This is certify that this dissertation entitled “**Relationship Between Aided Audiological Abilities And Academic Achievement Of Children With Hearing Impairment**” is the bonafide work submitted in part fulfilment of Master’s in special education (Hearing Impairment) of the student with Registration No. 14MSD004. This has been carried out under the guidance of a faculty of this institute. And not has been submitted earlier to any other university for the award of any degree or diploma.

**Prof. S.R. Savithri**

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## **CERTIFICATE**

This is certifying that this dissertation entitled “**Relationship between Aided Audiological Abilities and Academic Achievement of Children with Hearing Impairment**” has been prepared under my Supervision and guidance. It is also certified that this has not been submitted earlier to any other university for the award of any degree or diploma.

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## **DECLARATION**

This is to certify that this master's Degree entitled "**Relationship Between Aided Audiological Abilities And Academic Achievement Of Children With Hearing Impairment**" is the result of my own study under the guidance of Ms. Shobha N. Odunavar lecturer in special education department, All India institute of speech and hearing, Mysore and has not been submitted earlier to any other university for the award of any degree or diploma.

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**Registration No. 14MSD004**

May 2015

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A decorative arrangement of pink flowers and green leaves with small water droplets, positioned in the top-left corner of the page.

*Dedicated*  
*to.....*

*My Parents!*

*And My*

*Brothers and*

*Sisters...*

A decorative arrangement of pink flowers and green leaves with small water droplets, positioned in the bottom-right corner of the page.

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## **Introduction**

Hearing impairment is a generic term indicating severity from mild to profound. Impairment in hearing that does not entirely prevent daily communication through speech is called hard of hearing (Brill, McNeil & Newman, 1986). Thus, the child with hard of hearing generally enhances his residual hearing with the help of hearing aid and will be able to process linguistic information successfully through audition. During the preschool years, the focal point of the hearing impaired child's program is the rehabilitation of communication skills. At the elementary and secondary levels, the focus shifts to the application of language in the development of academic, social and vocational skills. Consistent effort must be made to develop the communication skills which are essential to gain the educational, social and vocational opportunities of the general population. At pre-school years, communication skills will enhance through training in pre-academic skills, cognitive skills and linguistic skills. At pre-school years, communication skills will be enhanced through training in pre-academic skills, cognitive skills and linguistic skills. Teaching of pre-academic skills covers pre-reading, pre-writing and pre-arithmetic and linguistic skills covers lexical categories whereas cognitive skills covers perception, auditory processing, attention, logic and reasoning, memory. To acquire these skills in individuals with hearing impairment effective listening training is important. To communicate verbally and to undergo listening training, audition is very essential. Most of the academic achievements, which involve reasoning skills related to concepts, abstractions and mental representations, are directly dependent on hearing. Effective learning supports the use of integration of all the five senses and among those hearing is essential.

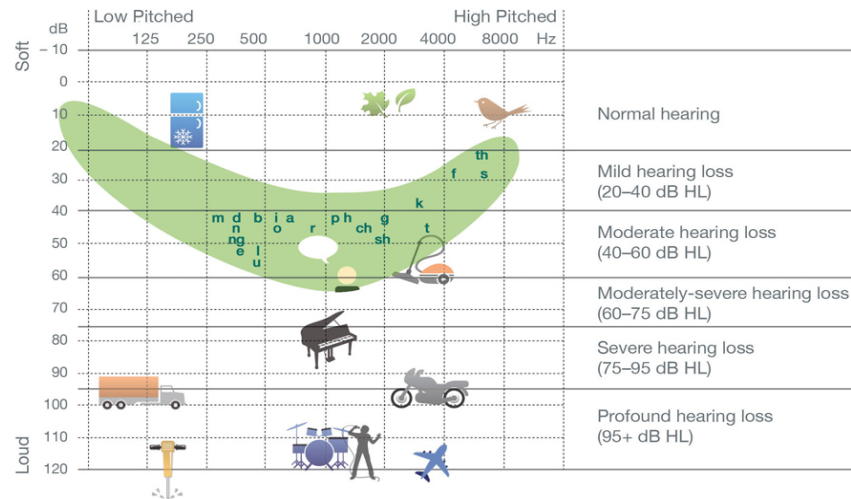
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Hence, to use the residual hearing of a child with hearing impairment in an appropriate way and to provide the opportunity to develop other skills which are dependent on hearing at the early age, it is essential to choose appropriate hearing aids as per the hearing loss of the child. Various subjective procedures are used for selection of hearing aids, one such procedure is checking of the aided audiological abilities through “Aided Audiogram”.

Aided audiogram is graphical representation of child’s sound field thresholds at different frequencies obtained with the hearing aid “ON” after programming to desired setting. The difference between the unaided and aided thresholds can provide information about the benefit obtained from a hearing aid. The information from aided audiogram helps to select a suitable hearing aid for a child with hearing impairment. The basic goal of hearing aid fitting is to provide perception of speech signal at normal conversation level to a child/adult with hearing impairment.

The overall average intensity of a speech signal is approximately 65 dB SPL as measured at 1-meter distance from a speaker. The speech spectrum varies with respect to frequency. The aim of providing signal at 30dB sensation level is to achieve threshold in desired audible zone. This audible zone in the audiogram is called as “Speech Banana” which is shown in Figure 1.1

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**Figure 1.1 shows Speech Banana** retrieved from

[http://urbanomnibus.net/redux/wpcontent/uploads/2012/10/stillspotting\\_bronx\\_chart](http://urbanomnibus.net/redux/wpcontent/uploads/2012/10/stillspotting_bronx_chart)

The speech banana is the area of an audiogram which covers the frequencies of all vowel and consonant sounds, as well as the intensities within which person with normal hearing sensitivity can hear them. For a hearing aid to be considered suitable, it is essential that the graph of the aided audiogram should lie within the speech banana. If the aided audiogram falls within this range, the hearing aid user will benefit significantly from the amplification and if it falls outside aided audiogram there will be limited benefit from hearing aids.

### **Need of the study**

“Aided audiogram” is one of the effective subjective methods carried out before beginning any academic activities of the child with hearing impairment. The aided Audiological abilities are the base for further development in terms of speech, language and communication. Development of these three areas is the foundation for the academic achievement of any child with hearing impairment.

Hence, early identification has an impact on all aspects of service delivered for young children with hearing loss. If appropriate access to Audiological and early intervention services are provided, many children will have the potential to follow a typical developmental trajectory (Robbins,Koch, Osberger,Zimmerman-Phillips, &Kishon-Rabin, 2004)

Children with Minimal Sensorineural Hearing loss (MSHL) failed in at least one grade. Further, children with MSHL exhibited significantly greater dysfunction than children with normal hearing on several subtests including behaviour, **energy**, stress, social support, and self-esteem. (Bess, Fred; Dodd-Murphy, Jeanne; Parker, Robert .1998).

Accordingly, early intervention services or pre-school services for children with hearing impairment are designed to use available abilities such as listening, speech perception and communicating abilities for their own development in stipulations of academic achievement. Listening abilities entirely depends on the aided audiogram which further becomes the overall development of the child for a longer duration. There are very less information available in the literature about the aided performance and academic performance of children with hearing impairment. Hence the present study was planned to find if there is any Relationship between Aided Audiologicalabilities and academic achievement of Children with Hearing Impairment.

### **Aim of the study**

To find the “Relationship between Aided Audiological abilities and Academic Achievement of Children with Hearing Impairment”.

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**Objectives of the study:**

1. To find the Relationship between aided Audiological abilities and achievement of Pre-academic skills among children with hearing impairment.
  2. To find the Relationship between aided Audiological abilities and achievement of Language skills among children with hearing impairment.
  3. To find the Relationship between aided Audiological abilities and achievement of Cognitive skills among children with hearing impairment.
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## **Review of Literature**

The present study is investigating the relationship between academic performance and audiologicalabilities of children with hearing impairment in time series manner. There are very less studies found in the area of academic achievement of children with hearing impairment and also comparison such as language, cognitive and pre- academic skills. But, there is very less work carried out related to audiologicalabilities and academic achievement. For the present study, academic achievement means children's achievement in pre-academic, language and cognitive skills. And Aided audiological abilities refers tothreshold obtained at 500 Hz, 1 KHz, 2 KHz and 4 KHz, aided thresholds for Ling sounds (a, i, u, s,sh, & m) and speech detection level/speech identification scores.

Tomblin, Oleson, Ambrose, Walker and Moeller (2014), revealed that longer duration of hearing aids experience was most beneficial for children who had the best aided hearing; the degree of improved hearing provided by hearing aids was associated with better speech and language development in children. In addition, the duration of hearing aids experience interacted with the aided hearing to influence outcomes on various measures.

Vijetha (2014) highlighted the benefits of cochlear implant for children with severe to profound hearing impairment studying in regular schools for improving their academic achievement. Participants included were 25 children with cochlear implants in the age range of 6-11 years. The relationship between academic achievement and factors such as age of testing, diagnosis and implantation, type of training received and duration of deafness across different age groups have been studied. The results

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indicated that there was significant relation between duration, deafness and academic achievement and there is no significant relation found between factors such as age at implantation, duration with cochlear implant, type of training received and gender in academic achievement when compared across different age groups in children with cochlear implant.

Fitzpatrick, Crawford, Durieux-Smith (2011) found that children with all categories of hearing loss who were fit with hearing aids and received auditory based rehabilitation services during the pre-school years demonstrated the potential to develop spoken language communication skills.

Dhingra, Manhas and Kohli (2010) investigated the relationship between the perceptual abilities and the academic performance of the children with hearing impairment. Perceptual abilities in four areas – visual, auditory, kinaesthetic and tactile were assessed and their relationship with three academic areas – reading, spellings and mathematics was explored. The findings show that on the whole the academic performance was significantly correlated with three perceptual abilities – visual, auditory and kinaesthetic. When considered separately, reading and spelling both were significantly associated not only with one another but also the three already mentioned perceptual areas. On the other hand, mathematics was found to be significantly correlated with only auditory and visual perception.

Smiley, Thelin, Lance and Muenchen (2009) conducted a study to evaluate the problem solving ability of children with hearing impairment. The performance of a group of children with hearing impairment (HI Group) was compared to that of a group of children with normal hearing (N H Group). The participants were asked to solve two types of mathematical problems: those requiring computation alone and word problems requiring the use of both language and mathematical computation. The

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results of this study revealed that there were no significant difference between HI and NH Group in the ability to solve mathematical equations involving the use of language and mathematical computation problems. Additionally, it was found that problem-solving ability was related to language ability, but not to hearing ability in the children with hearing impairment.

DesJardin (2009) reported that there is a positive association between speech perception abilities and language skills. It also revealed that assessment of speech perception, in combination with formal and informal language measures provides a more complete profile of the communication skills of young children with hearing impairment.

Chatterjee, Mishra (2004) reported that hearing impaired children who attended a formal Parent Infant Programs showed better pre-school performance in academic and cooperativeness, as compared to their counterparts who did not attend.

Bess, Fred, Murphy, Jeanne and Robert (1998) created a single-staged sampling frame of all schools in the district for 3rd, 6th, and 9th grades. The study revealed that thirty-seven percent of the children with minimal sensory neural hearing loss (MSHL) failed at least one grade. Further, children with MSHL exhibited significantly greater dysfunction than children with normal hearing on several subtests including behaviour, energy, stress, social support, and self-esteem.

Akinpelu (1998) showed that female hearing impaired students achieved academically better than male students and also the self-concept of male hearing-impaired students was not significantly different from that of female hearing-impaired students.

Bessand Tharpe (1988) studied academic achievement and functional status of children with minimal sensory-neural hearing loss, and indicated the deficiencies the

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children encountered in their academic work and also academic achievement problems particularly for the children in the lower grades. For the higher grades, functional comparison reviewed poorer scores for stress, self-esteem and social support than those observed with the normal children.

Davis, Elfenbein, Schum and Bentler (1986) revealed that there were no significant differences among age or hearing loss in 112 children with hearing impairment subgroups for the measure of performance or verbal IQ, further it shows that the performance on the PPVT testing revealed that mildest hearing losses causes delays in vocabulary development. Also, it shows that no significant differences were found among the academic achievement for the hearing loss or age categories.

Further, Moores (1985); Heward and Orlansky (1988) indicated that there are certain conditions, which affects the academic success of hearing impaired students, one among them is the severity of the hearing impairment, i.e., greater the hearing loss, the more difficulties the child experiences. The age and onset of the hearing loss in children impede serious challenges on child's performance. Those with profound loss are likely to encounter more as well as serious academic challenges than those with severe, moderate and mild hearing losses.

Davis et al. (1981) reported the standardized test scores for academic achievement, as well as intelligence and language development, of more than a thousand children with hearing impairments from mild to severe. The authors found that the academic achievement of children with mild hearing impairments did not differ significantly from the normal hearing child. However, children with more severe hearing impairments (greater than 50 dB) exhibited significant achievement

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problems that increased with age. However, Davis et al. (1986) studied the academic achievement of 40 children who differed in severity of hearing impairments and reported that hearing impairment has affected the academic achievement of these children, hence there was a great deal of variation in academic achievement among the individuals in their study. The authors concluded that even mild hearing loss also can cause difficulty with academic achievement.

From the above review it is evident that, the academic performance of children with hearing impairment depends on the severity of hearing impairment, perception abilities, age and onset of hearing loss etc which in turn affects language skills, speech abilities, and problem solving abilities. However, there are very less studies done about the comparison of academic performance and aided audiological abilities. Hence, the present study was planned to find out the relationship between academic achievement and aided audiological abilities of children with hearing impairment.

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## **Method**

The present study focuses on finding the relationship between aided audiological abilities and academic performance of children with hearing impairment at pre-school age. Hence, as per the requirement of the study, the following method was followed.

**Research Design:** The present study is probing the aided audiological abilities and the consecutive period's academic performance of children with hearing impairment. It has also focused to find the relation between these variables. Hence, a time series descriptive research design is followed. Purposive sampling technique was used for the present study.

### **Participant's selection criteria**

- Children with hearing impairment attending pre-school training at AIISH in two different languages (Kannada, Hindi) since three years. At the time of data collection they were in third year i.e., academic year 2014-15 from June 2014 to April 2015 were selected for the study.
  - Age range of the children was 5 to 6 years.
  - Totally 29 children with hearing impairment who were honored from AIISH pre-school were selected for the study. However, out of 29, 2 of Malayalam language children and 2 Hindi language children were not completed the three years of duration of pre-school training and 3 Kannada language children were gone for cochlear implant surgery. Hence finally, 20 participants were included in the present study.
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## **Procedure**

- The information about aided audiological abilities (thresholds for both the ears at 500 Hz, 1kHz, 2 kHz & 4kHz, thresholds for ling sounds - /a/, /i/, /u/, /s/, /sh/ & /m/, speech identification scores/speech detection threshold) were collected from case file (aided audiological reports) of each child from two terms from December 2014 to April 2015.
- The academic performance of each child in different areas like pre-academic, language and cognitive skill for the end of two terms i.e., December 2014 and April 2015 was collected from concerned class teacher of the pre-school.

## **Data analysis**

To arrive at the goal, the data collected was tabulated and analyzed using appropriate statistical procedures using SPSS Version 17. The values were obtained for various parameters of aided audiological abilities like thresholds for both the ears at 500 Hz, 1 kHz, 2 kHz & 4 kHz, thresholds for ling sounds like /a/, /i/, /u/, /s/, /sh/ and /m/, speech identification scores/speech detection threshold and academic performance such as pre academic, language and cognitive skills. The data obtained for these various parameters for hearing impaired children were compared using appropriate statistical analysis.

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## **Result and Discussion**

The aided Audiological abilities are the base for further development in terms of speech, language and communication in children with hearing impairment. Development in these three areas becomes the foundation for the academic achievement of any child. The present study is aimed to find the relation between the academic performances of children with hearing impairment with that of aided audiological abilities, because effective learning is supported the use of integration of all the five senses, among those hearing is most essential.

The present study covers the academic performance of children with hearing impairment in three major areas like pre-academic language and cognitive skills. Aided audiological abilities using own hearing aids were obtained through the Aided audiogram for two terms i.e. in December 2014 and April 2015. Each term has six months of duration.

The response obtained from children for both audiological abilities and academic performance was analysed using the statistical packages for social science (version 17.0). The statistical analyses used to analyse the obtained data were

- Descriptive statistics was done to obtain the Mean and standard deviation for academic performance and aided audio logical abilities.
- Pearson's correlation was done to find the relation between the academic performance and aided audiological abilities.

**The results of academic performance-pre-academic, language and cognitive skills**

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The mean and standard deviation (SD) of the academic performance (pre-academic, language and cognitive skills) of children with hearing impairment for two terms i.e. December 2014 and April 2015 is shown in table 4.1

**Table 4.1**

*Mean and standard deviation of academic performance in pre-academic skills (PA), language skill (Lang.) and Cognitive skill (COG) of two terms i.e. December 2014 and April 2015.*

<b>Skill</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>Term 1: December 2014</b>			
PA	20	85.3	14.36
Lang.	20	87.25	9.26
COG	20	84.9	13.67
<b>Term 2: April 2015</b>			
PA	20	87.9	11.26
Lang.	20	88.15	11.97
COG	20	83.45	12.23

As, it is evident from table 4.1 that the academic performance of children with hearing impairment is observed to be very good for all the three skills. It is also seen that there is no difference in academic performance for all the three skills for both the terms.

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The results of aided audiological abilities of children with hearing impairment (thresholds at 500 Hz, 1 kHz, 2 kHz and 4 kHz for both the ears) for December 2014 and April 2015.

Terms	RIGHT EAR				LEFT EAR			
	Aided Thresholds	N	Mean	Std. Deviation	Aided Thresholds	N	Mean	Std. Deviation
First December 2014	500Hz	20	41.5	9.33	500Hz	20	38.5	8.28
	1kHz	20	46.5	10.77	1kHz	20	42.25	8.95
	2kHz	20	50	11.00	2kHz	20	48.5	8.59
	4kHz	20	55.5	14.40	4kHz	20	54	11.42
Second April 2015	500Hz	20	41	8.97	500Hz	20	43	9.37

The mean and standard deviation of aided audiological abilities (thresholds

at 500 Hz, 1 kHz, 2 kHz and 4 kHz for both the ears) of children with hearing impairment for December 2014 and April 2015 are given in table 4.2.

Table 4.2

*Mean and standard deviation of aided Thresholds from 500 kHz, 1 kHz, 2 kHz and 4 kHz for both ears in both the term i.e. December 2014 and April 2015.*





1kHz	20	43.5	9.47	1kHz	20	44.5	11.68
2kHz	20	46.75	10.16	2kHz	20	50	13.47
4kHz	20	55	12.35	4kHz	20	57	14.54

As it can be observed from table 4.2 the overall aided thresholds are noticed to be within speech spectrum for both right and left ears for both the terms. The aided thresholds at 500Hz and 1 kHz are shown to be better compared to 2 kHz and 4 kHz for both the ears and both terms, however, the threshold are noticed to be better at 2 kHz for right ear during second term.

Table 4.3

*Mean and standard deviation of aided lings sounds identification in both the termi.e. December 2014 and April 2015 is show in this table.*

Terms	RIGHT EAR				LEFT EAR			
	Speech Sounds	N	Mean	Std. Deviation	Speech Sounds	N	Mean	Std. Deviation
First December 2014	/a/	18	34.16	6.24	/a/	18	33.61	7.63
	/i/	18	40	7.47	/i/	18	39.16	9.11
	/u/	18	38.61	8.54	/u/	18	38.61	8.36
	/s/	18	50	9.23	/s/	18	48.88	10.22
	/sh/	18	51.66	7.66	/sh/	18	48.61	9.82
	/m/	18	42.77	8.61	/m/	18	42.22	9.27
Second April 2015	/a/	20	35.5	9.017	/a/	19	35.78	11.69
	/i/	20	38.75	9.30	/i/	19	41.05	13.07
	/u/	20	38.25	7.65	/u/	19	40.26	12.63
	/s/	20	51.25	13.26	/s/	19	50.52	10.91
	/sh/	20	52	13.80	/sh/	19	51.05	12.97
	/m/	20	45.5	11.57	/m/	18	46.11	11.95

It is depicted in the table 4.4 that the aided ling's sounds identification is shown to be within the speech spectrum for all the sounds. However, the sounds /a/, /i/, /u/ and /m/ is observed to be better i.e. the responses are obtained at lower intensity level compared to /s/ and /sh/ in both the ears for both the terms.

**The results of aided audiological abilities (speech identification responses in closed set/Speech detection threshold for both the ears) of children with hearing impairment for December 2014 and April 2015.**

The speech identification responses in closed set/Speech detection threshold for both the ears of children with hearing impairment for December 2014 and April 2015 are shown in table 4.4.

**Table 4.4**

*Mean and standard deviation of speech identification responses in closed set/Speech detection threshold for both the ears for December 2014 and April 2015.*

Terms	Right Ear			Left Ear		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
SIS First	6	18.66	3.32	5	18.8	3.49
SDT First	14	45	4.02	15	40	3.6
SIS Second	11	18.09	3.50	9	15.55	5.63
SDT Second	9	40	3.40	11	40	3.30

As it can noted from table 4.4 the speech identification responses were obtained for only 6 children for right ear and 5 children for left in first term. The speech identification responses were found to be good (18/25) i.e. about 72% for right ear for first and second and for the left ear during first term. However, it was found to be 15/25 (60%) for the left ear during second term.

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For children whom speech identification responses could not be obtained, speech detection threshold was obtained and it was found to be within speech spectrum for both ears for both the terms.

**Relationship between academic performance and aided audiological abilities for children with hearing impairment.**

In order to see if there is correlation between academic performance-pre academic, language and cognitive skills and aided audiological abilities (thresholds at 500 kHz, 1 kHz, 2 kHz and 4 kHz for both the ears, thresholds for identification of lingual sounds- /a/,/i/,/u/,/s/,/sh/,/m/ and SIS/SDT) Pearson's correlation two-tailed test was used. The results are given in table 4.5 and 4.6

Table 4.5

*Correlation between the academic performance and aided audiological abilities (threshold at 500 kHz, 1kHz, 2kHz and 4kHz for both the ear in two terms i.e. December 2014 and April 2015.*

Term 1: December 2014 and Term 2: April 2015									
SKILL /Terms		RIGHT EAR				LEFT EAR			
		500 Hz	1kHz	2 kHz	4 kHz	500 Hz	1 kHz	2 kHz	4 kHz
PA Term 1	Pearson correlation	-0.05	-0.05	-0.05	0.00	-0.31	-0.31	-0.28	-0.17
PA Term 2	Pearson correlation	-0.46	-0.63	-0.39	-0.03	-0.13	-0.31	-0.22	0.03
Lang Term 1	Pearson correlation	0.29	0.18	0.35	0.36	-0.14	0.04	0.05	0.26
Lang Term 2	Pearson correlation	-0.43	-0.45*	-0.32	-0.18	-0.26	-0.16	-0.11	-0.04
COG Term 1	Pearson correlation	0.01	0.09	0.16	0.06	-0.08	-0.05	0.05	0.02

COG Term2	Pearson correlation	-0.53*	-0.50*	-0.31	0.05	-0.13	-0.12	-0.24	-0.02
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\*Significant at 0.05 level

From the table 4.5 it can be observed that the pre-academic and cognitive skills of term 2 were related significantly ( $p < 0.05$ ) with aided thresholds at 500Hz and 1 kHz of right ear. The language skills in term 2 were significantly related with 1 kHz of right ear. However, for all three skills there was no relation found for aided thresholds across frequencies for first term. For the left ear there was no relation found for any of the skill for both the ears for both the terms.

Table 4.6

*Correlation between aided thresholds for identification of ling sounds - /a/, /i/, /u/, /s/, /sh/, /m/ and the academic performance for both the ear in two terms i.e. December 2014 and April 2015.*

<b>First term : December 2014</b>							
Speech sounds	Statistics	Right Ear			Left Ear		
		COG	LANG	PA	COG	LANG	PA
/a/	Pearson Correlation	-0.53*	0.02	-0.58*	-0.20	0.09	-0.42
/i/	Pearson Correlation	-0.33	0.13	-0.47*	-0.09	0.35	-0.45
/u/	Pearson Correlation	-0.10	0.31	-0.24	-0.20	0.23	-0.38
/s/	Pearson Correlation	0.01	0.48*	-0.20	0.11	0.48*	-0.19
/sh/	Pearson Correlation	-0.00	0.34	-0.25	0.23	0.57*	-0.13
/m/	Pearson Correlation	-0.07	0.25	-0.40	0.04	0.26	-0.19
<b>Second term: April 2014.</b>							
Speech Sounds	Statistics	Right Ear			Left Ear		
		COG	LANG	PA	COG	LANG	PA

/a/	Pearson Correlation	-0.33	-0.35	-	-0.38	-0.45*	-0.31
/i/	Pearson Correlation	-0.33	-0.34	-	-0.21	-0.43	-0.21
/u/	Pearson Correlation	-0.25	-0.39	-	-0.26	-0.40	-0.25
/s/	Pearson Correlation	-0.37	-0.24	-0.34	-0.37	-0.58*	-
/sh/	Pearson Correlation	-0.28	-0.25	-0.24	-0.13	-0.31	-0.14
/m/	Pearson Correlation	0.05	-0.39	-0.30	-0.19	-0.36	-0.18

\*Significant at 0.05 level

As it is evident from table 4.6 that for the term 1, there was a significant correlation for the sound /a/ of right ear with cognitive skills and pre-academic skills; /i/ with pre-academic skills. The sound /s/ of the right and left ear related significantly with language skills. There was no relation found for the sound /a/ of the left ear; /i/,/u/,/m/ of both the ears for any of the academic performance.

As it is evident from table 4.6 that for the term 2, there was a significant relation for the sounds /a/,/e/,/u/ of the right ear with pre-academic skills. The /a/ of the left ear correlated with language skills. The sound /s/ of the left ear correlated with language and pre-academic skills. However, the sounds /i/ and /u/ of left ear had no relation with any of the skills, and the sounds /sh/ and /m/ of both ears has no relation with any of the academic skills.

As the speech identification responses were obtained for only 6 children for right ear and 5 children for left in first term, the correlation test could not be carried out. For these children the speech identification responses were found to be good

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(18/25) i.e. about 72% for right ear for first and second term and for the left ear during first term and also they had better performance in all the three academic skills.

## **DISCUSSION**

The objectives of the study focused to find the relation between aided audiological abilities and academic performance of the children with hearing impairment. The academic performance covers the achievement in the areas of pre-academic, language and cognitive skills. Similarly, the aided audiological abilities include thresholds at 500 Hz, 1 kHz, 2 kHz and 4 kHz, thresholds for identification of ling's sounds (/a/, /i/, /u/, /s/, /sh/ and /m/). For the academic skills - pre-academic, language and cognitive skills, the performance of all the children with hearing impairment is better.

Whereas the aided audiological abilities also lies within the speech spectrum. That means aided hearing ability has the influence on the performance at school in day to day classroom activities. Because, for the performance of all these activities, hearing ability is the basic requirement. The degree of improved hearing provided by hearing aids was associated with better speech and language development in children. In addition, the duration of hearing aids experience interacted with the aided hearing to influence outcomes (Tomblin, Oleson, Ambrose, Walker & Moeller 2014).

Even though, academic performance correlated with the aided abilities, there are various other factors like regular drill work done by the special educators at school and also by caregivers at home for a particular skill to develop among children. Also the type of training received in the pre-school, the suitable method of teaching followed by special educator, duration of the pre-school training and stages of special education services before entering into pre-school like parent infant programme (PIP),

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Preschool parent empowerment programme (PPEP) also affects the children's performance. Children with hearing impairment who attended a formal Parent Infant Programs showed better pre-school performance in academic (Chatterjee, Mishra 2004).

The correlation between pre-academic and cognitive skills with aided threshold at 500Hz and 1 kHz of right ear for the second term could be due to better threshold obtained at these frequencies compared to other frequencies. The improvement in performance noticed during second term compared to first term could be due to training of specific skills individually, the consistent training received during three years of pre-school training. One more reason could be the curriculum used in the pre-school training is based on the development of language, speech and communication skills in general which gives the scope to utilize the audiological capacity of the children effectively. Hence, the child is highly motivated to respond to these aspects in a better way. The better relation obtained for right ear compared to left ear could be due to right ear advantage that is the stimulus presented in right ear is processed in the left hemisphere. However, during pre-school training children use binaural hearing aids. And hence the performance becomes better with the same.

Children with all categories of hearing loss who were fit with hearing technology and who received auditory based rehabilitation services during the pre-school years demonstrated the potential to develop spoken language communication skills (Fitzpatrick, Crawford, Durieux-Smith 2011).

The aided identification of /a/,/i/,/u/ and /m/ sounds were observed to be better compared to /s/ and /sh/ sounds could be due to the better responses obtained at 500 Hz and 1kHz which are of low frequencies. With respect to speech

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identification responses the responses were found to be good for right ear (72%) for both the terms and for the left ear during first term. This observation was noticed only for 6 children (right ear), and 5 children for left ear. The reasons for poorer responses obtained for speech identification scores for remaining children could be due to late identification of hearing loss, in consistency in attending therapies or not availing early intervention services before pre-school training or poor parental involvement in training process.

Further, correlation was seen between the individual speech sound and the performance of academic skills. /a/ of right ear for first term has correlated with cognitive and pre-academic skills. /s/ of right and left ear related with language skill. However no relation was found for /a/ of left ear and /i/, /u/, /m/ of both ears for any of the academic performance. For the term 2 significant relation was found for the sound /a/, /i/, /u/ of the right ear with pre-academic skills, /a/ of left ear with language skills, /s/ of left ear with language and pre-academic skills.

The academic performance of term 2 has significant relation with most of the sounds compared to term 1. This could be because of pre-academic skills which includes the pre-reading, pre-writing and pre-arithmetic activities, which focuses to teach the alphabets in isolation level and word level. Hence there is opportunity for a child to use the auditory ability. Further the activities or the syllabus carried out in pre-school teaching focuses the language concept related to words and grammatical aspects which most children come across in their day to day life. Also it is known fact that words and grammatical rules are made-up of basic alphabets and pre-academic activities entirely depends upon the development of knowledge about the alphabet, words identification, comprehension. It also clarifies that the perceptual abilities and academic performance has impact on each other, because pre-reading and pre-writing

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covers the perceptual abilities in four areas like– visual, auditory, kinaesthetic and tactile. Dhingra, Manhas and Kohli (2010), reported that the whole academic performance was significantly correlated with three perceptual abilities – visual, auditory and kinaesthetic. When considered separately, reading and spelling both were significantly associated not only with one another but also the three already mentioned perceptual areas.



## **Summary & Conclusion**

The present study titled, 'Relationship between aided audiological abilities and Academic achievement of children with hearing impairment' and aim of the study was to find the Relationship between Aided Audiological abilities and academic achievement of children with hearing impairment. The purpose of the study was to find how the aided audiological abilities are helpful in academic achievement of children with hearing impairment

### **5.1 Objectives of the study**

- To find the Relationship between aided Audiological abilities and achievement of pre-academic skills among children with hearing impairment.
- To find the Relationship between aided Audiological abilities and achievement of Language skills among children with hearing impairment.
- To find the Relationship between aided Audiological abilities and achievement of cognitive skills among children with hearing impairment.

### **5.2 Method of the study**

- The present study is probing the consecutive period's academic performance of children with hearing impairment and also the aided audiological evaluation of those children. It is also focused to relate between both the variables. Hence, a time series descriptive research design is followed. A purposive sample of 20 children with hearing impairment of AIISH Pre-school who were completed the third year of
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pre-school training for the two terms i.e. academic year June 2014 to April 2015; December 2014 and April 2015 were included in this study. The relationship between aided audiological abilities and academic achievement was compared by using SPSS Version 17. Descriptive statistics was done to obtain the Mean and standard deviation for academic performance and aided audio logical abilities. Pearson's correlation was done to find the relation between the academic performance and aided audiological abilities.

### **5.3 Findings of the study**

- The academic performance of children with hearing impairment is observed to be very good for all the three skills. It is also seen that there is no difference in academic performance for all the three skills for both the terms. For the academic skills - pre-academic, language and cognitive skills, the performance of all the children with hearing impairment is better. But it also shows that there is influence of other aspects like type of training at pre-school, method of teaching particular skills, parental involvement in training etc.
  - The overall aided thresholds are noticed to be within speech spectrum for both right and left ears for both the terms. The aided thresholds at 500Hz and 1 kHz are shown to be better compared to 2 kHz and 4 kHz for both the ears and both terms, however, the threshold are noticed to be better at 2 kHz for right ear during second term. That means aided hearing ability has the influence on the
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performance at school in day to day classroom activities. Because, for the performance of all these activities, hearing ability is the basic requirement.

- The aided ling's sounds identification is shown to be within the speech spectrum for all the sounds. However, the sounds /a/, /i/, /u/ and /m/ is observed to be better i.e. the responses are obtained at lower intensity level compared to /s/ and /sh/ in both the ears for both the terms.
- The pre-academic and cognitive skills of term 2 were related significantly ( $p < 0.05$ ) with aided thresholds at 500Hz and 1 kHz of right ear. The language skills in term 2 were significantly related with 1 kHz of right ear. The better relation obtained for right ear compared to left ear could be due to right ear advantage that is the stimulus presented in right ear is processed in the left hemisphere. However, during pre-school training children use binaural hearing aids. And hence the performance becomes better with the same.
- For the term 1, there was a significant correlation for the sound /a/ of right ear with cognitive skills and pre-academic skills; /i/ with pre-academic skills. The sound /s/ of the right and left ear related significantly with language skills.
- For the term 2, there was a significant relation for the sounds /a/, /i/, /u/ of the right ear with pre-academic skills. The /a/ of the left ear correlated with language skills. This could be because of pre-academic skills which includes the pre-reading, pre-writing and pre-arithmetic activities, which focuses to teach the alphabets in isolation level and word level. Hence there is opportunity for a child to use the auditory ability.

#### **5.4 Implications of the Study**

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- Results can be used by the special educators, parents to understand their children's aided audiological abilities and academic performance in a better way.
- Special educators can use these results to recommend children for further stage of learning, periodical follow up for aided audiogram.
- Teachers can use the aided audiological abilities of every child while planning for training in particular skill.
- Results can be used to change the hearing aid technology for the better performance of the children with hearing impairment.

### **5.5 Recommendations**

- The study can be conducted in other special schools.
- The similar study can be conducted at different level of schooling, like pre primary, primary.
- Study can be conducted particular subjects like mathematics, social science, science, language etc.

### **5.5 Limitation of the study**

- The study covers only the pre-school children from AIISH.
  - This study included only 5-6 year old children.
  - The study considered only those children who were completed 3 years of pre-school training.
  - Sample size was less.
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