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ASSESSMENT OF SENSORY PROCESSING CHARACTERISTICS IN CEREBRAL PALSY CHILDREN

Mehreen Zahid
Physiotherapist
Saudia Arabia
mehreenwahaj@hotmail.com

ABSTRACT

AIMS & OBJECTIVES

Children with cerebral palsy presents with complain of motor and sensory deficits. The movement and posture difficulties are well address by the rehabilitation team; however, sensory deficits remain un-address. Therefore, this study aims to assess the sensory processing characteristics in Spastic Diplegic children using Short Sensory Profile.

METHODOLOGY

This cross-sectional study was conducted at Special Education Institutes/Schools of Karachi. The Cerebral Palsy children with Spastic Diplegia aged 4-15 years were enrolled through Non-Probability Convenience Sampling Technique. Data was collected from parents/guardians of the participants using Short Sensory Profile questionnaire.

RESULTS

A sample of 70 participants was obtained out of 133 with a highest reported mean score of 17.38 in Tactile Sensitivity, while lowest in Taste/Smell and Movement Sensitivity i.e. 8.77 and 6.12 respectively. Moreover, a significant weak correlation was determined between Tactile and Movement Sensitivity ($p<0.05$).

CONCLUSION

It was found that all CP children enrolled in the study were showed A-typical sensory performance on Short Sensory Profile. Further investigation is required to establish psychometric properties of Short Sensory Profile on CP population and understand the correlation of sensory modulation impairments with functional performance for better intervention outcome for CP children.

KEYWORDS

Cerebral Palsy, Spastic, Diplegia, Dysfunction, Activities of Daily Living, Rehabilitation.

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INTRODUCTION

Cerebral palsy is considered as one of the leading cause of physical disability in early childhood[1]. It is a group of movement and posture disorder caused due to non-progressive brain damage in early years of life; resulting in activity limitation[2]. The motor disturbances of Cerebral Palsy are often influence by sensational abnormalities, perception, cognitive awareness, speech and behavior[3]. Depending on the neuromuscular deficits, it is clinically classified into Spastic, Dyskinetic and Ataxic Cerebral Palsy, in which 70 to 75% accounts with spastic cases[4].

Cerebral Palsy is prevailing variant from country to country. It has been shown to occur more prevalent in lower and middle-income countries in comparison to high-income countries[5]. The survey based study conducted and the registered cases of Cerebral Palsy based in Europe, United States and Australia reported 1.8 to 2.3 cases/1000 lives births[5]. Whereas the prevalence in Asia was found to be 3.5, 3, 2.1 per 1000 live birth in Bangladesh, India and Iran respectively[6,7,8] however reportedly Pakistan has less number of cases i.e. 1.2, as compared to its neighboring countries[9].

Sensory modulation refers to physiological and neurological changes that take place in the central nervous system in order to control and classify the degree, pattern and intensity of sensory input[10].The sensory information act as sensory stimuli that directs information and sends feedback regarding body position in space, allowing for adaptive responses to be developed[11]. Jean Ayers, proposed the theory of sensory integration (SI) that reinforces on the processing of sensory awareness and information[12]. The theory centralized the idea that disruption in neural development and sensory input integration that disturbs the desirable behavior necessitated for child development, thus the need for therapy is essential to guide sensory stimuli in order to elicit an adaptive motor response[13]. Sensory integration deficits occasionally occur with impairment in motor function, leading to motor disorders[14]. The sensory processing disorder has adverse impacts on coping habits such as feeding, sleeping and activities related to bath and bedtime. It also manifest as difficulty in acquiring skills, self-identification and assoications[15].There is a high incidence of sensory processing impairments in children. Numbers of studies have investigated sensory integration in different population such as Autism Spectrum Disorder[16], Intellectual Development Deficits[17], Major Affective and Anxiety Disorder[18]Preterm Preschool children[19] and Preterm Infants[20]; additionally, some studies surveyed sensory processing in the healthy population[21].A specific instrument or standardized assessment tool is required to measure sensory processing disorder that are suitable for use with children. There are studies that measured the sensory processing in Cerebral Palsy children with the help of neuroimaging equipment that is not commonly available in clinical settings. The measurement of Sensory processing disorder via a specific clinical measure is yet not common however; studies showed that short sensory profile provides comprehensive details of sensory integration issues in children[11, 14].

Sensory profile helps in the evaluation of behaviors and the abilities associated with integration function of modulation and input of sensory afferents, directing a wide and comprehensive assessment of sensory processing disorders[22]. It offers a global assessment of how children relate with the environment and respond to multiple sensory stimuli, characterizing children's outcome patterns and providing families with a practical guide to resolve sensory processing deficits[11].Therefore, the aim of this study is to assess the sensory processing characteristics among Cerebral Palsy children. The results of this study could help therapist in providing the appropriate rehabilitation plan according to the abilities of the children and their responsiveness to the environment.

METHODOLOGY

STUDY DESIGN
Cross-sectional study

STUDY SETTING
The study was conducted at Al-Umeed Rehabilitation Association (AURA) and Imran Rehabilitation Centre (IRC), Karachi.

TARGET POPULATION
Spastic Diplegic Cerebral Palsy children

DURATION OF STUDY
6-8 months

SAMPLING TECHNIQUE
Non-Probability Convenience Sampling Technique

SAMPLE SIZE
Sample size was calculated by online software named as Open Source Epidemiologic Statistics for Public Health (Open EPI) version 3.01 by considering a study conducted by Pavao S.L (2015)[23]. Considering proportion of 67.1%, 95% confidence level and 8% bound of error, the calculated sample was n =133.

SAMPLE SELECTION
Inclusion Criteria
- Both male and female Spastic Diaplegic Cerebral Palsy children aged4-15 years[23].

Exclusion Criteria
- Cerebral Palsy children with severe comorbidities and secondary disorders such as Spina Bifida, Epilepsy, Intellectual Disability, Visual Impairments etc. were excluded[23].

DATA COLLECTION TOOL
Data was collected through the Short Sensory Profile (SSP) questionnaire[23], a reliable tool to assess sensory processing characteristics and the pattern of performance in children with various disability groups. The SSP is comprised of seven sections i.e. Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Under-responsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak and Visual/ Auditory sensitivity, under which 38 questions are framed to assess sensory processing characteristics on a 5-point Likert Scale consisted of 1=Always, 2=Frequently, 3=Occasionally, 4= Seldom, 5= Never. The total scoring is classified into Typical Performance (190-155), Probable Difference (154-142) and Definite Difference (141-38) respectively.

DATA COLLECTION PROCEDURE
Data was collected from the Special education settings of Karachi. Following the consent from parents/guardian, participants were enrolled according to the inclusion criteria. The therapists explained the questionnaire; moreover, questions were also translated into local language to overcome language barrier issues. After ensuring the caretakers understanding, the assessment of sensory processing characteristics was performed of on SSP questionnaire. Afterwards, the therapists to comprehend the total scoring in order to evaluate the sensory processing characteristics of children evaluated the data provided by the parents/guardians.

DATA ANALYSIS STRATEGY
Data was entered and analyzed on IBM SPSS Statistics software version 20. Descriptive statistics was applied to calculate mean and standard deviation for numerical data whereas in inferential statistics, Spearmen/Pearson correlation was calculated in between the different items of SSP.

ETHICAL CONSIDERATIONS
Prior to data collection, Informed consent was obtained from the children's parents/guardians by briefing about the purpose and method of data collection. Furthermore, it was ascertain that all the data will remain confidential under the investigator's supervision.

RESULTS

Out of 133, 70 participants were enrolled in the study including 31 males and 39 females with mean age of 9.5±2.84 years.

The results of the study revealed that all patients fall under definite difference that showed marked sensory integration impairment in the sample. The mean scores of for each item on SSP are depicted in Table-1, Figure-1.

Table-1 Depicting Mean Scores of Participants on SSP

Items	Mean±S.D.
Tactile Sensitivity	17.38±3.41
Taste/Smell Sensitivity	8.77±3.21
Movement Sensitivity	6.12±1.99
Under-responsive/ Seeks Sensation	16.54±4.37
Auditory Filtering	15.2±3.79
Low Energy/Weak	14.82±3.24
Visual/Auditory Sensitivity	15.52±3.24

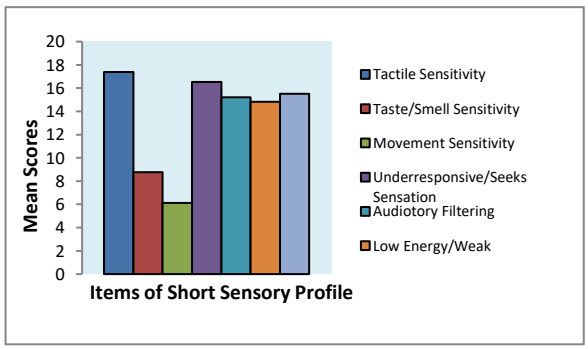

Figure.1 illustrates mean scores of participants on SSP

Pearson and Spearman Correlation test were run between different items of SSP. Auditory Filtering and Visual/Auditory Sensitivity showed insignificant results with a weak positive correlation between the two variables (r=0.10, p=0.37) followed by Movement Sensitivity and Visual/Auditory Sensitivity correlation again showing insignificant results with a weak positive correlation (r=0.16, p=0.17). However significant correlation was observed between Tactile Sensitivity and Movement Sensitivity but the strength of correlation was weak (r=0.26, p=0.027).

Table-2 Showing Correlation of Different Items in SSP

Variables	Correlation (r)	P value (<0.05)
Auditory Filtering Visual/Auditory Sensitivity	0.10	0.37
Tactile Sensitivity Movement Sensitivity	0.26	0.027
Movement Sensitivity Visual/Auditory Sensitivity	0.16	0.17

DISCUSSION

The results of this study indicated variability of mean scores in items of SSP i.e. highest mean scores (17.38) was obtained on Tactile Sensitivity, (16.54) Under-responsive/Seek Sensation (15.2) Auditory Filtering, Visual/Auditory Sensitivity and (14.82) Low Energy/Weak domain. Whereas, lowest mean sores (8.77) and (6.12) was recorded in Taste/Smell and Movement Sensitivity components respectively. The results show the undesirable performance of the children that may serve as the indicator of sensory integration impairments.

Number of studies has indicated that number of disorders such as sensory accompanies Cerebral Palsy children, perceptual, cognitive and behavioral due to the lesions in white matter, present in almost 45% of the children[24]. Further, it was advocated that sensory impairments might co-exist with motor deficits in children with developmental disabilities that may affect manifest as activity limitation, slow information processing and Impair adaptive[25]. However, limited studies have been conducted to address the disturbances of sensory processing abilities

in Cerebral Palsy children. A study conducted by Wickremasinghe et al[26]showed that 39% of the children had an overall atypical sensory profile in which tactile, auditory and vestibular processing was most likely to be affected. On the contrary, our study showed typical performances in Tactile and Visual/Auditory Sensitivity items, however weak correlation was observed (r=0.26) between these two items that might be an indicator of risk for neurodevelopment impairments in future. The sensory modulation mediates posture control and movements in children. Input from all the six sensory receptors is integrated to form body schema and understanding of body position in relation to space. This information is use by brain to generate movement and correct posture according to activity and environment demands [25-26]. Thus addressing sensory modulation difficulties should be identified and address at early stages. In a study conducted by Lane, Molloy and Bishop[27] concluded that children of younger age have sensory hyperactivity that may serves an indicator of intellectual impairments in future. Moreover, atypical sensory reactivity either hyperactive and/or hypoactivity may be a discriminating characteristic that might be useful in the early identification of disabilities in susceptible children. It has also been suggested that the impairments in sensory profile may manifest in differing temperaments that is highly susceptible to environmental and developmental factors of the early childhood interplay[24-27]. Likewise, as our study reported hypo-sensory reactivity in Tactile and Visual/Auditory domain, thus -careful assessment and monitoring of sensory disturbance is required to understand the emergence of sensory subtypes at the time of diagnosis. Furthermore, Lane, Molloy and Bishop[27] performed model based cluster analysis to classify individuals on the type of pattern difference to evaluate most sensitive area however; it was not possible in our study as all the participants were specified to definite difference on SSP. Nevertheless, these studies had been conducted on various disability groups of different population therefore; generalizability of the results may not be relevant due to socio-demographic characteristics and spectrum of questionnaire.

Our study aimed to assess the sensory processing characteristics and pattern of performance among Cerebral Palsy children with an insight that early detection may provide a strong base for sensory integration intervention, which is crucial for better development of children with Spastic Diplegia. For this purpose, SSP questionnaire was used for the screening of sensory characteristics and pattern of performance in children with 4-15 years that revealed definite pattern of performance among the children. However, few studies were found to explore the use of SSP on Cerebral Palsy children with the similar age group. In addition to this, a study revealed that 57% children have problem in functional abilities and sensory modulation. The sensory processing disorders were categorized into definite difference in comparison with the children who have typical healthy performance. However, other falls in the category of the probable and typical difference. Thus, it was concluded that strong variation in the sensory integration is associated with children having functional disabilities[28].On the other hand, a study conducted among the Saudi children with autism revealed the apparent sensory processing dysfunction through sensory profile demonstrated that 84.8% of children with autism have definite sensory processing dysfunction. The most prevalent sensory processing dysfunctions involved the Under-Responsive/Seeks Sensation (89.13%), Auditory Filtering (73.90%), and Tactile Sensitivity (60.87%) domains. These results draw the conclusion that the children have clinically significant sensory dysfunctions. Although, the prevalence of sensory dysfunctions in children with autism is significantly higher than in the children without autism whereas limited studies reported to assess the variable on Cerebral Palsy children[29]. Furthermore, Pollock, Metx and Barabash[30]stated that significant number of individuals with eliminating disorder was found to be associated with sensory

integration problem and it was found with the help of short sensory profile. Therefore, it is important to evaluate the sensory profile for effective treatment of the Cerebral palsy and other developmental disorders. Nevertheless, the vague outcomes and probability of false positive results of above studies focused the need of the further investigation and fact of not to be dependent on the short sensory profile, merely for making effective treatment plans and measuring the true sensory capabilities of a child. Furthermore, the reliability of tool is needed to be analyzed among various developmental disorders of children to strategize an effective treatment strategy. Despite, several studies reported the sensory issues in various disability group yet the results of these studies are doubted due to differing characteristics of population and questionnaire reliability.

STRENGTH &LIMITATIONS

To the best of author's knowledge, this cross-sectional survey is the first to assess the sensory processing abilities in Cerebral Palsy children. In our study, a definite difference was found in Spastic Diplegic Cerebral Palsy children that is an indicator of distinct variability in sensory integration domains and susceptibility to deterioration of functional skills in future. Moreover, SSP has shown the trend of higher scores in typically developing children in most of the items. Although assessment through SSP have explicitly not been included as diagnostic criteria in children with development disabilities yet it is useful to predict the performance difficulties that may be associated with sensory disturbances associated with particular disability. Moreover, one of the limitations of the study is limited sample size. As Cerebral Palsy children were not classified according to the GMFCS levels since during the assessment children were experiencing different stages of development therefore wider inferences in the results may have been occur. Furthermore, few studies have been conducted to assess the sensory processing issues while demonstrated varying spectrum of questionnaire in which most of the sensory profiles were caregiver reported questionnaire. Therefore, subjective nature of answers may vary due to sociocultural characteristics of the parents/guardians and children however this perspective is somewhat beneficial in order to rule out sensory processing issues that may leads to future investigations based on the subjective experiences of children and their families affecting their quality of life.

FURTURE RECOMMENDATIONS

Further investigations are required to assess the sensory processing abilities in different age ranges and homogenous GMFCS among Cerebral Palsy children to evaluate the pattern of performance with respect to varying classifications that may exhibit interesting findings ahead. Furthermore, healthcare professionals should develop an adequate knowledge of the sensory processing impairments that may indulges them in functional rehabilitation of the children thereby adding a specific sensory stimuli to improve their independency. Moreover, future work should involve cordial relationships between therapist-client/parent for the establishment of facilitator factor child's health condition.

CONCLUSION

It is concluded the selected participants of the study has shown Atypical sensory performance on the Short Sensory Profile. The reliability and validity of Short Sensory profile is found for ASD while for CP the psychometric properties of Short Sensory profile is yet to establish. Further studies are required to evaluate the usefulness of questionnaire in various disability groups. Moreover, healthcare professionals should develop an adequate knowledge of the sensory processing impairments and establish cordial relationships with caregivers for functional rehabilitation of children with Cerebral Palsy.

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