STUDY OF NON VERBAL IQ AMONG CONGENITALLY DEAF CHILDREN

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Background & Objectives: A person's intelligence depends on his capacity to understand his impulses as quickly as possible and direct his behaviour. Hearing gives a child the acoustic correlates of physical world. The primary consequence of childhood deafness is that it blocks the development of spoken language. However due to cross modal plasticity, when auditory information is unavailable, the brain allocates more of its resources for processing visual information. The Objective of the present study was to test non verbal IQ in congenitally deaf children using Raven's Standard Progressive Matrices and compare its results with those obtained in normally hearing subjects. **Materials and Methods:** 30 congenitally deaf children and 30 normally hearing subjects aged between 10-14 yrs were tested for non verbal intelligence using Raven's Standard Progressive Matrices. **Results:** The findings of the present study revealed higher IQ scores among congenitally deaf children compared to their normal counter parts. **Conclusion:** Since childhood deafness has diverse effects on children's cognitive development early intervention by restoring the damaged auditory input and the development of all the neuropsychological abilities linked to hearing need to be done.

Key Words: Congenitally deaf, Non verbal IQ, Raven's Progressive Matrices

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Introduction:

"Intelligence" is a term which is so commonly used though difficult to define in a precise and generally accepted from. It is multi-faceted and reflected in the coordinated performance of numerous language and non-language tasks including perception, memory, mental imagery, concept formation, problem solving,language learning and academic achievement. [1] It is a composite construct involving various variables including age, educational level, social level, environmental stimulation, educational level of parents and genetics[2].A person's intelligence depends on his capacity to understand his impulses as quickly as possible thus directing his behaviour. Sensory perception is a determinant of neurological development. Sensory inputs not only participate in a simple additive way but also has a reciprocal influence as it synergistically modulates the building of neural networks[3]. Hearing is the sensory modality through which the child perceives speech that link individuals,families and societies together. It gives the child the acoustic correlates of the physical world. Children born with bilateral hearing loss which is severe (70–89 dB loss) or profound (>90 dB loss) are generally referred to as deaf. The primary consequence of childhood deafness on neuropsychological development is that it blocks the development of spoken language. [4]Since human mind is characterized by enormous linguistic creativity, group of people when deprived from auditory language; spontaneously tend to use visual clues. Also due to phenomenon of cross modal plasticity, when auditory information is unavailable, the brain allocates more of its resources to the processing of peripheral visual information.[3] Visual skills that typically benefit from cross-modal auditory information in hearing individuals, such as processing of peri-personal and peripheral space, may be more likely to reorganize after early deafness. This would enable deaf individuals to attain similar performance levels as hearing individuals while relying on only one modality, i.e. vision, rather than two, i.e., vision and audition. An alternative view holds that compensatory plasticity enhances many aspects of the remaining modalities, with deaf individuals possibly displaying enhancement on a wide range of visual skills. In the absence of audition, the remaining modalities, and in particular vision, are put under increasing demands, leading to the expression of use-dependent plasticity in visual functions[5]. Although the majority of neural connections in humans are patterned during fetal development, refinement of neural organization depends on sensory information received from the world around us during childhood as a product of neural activity and synaptic transmission.[6]Deaf individuals usually rely on visual input for communication, by supplementing oral communication with lip reading . Since the deaf children must rely on vision to figure out the world to a much greater extent ,they might not show the same level of difficulty for visual images as compared with hearing children. Research performed by parasnis and samar in 1982 reveled that visual attentional mechanism in deaf is organized differently than in hearing people due to their increased reliance on the visual modality for alerting and analysis functions. Later from the study in 1985 it was found that deaf signers were superior to hearing nonsigners in redirecting their visual attention in tasks that stress the attentional system performance.[7]Intelligence tests were originally devised to predict academic performance thus lower than average academic achievement of the deaf population relative to the hearing population was correlated with lower than average IQ[1]. Nonverbal intelligence tests measure skills like perceptual organization, abstract reasoning and problem solving, and they assess intelligence without the need for verbal language on the part of the examiner or the examined. These tests are useful for the assessment of individuals who have cultural, verbal or severe motor impairments that may lead to significant errors in IQ scores when assessed using traditionally administered tests. Although studies suggest that the mean nonverbal IQ of the deaf population approximates that of the hearing population[8,9], some researchers say that the strength and weakness of performance IQ in the deaf population are not identical to those of the normally hearing population . Few researchers have found that people with congenital deafness but no neurological impairment have normal general intelligence and few others have found visuospatial processing to be enhanced. Due to differences in the opinion from various studies the present study is an attempt to compare the results of the non verbal IQ in congenitally deaf children using Raven's Standard Progressive Matrices with those obtained in normally hearing subjects.

Materials And Methods:

The study included 30 congenitally deaf children from Victory boarding school of hearing impaired,setty palle ,Kuppam and 30 normally hearing subjects from Government primary school, Rallabudagur, Kuppam aged between 10-14 yrs. Subjects with history of externalizing disorder, emotional disturbances and any other psychological disturbances were excluded from the study.The study was conducted after obtaining permission from the principal of the concerned school and chairman of victory boarding school of hearing impaired. The ethical clearance was obtained from PES Institute of Medical Science and Research, Kuppam prior to the collection of data .

Each subject were tested for non verbal IQ using Raven's Standard Progressive Matrices (SPM), published in 1938, [10]which is a performance based test that tests the person's capacity at that time to apprehend meaningless figures presented for his observation, see the relation between them, find out the nature of the figure completing each system of relations presented, and, by doing so, develop a systematic method of reasoning. The scale consists of 60 problems divided into five sets of 12. In each set the first problem is as nearly as possible self-evident, the problems which follow become progressively more difficult. The order of the items provides opportunity for progressive assessment of a person's capacity in intellectual activity. Internal consistency of the scale was reported by Dolke and Sharma in which the score ranges from 0.87-0.93 as mentioned in one of the article [11].

After thorough history taking and detailed examination to rule out systemic and psychiatric illness, record forms were distributed to the individuals and instructions regarding filling of particulars about themselves in the record form was explained. When this was done, the test booklet and answer sheets were given out. Followed by it the subjects were briefed about the procedure of the test. A demo picture was displayed for the group to see and instructions were given in the following sequence "At the top you have set A and you have a column here, on your answer sheet, for set A, the first box is A_1.In this page you can see that a portion of pattern is missing and in each of these pieces given below is the right shape to fit in the space and complete the whole design, but other forms do not fit into the pattern to complete the design. Similarly on every page in the book there is a pattern with a portion missing. For each one decide which of the portion below is the right one to complete the pattern above. When the right one is found enter the number down in the answer sheet

.The patterns seem to be simple at the beginning and gets harder as it goes on. Try each in turn, from the beginning right to the end of the book. Work at your own pace as there is no time limit. For deaf individuals instructions regarding the procedure which was employed for testing IQ scores was given through sign language by their class teachers along with the sample test. Sufficient time was given for completing the task.SPM scores were obtained after correcting the record forms and was then converted to IQ scores using the table designed by Arthur R J[12]

Results:

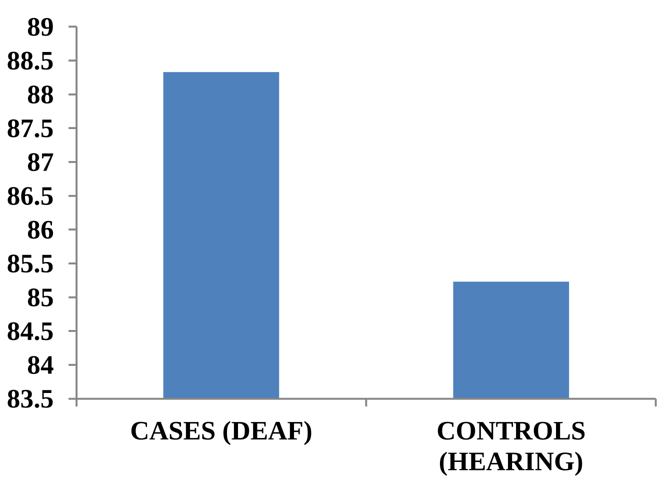
The results were expressed as Mean±SD and analyzed using Student's unpaired t-test for comparison of means. 'P' value of less than 0.05 was considered significant.

TABLE 1: **IQ SCORES IN CONGENITALLY DEAF AND NORMALLY HEARING CHILDREN**

	Cases	Controls	P Value
IQ SCORES	88.33 $\pm$5.30	85.23 $\pm$6.40	0.045*

***significant**

GRAPH 1: **IQ SCORES IN CONGENITALLY DEAF AND NORMALLY HEARING CHILDREN**



Discussion:

Sensory perception is a determinant of neurological development. Deafness also affects neuropsychological and motor development. Studies suggest that people with congenital deafness but no neurological impairment have normal general intelligence and children who are deaf due to hereditary causes are less likely to have additional handicaps. However, there are some subtle differences. Hemispheric representation is atypical for speech production and visuospatial processing among deaf individuals.[13,14] The differences in neural processing between deaf and hearing groups can be found in specific aspects of spatial cognition. The findings of the present study reveals higher IQ scores among congenitally deaf children compared to their normal counter parts.Higher scores may a consequence of appropriate educational experiences at the appropriate young age despite often severe language delay. The present study is in agreement with studies by the Leiter, and the Hiskey in which average performance IQ for the general hearing population was 100. Mean nonverbal IQ for deaf children with *no* additional handicap was 100.1 and findings of Braden who performed meta-analysis of 285 studies that together tested171,517 deaf students from 1900–1988 and found that mean nonverbal performance IQ across the studies was 97.4 with a SD of 15.33.One of the important finding in this study was that the mean nonverbal IQ increased as the study publication date increased. [4] This improvement in IQ test scores may be due to better awareness of the special needs of deaf children in recent years. Studies using functional magnetic resonance imaging to measure visually evoked activity in auditory areas of individuals who were deaf at an early age and hearing individuals releaved that deaf subjects exhibit activation in the region of the right auditory cortex, corresponding to Brodmann's areas 42 and 22, as well as in area 41 (primary auditory cortex), demonstrating that early deafness results in the processing of visual stimuli in auditory cortex.[15] Studies related to visual perception has led to controversial results. One aspect of vision that has been reliably documented to be enhanced following auditory deprivation is enhanced peripheral visual processing.[16]This would enable deaf individuals to attain similar performance levels as hearing individuals while relying on only one modality mainly vision.

While deaf individuals do display differences in visual attention, it is important to note that not all aspects of vision are different in deaf and hearing people.

Considerable evidences accumulated till now suggests that deaf signers display advantages over hearing people on a wide variety of visual spatial tasks. Enhanced abilities have been reported for mental rotation [17]for imagery [18] and motion detection in peripheral vision[19] There is also some evidence that deaf signers exhibit enhanced ability to generate relatively complex images and to detect mirror image reversal. [20]This may be due to the differences in neural processing between deaf and hearing groups in specific aspects of spatial cognition.

Several investigators have also observed that a subset of the deaf population show higher than average performance on nonverbal IQ tests. In a study of more than 1000 deaf students, Sisco and Anderson observed that deaf students who had deaf parents outperformed their deaf peers who had hearing parents .[21] Several explanations have been proposed to account for the higher than average nonverbal IQ shown by deaf children raised in deaf families. One such hypothesis is *genetic* hypothesis, which argues that at least half of intelligence is inherited and till illdate, 80 loci for non syndromic hearing loss have been mapped and more than 30 genes which is known to cause deafness have been identified.[22]

The second explanation, which is called the *early learning* hypothesis, emphasizes the impact of the child's early environment on cognitive development. The third hypothesis suggests that the effect relates to the physical form of the language being learned in early childhood with the view that learning a visuospatial, or three-dimensional grammar boosts the child's visual and spatial abilities to higher than average levels .[4]

Another possible explanation for the higher than average nonverbal IQ of genetically deaf individuals was investigated by Braden who tested the performance of genetically deaf, non genetically deaf, and normally hearing using the Ravens Progressive Matrices. The performance of the genetically deaf and hearing groups did not differ on the Ravens Progressive Matrices but the non genetically deaf group performed at a lower level[23] which is in agreement with the present study involving congenitally deaf individuals.

Limitations of our study:

The study involves a small group comprising of 60 subjects. Further studies involving a larger group of deaf individuals and use of various scales for measuring intelligence may be required for better understanding of various factors that affect the performance of an individual .

Conclusion:

Human brain is remarkably flexible and is not fooled by superficial differences in sensory form. Childhood deafness has diverse effects on child's cognitive development as a function of early access to language, family and educational environments. Although auditory impairment does not cause pathological delay in the nonverbal development as per our observations,it does produce difference in certain neuropsychological functions. Therefore early intervention by restoring the damaged auditory input and the development of all the neuropsychological abilities linked to hearing need to be done

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