

Significance of Neurolinguistic Approach to Brain Abnormalities Perceived by Magnetic Resonance Imaging (MRI) among Children with Language and Behavioral Disorders: A Cross Sectional Descriptive Observational Study

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Abstract

Introduction: Language and behavioral disorders result from abnormal brain development interfere with the child's language development. When language development impair than behavioral disorders arises. In this perspective, Magnetic Resonance Imaging (MRI) analysis can help to identify the causes of these disorders, allowing them to be correlated with clinical symptoms for early diagnosis and intervention.

Objective: The aim of this study is to observe the significance of MRI analysis of children with language and behavioral disorders who have brain abnormalities.

Methodology: This is a cross-sectional descriptive study, with a neurolinguistic approach was conducted during the period from January 2022 to January 2023 at the Department of Psychiatry, Z.H. Sikder Women's Medical college and hospital patient attending with the language and behavioral disorders with MRI report.

Result: This study shows that the average age of the interviewees was 6.28 ± 1.7 years old in the range of 3 to 12 years. Most of them (60%) were 6 to 10 years old male were predominant (72%). Depending on the finding of brain abnormalities perceived by MRI. Most of the children (64%) had injury in the cerebral cortex with hypo or hyper intensities of isolated parenchyma, 28% children had cerebral atrophy with ventriculomegaly and 0.8% children had no abnormality in brain MRI report, among them speech/phonetic and phonological disorder was (42%), receptive/perceptive disorder were present among (58%) children and inability to communicate according to the social situation and context (84%). Children showed behavioral problems as due to abnormal brain developments. Inattention and hyperactivity with microcephaly (74%), deficit in intellectual and adaptive functioning with cerebral palsy were (56%), childhood depression with phonetic and phonological disorder were (52.0%), specific learning disorder in (65%) children, intellectual developmental disorders with microcephaly also impulsivity and hyperactivity in (76%) children. The relationship in brain abnormalities perceived by MRI and clinical symptoms of language and behavioral disorders were significant $P < 0.05$.

Conclusion: Abnormalities within the brain often come along with language and behavioral disorders. Therefore, meticulous history and magnetic resonance imaging analysis in brain abnormalities offers clues to evaluate and explain the phenomenology of these disorders for early and accurate diagnosis and allows for planning and initiation of speech language therapies that improve prognostic outcomes. This work makes a pioneering neurolinguistic approach in Bangladesh further large-scale studies are needed to better visualize the extent of the problem.

Keywords: MRI analysis; Brain abnormalities; Language and behavioral disorders; Neurolinguistics; Bangladesh

Introduction

The neurolinguistic analysis of magnetic resonance of the brain structure associated with language and behavioral development provides an opportunity to identify neurobiological bases of language and behavioral impairment [1]. The investigation through the analysis of magnetic resonance imaging, which provides images of soft tissues, blood vessels and other internal structures at the deepest level [2]. This research associates brain abnormalities with speech language and behavioral problems endeavor to evaluate the linguistic process as a whole from the perception of stimuli to their processing in the central cognitive system [3]. Speech and language disorders are two related conditions. Children acquire language acquisition from intrauterine life through the development of the nervous system and also sensory skills, already in the environmental exposure after birth, there is an important neuro-development period at the age of 5 to 6 years old [4,5]. Language disorders refer to speech/expressive language disorders represent abnormalities present in the brocas area more specially

related to articulation disorders such as motor errors, verbal execution or phonetic and phonological errors, receptive/conceptual (wernicke's area) and socialization (pragmatic) disorders. The detection of language disorders depends on which aspect of language processing is most

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Received: 22-Feb-2024, Manuscript No. JADP-24-128036; **Editor assigned:** 26-Feb-2024, PreQC No. JADP-24-128036 (PQ); **Reviewed:** 11-Mar-2024, QC No. JADP-24-128036; **Revised:** 18-Mar-2024, Manuscript No. JADP-24-128036 (R); **Published:** 25-Mar-2024, DOI: 10.4172/2161-0460.1000592

Citation: Ferdous F, Monte-Serrat DM, Nabi S (2024) Significance of Neurolinguistic Approach to Brain Abnormalities Perceived by Magnetic Resonance Imaging (MRI) among Children with Language and Behavioral Disorders: A Cross Sectional Descriptive Observational Study. J Alzheimers Dis Parkinsonism 14: 592

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impaired (syntax, semantics). The impairment of the development of the nervous system can be linked to affected speech or language than behavioral problems arises, such as aggression, impulsivity and hyperactivity, depression and anxiety [6-13]. Neuroimaging studies can serve to identify pathogenesis and pathological changes due to damage in different parts of the brain structure, justifying clinical symptoms [14,15]. Magnetic resonance imaging is a valuable technique for the neurolinguistic study of the brain representation of disorders related to neurological causes (brain trauma during pregnancy, epilepsy) and explain the clinical presentation in a new way [16-18].

There is a significant burden found in the children with language and behavioral disorders in brain abnormalities. Thus, MRI analysis through neurolinguistic approach has a significant role for early diagnosis and intervention. Although these domain are still unnoticed in Bangladesh.

Therefore, the objective of the study is the significant of brain abnormalities perceived by MRI among children with language and behavioral disorders following the basis of the neurolinguistic approach.

Materials and Methods

Search strategy and selection criteria

This cross-sectional study was conducted at the Department of Psychiatry at Z.H. Sikder Women's Hospital and Medical college and hospital, Dhaka, Bangladesh. 110 children under went this study 75 children met the inclusion criteria: (i) Age group between 3 to more than 10 years, both sexes; (ii) With a history of language and behavioral disorders; (iii) Brain MRI report also record were obtained along with information about the children, during the antenatal and intrapartum period, the problems of growth and maturity of the fetus, position of the placenta, amniotic fluid volume the record of antenatal and intrapartum diseases, the type of delivery and its duration, maternal medical condition (malnutrition, post dated pregnancy, Toxoplasmosis, Rubella Cytomegalovirus, Herpes simplex and (Human Immunodeficiency Virus (HIV)) (TORCH) infection, chorioamnionitis) during childbirth; (iv) Children with vision and hearing abilities with in normal limits as documented by either formal audiovisual evaluation or screening. Children were recruited from the Out Patient Department (OPD). Purposive sampling method was used for the selection of cases during the period of January 2022 to January 2023. The protocol of the study was approved by institutional ethical committee and informed consent was obtained from the parents or authorized representative of each child.

All participants diagnosed clinically, assessment with an experienced clinical linguist/speech language specialist, psychiatrist, neurologist, radiology and imaging specialist. This researcher informed them that all data obtained will be kept confidential and that they could withdraw from the research at any time, whenever they wished.

All children who had a clinical diagnosis of language and behavioral disorders associated with brain MRI report. Imaging finding clinically co-related with finding:

Multiplexer and multisequences without contrast which included saggital T1, Axial Fluid Attenuated Inversion Recovery (FLAIR), axial diffusion and Apparent Diffusion Coefficient (ADC), Gradient Echo (GRE) and axial transverse relaxation time (T2), coronal. T2 sequences had abnormalities, longitudinal relaxation time (T1) had hypo intensities and T2, FLAIR hyperintensities in isolated parenchymal injury in the cerebral cortex, some report had ventricular dilatation with cerebral atrophy. MRI report susceptibility weighted images and functional

MRI fiber-tracking technique were used to map re-organization of the linguistic functions, made by a radiology and imaging specialist.

Abnormalities in MRI result sod some children are related to: a hyperintense area was found in the frontal lobe (broca's area or area 44, 45) which is an area responsible for expression of language. Abnormalities found in this area represent that expressive/speech disorders are more specially related to articulation disorders such as motor errors, verbal execution or phonetic and phonological errors of language. In the temporal lobe, wernicke's area is responsible for the perception, interpretation and understanding of visual and auditory linguistic information.

The research instruments were: a pre-elaborated structured questionnaire, developed for caregivers used by speech language specialist for the diagnosis of the speech and pattern of language disorders, the Diagnostic and Statistical Manual-5 (DSM-5) attentive by psychiatrist for diagnosis of the language with behavioral disorders, brain MRI report describe by the radiology imaging specialist. After finding this pathology association was done from a neurolinguistic perspective.

Exclusion criteria

Previous history of meningitis or encephalitis, vision and hearing disorders, social deprivation, neurodevelopmental disorders and other psychiatric disorders were considered as exclusion criteria.

Limitation of the study

Limitations for the study were observed, for example, the cases in which the patient, caregiver (mainly the mother) was undergoing treatment far from the city of Dhaka, hampered their daily work during travel to Dhaka city and the follow up journey, having faced many challenges due to lack of funding for their trips and another difficulty is the low education level of the caregiver, which limits the data collection procedure.

Results

The duration of study was one year. Participation rate 75 patients.

The average age of the respondents was 6.28 ± 1.7 years old within the range of 3 to 12 years old. Among the 75 enrolled children, most of them (60%) were 6 to 10 years old and the remaining (36%) were 3 to 5 years old. 4% were >10 years old. Male were predominant 72% than female 28%. Most children (56%) lived in rural areas and their most of the parents were illiterate (54%) (Table 1).

| Demographic distribution (N) | Frequency (n) | Percentage (%) |
|--|---------------|----------------|
| Age (years) | | |
| 3-5 | 27 | 36 |
| 6-10 | 45 | 60 |
| >10 | 3 | 4 |
| Mean \pm standard deviation=6.28 \pm 1.7 | - | - |
| Min - Max=3.00 - 12.00 | - | - |
| Gender | | |
| Male | 54 | 72 |
| Female | 21 | 28 |

| Habitant | | |
|------------------------|----|----|
| Rural | 42 | 56 |
| Urban | 33 | 44 |
| Parents education | | |
| Illiterate | 43 | 54 |
| Primary (class-V) | 21 | 22 |
| Secondary (class-VIII) | 7 | 14 |
| SSC | 4 | 10 |

Note: SSC: Secondary School Certificate.

Table 1: Demographic distribution of the patients (N=75).

All children have an clinical diagnosis of language disorders and behavioral problems. Among them most of the children 64% had hyper or hypo intensities of isolated parenchymal injury found in the cerebral cortex and 28% had cerebral atrophy with ventriculomegaly. 8% children had no abnormality (Table 2).

| | Frequency (n) | Percentage (%) |
|--|---------------|----------------|
| Structural lesion present in hypo and hyper intensities of isolated parenchymal injury in the cerebral cortex. | 48 | 64 |
| Cerebral atrophy with ventriculomegaly. | 21 | 28 |
| Brain abnormality absent. | 6 | 8 |

Table 2: MRI analysis of brain according to preferential structural lesion (N=75).

The fisher's exact test was done. All children were clinically diagnosed with language disorders with behavioral problems. Among 69 children with brain abnormalities findings present in MRI, 57 children longitudinal relaxation time had conceptual/perceptive/receptive language developmental disorders. The association between receptive language development disorder (clinical symptoms) with brain abnormalities findings was significant ($p < 0.05$) (Table 3).

| (Conceptual/perceptive disorder) | MRI of brain | | p-value |
|----------------------------------|-------------------------------------|-------------------------------------|---------|
| | Pathological finding present (n=69) | Pathological finding absent (n=06) | |
| Present (57+2)=59 | 57 (82.6) | 2 (33.3) | 0.015 |
| | Receptive language disorder=Present | Receptive language disorder=Present | |
| | Pathological finding in MRI=Present | Pathological finding in MRI=Absent | |
| Absent (12+4)=16 | (69-57)=12 | (06-02)=04 | |
| | Receptive language disorder=Absent | Receptive language disorder=Absent | |
| | Pathological finding in MRI=Present | Pathological finding in MRI=Absent | |
| Total children =75 | Total children=69 | Total children=06 | |

Table 3: Association between brain abnormalities perceived by Magnetic Resonance Imaging (MRI) and domain of language disorder (conceptual/perceptive language disorder).

The fisher's exact test was done. All the children were clinically diagnosed with language disorders and behavioral problems. Among them 69 children had pathological findings in MRI, (42%) children had clinical symptoms of expressive/speech language developmental disorder. Expressive/speech/phonetic and phonological language development disorder was found significant among children with language and behavioral problems with brain abnormalities perceived by MRI ($p < 0.05$) (Table 4).

| Expressive/speech/phonetics and phonological language development disorder | MRI of brain | | p-value |
|--|--------------------------------------|--------------------------------------|---------|
| | Pathological finding present (n=69) | Pathological finding absent (n=06) | |
| Present (68+4)=72 | 68 (98.6) | 4 (66.7) | 0.0001 |
| | Expressive language disorder=Present | Expressive language disorder=Present | |
| | Pathological finding in MRI=Present | Pathological finding in MRI= Absent | |
| Absent (02+01)=03 | (69-68)=01 | (06-04)=02 | |
| | Expressive language disorder=Absent | Expressive language disorder=Absent | |
| | Pathological finding in MRI=Present | Pathological finding in MRI=Absent | |
| Total children=75 | Total children=69 | Total children=0 | |

Table 4: Association between brain abnormalities findings perceived by Magnetic Resonance Imaging (MRI) and domain of expressive/speech/phonetics and phonological language disorder.

The fisher's exact test was done. Among 69 children with brain abnormalities findings present in MRI report, 84% children had clinical symptoms of communicative competence/sociolinguistic development disorder and this finding had significant association between disorders children with brain abnormalities findings ($p < 0.05$) (Table 5).

| Communicative competence / sociolinguistic development disorder | MRI of brain | | p-value |
|---|--|--|---------|
| | Pathological finding present (n=69) | Pathological finding absent (n=06) | |
| Present (54+02)=56 | 54 (78.3) | 2 (33.3) | 0.015 |
| | Sociolinguistic development disorder=Present | Sociolinguistic development disorder=Present | |
| | Pathological finding in MRI=Present | Pathological finding in MRI=Absent | |
| Absent (15+04)=19 | (69-54)=15 | (06-02)=04 | |
| | Sociolinguistic development disorder=Absent | Sociolinguistic development disorder=Absent | |
| | Pathological finding in MRI=Present | Pathological finding in MRI=Absent | |
| Total children=75 | Total children=69 | Total children=06 | |

Table 5: Association between brain abnormalities findings perceived by Magnetic Resonance Imaging (MRI) and domain of communicative competence/sociolinguistic development disorder.

Linguistic disorders were present among children with brain abnormalities perceived by MRI was speech disorder (42%) and receptive/perceptive were present among (58%) children. Due to speech and disorder of reception/perception evidencing inability to communicate according to the social situation and context (84%) (Table 6).

| | Frequency (n) | | Percentage (%) | |
|---|---------------|--------|----------------|--------|
| | Present | Absent | Present | Absent |
| a) Speech/phonetics and phonological disorders. | 21 | 29 | 42.0 | 58.0 |
| b) (Conceptual/perceptive disorder) unable to competence in memory academic performance, acquisition of practical knowledge. | 29 | 21 | 58.0 | 42.0 |
| c) (Communicative competence disorder) involves impairment awareness of others thoughts, feelings, experiences; empathy: interpersonal communication skills; friendship abilities and social judgment among others. | 70 | 5 | 84.0 | 16.0 |

Table 6: Pattern of language disorders were present among children with brain abnormalities perceived by Magnetic Resonance Imaging (MRI) (N=75).

Due to abnormalities in brain development, children showed behavioral problems as inattention and hyperactivity with microcephaly (74%), deficit in intellectual and adaptive functioning with cerebral palsy were (56%), childhood depression with phonetic and phonological disorder were (52.0%) children, difficulties learning and using academic skills in (68%) children, intellectual developmental disorders with microcephaly with impulsivity and hyperactivity in (76%) children (Table 7).

| | Frequency (n) | | Percentage (%) | |
|---|---------------|--------|----------------|--------|
| | Present | Absent | Present | Absent |
| a) Inattention and hyperactivity with microcephaly. | 48 | 27 | 74.0 | 36.0 |
| b) Intellectual development disorder with cerebral palsy. | 42 | 33 | 56.0 | 44.0 |
| c) Childhood depression with phonetic and phonological disorder. | 39 | 36 | 52.0 | 48.0 |
| d) Specific learning disorder. | 51 | 24 | 68.0 | 32.0 |
| e) Intellectual developmental disorders with microcephaly with hyperactivity and impulsivity. | 57 | 24 | 76.0 | 24.0 |

Table 7: Behavioural disorders were present among children with brain abnormalities perceived by Magnetic Resonance Imaging (MRI) (N=75).

Discussion

Childhood is a valuable period for the development of the language network and language pathways. Magnetic resonance analysis demonstrated the neurobiological perspective of the complex language development process, providing early diagnosis and opportunities for intervention in children with language impairment due to abnormalities in brain development. In our study 72% were male and most of the children (60%) were of school age (6-10) years. Majority children (56%) lived in rural areas and their parents' was illiterate (54%), due to socioeconomic condition. Hinde, et al. observed in his research a major health problem globally with higher economic burden in low and middle income families [19]. As for linguistic

findings, it was observed in our study most of the children (64%) had hypo or hyper intensities of isolated parenchymal injury found in the cerebral cortex and 28% had cerebral atrophy with ventriculomegaly due to abnormalities in brain development linguistic disorders were present among children were speech disorder (42%) and receptive/perceptive were present among (58%) children. Due to speech and disorder of reception/perception evidencing inability to communicate according to the social situation and context (84%) and the correlation between clinical symptoms of domains of language disorders and the abnormalities in brain development perceived by MRI was significant $p < 0.05$.

One study done in Brazil, discovered that the process of language acquisition and development was impaired in children with neurological injury, that is structural brain injury. Among them, twenty-four (60%) of the subjects were boys [20]. Another study identified that speech and language disorders are prevalent, affecting more than 10% of school-age children [21]. Chin, et al. [1] point out in their studies that use magnetic resonance imaging that: there is a structural lesion in the cortical/subcortical area that affects expressive language disorder in 8.1% of patients, there is receptive language disorder in 18.5%, there is a structural lesion of the basal ganglion/thalamic area causing expressive language disorder in 5.7% of the patients observed, there is receptive language disorder in 6.5%, presence of structural lesion of the cortical/subcortical area and basal ganglion/thalamic area causing expressive language disorders in 4.0% of patients and receptive language disorders in 3.5% of patients who were between 4 and 7 years old. Bax, et al. found in their research that the pathologic basis of cranial MRI had a strong correlation with clinical findings. In their research, they observed white matter damage was (42.5%), basal ganglia damage (12.8%), cortical and sub-cortical damage (9.4%), focal infarct in frontal and temporal lobes (7.4%), normal (11.7%) and speech, language disorders were present in 58% of the cerebral palsy children [22]. In our study due to brain lesion, children showed behavioral problems as: inattention and hyperactivity (74%), deficit in intellectual and adaptive functioning were (84%), childhood depression were (66.0%) children, difficulties learning and using academic skills in (82%) children and impulsivity and hyperactivity in (76%) children. According to World Health Organization (WHO), the prevalence of intellectual developmental disorders worldwide is 1 in every 8 people. World bank also estimated 85% of the global population with intellectual development disorder with behavioural problems lived in low-middle-income countries.

Conclusion

Children with language disorders and behavioral problems in brain abnormalities are a challenge for the clinician as well as for the patients. For the early identification of these morbidities, special attention must be given to the analysis of magnetic resonance linked to the awareness that language is not a substance, but is a form, a process in which stimuli travel a path to the central cognitive system, where they will be identified and translated into mental representations that will serve as a basis for decision making. The identification of language impairments and early intervention in a multidisciplinary approach can reduce the morbidity of these children also reduce the burden on these families and the state and children can lead a meaningful life.

Conflict of Interest

None.

Funding

Self-funded.

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