

## RESEARCH REPORT

# ASSESSMENT OF SENSORY PROCESSING CHARACTERISTICS IN CEREBRAL PALSY CHILDREN

### ABSTRACT

#### AIMS & OBJECTIVES

children with cerebral palsy present with the complain of motor and sensory deficits. The movement and posture difficulties are well addressed by the rehabilitation team; however, sensory deficits remain unaddressed. 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 showing Atypical 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 causes of physical disability in early childhood<sup>1</sup>. 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<sup>2</sup>. The motor disturbances of Cerebral Palsy are often influenced by sensational abnormalities, perception, cognitive awareness, speech and behaviour<sup>3</sup>. 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<sup>4</sup>.

Cerebral Palsy is a prevailing variant from country to country. It has been shown to occur more in lower and middle-income countries in comparison to high-income countries<sup>5</sup>. 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 live births<sup>5</sup>. Whereas the prevalence in Asia was found to be 3.5, 3, 2.1 per 1000 live birth in Bangladesh, India and Iran respectively.<sup>6,7,8</sup> However, reportedly Pakistan has less number of cases i.e. 1.2 as compared to its neighbouring countries<sup>9</sup>.

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<sup>10</sup>. The sensory information acts as sensory stimuli that directs information and sends feedback regarding body position in space, allowing for adaptive responses to be developed<sup>11</sup>. Jean Ayers, proposed the theory of sensory integration (SI) that reinforces the processing of sensory awareness and information<sup>12</sup>. The theory centralised the idea that disruption in neural development and sensory input integration that disturbs the desirable behaviour necessitated for child development, thus the need for therapy is essential to guide sensory stimuli in order to elicit an adaptive motor response<sup>13</sup>. Sensory integration deficits occasionally occur with impairment in motor function, leading to motor disorders<sup>14</sup>. The sensory processing disorder has an adverse impact on coping habits such as feeding, sleeping and activities related to bath and bedtime. It also manifests as difficulty in acquiring skills, self-identification, and associations<sup>15</sup>. There is a high incidence of sensory processing impairment in children. Numbers of studies have investigated sensory integration in different population such as Autism Spectrum Disorder<sup>16</sup>, Intellectual Development Deficits<sup>17</sup>, Major Affective and Anxiety Disorder<sup>18</sup> Preterm Preschool children<sup>19</sup> and Preterm Infants<sup>20</sup>; additionally, some studies surveyed sensory processing in the healthy population<sup>21</sup>. A specific instrument or standardised assessment tool is required to measure sensory processing disorder that is 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 a short sensory profile provides comprehensive details of sensory integration issues

in children<sup>11, 14</sup>.

Sensory profile helps in the evaluation of behaviours and the abilities associated with integration function of modulation and input of sensory afferents, directing a wide and comprehensive assessment of sensory processing disorders<sup>22</sup>. It offers a global assessment of how children relate with the environment and respond to multiple sensory stimuli, characterising children's outcome patterns and providing families with a practical guide to resolve sensory processing deficits<sup>11</sup>. Therefore, the aim of this study is to assess the sensory processing characteristics among Cerebral Palsy children. The results of this study could help therapists in providing 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 the online software named Open Source Epidemiologic Statistics for Public Health (Open EPI) version 3.01 by considering a study conducted by Pavao S.L (2015)<sup>23</sup>. 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 Diplegic Cerebral Palsy children aged 4-15 years<sup>23</sup>.

#### Exclusion Criteria

- Cerebral Palsy children with severe comorbidities and secondary disorders such as Spina Bifida, Epilepsy, Intellectual Disability, Visual Impairments etc. were excluded<sup>23</sup>.

### Data Collection Tool

Data was collected through the Short Sensory Profile (SSP) questionnaire<sup>23</sup>, 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 special educational settings in Karachi. Obtaining consent from parents/guardian, participants were enrolled according to the inclusion criteria. The therapists explained the questionnaire; moreover, questions were also translated into the 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 comprehended the total scoring in order to evaluate the sensory processing characteristics of children, and evaluated the data provided by the parents/guardians.

**Data Analysis Strategy**

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

**Ethical Considerations**

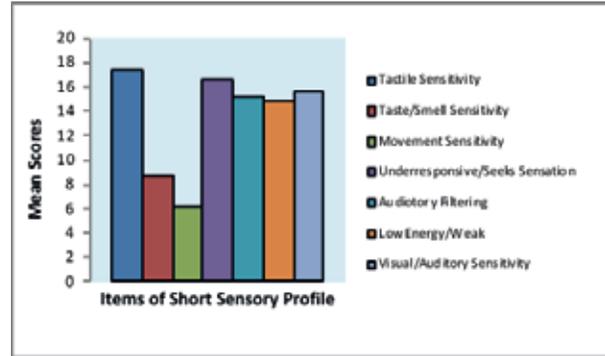
Prior to data collection, informed consent was obtained from the children's parents/guardians by briefing them about the purpose and method of data collection. Furthermore, it was ascertain that all the data will remain confidential under the investigator's supervision.

**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 for each item on SSP is 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.

**Table.2 Showing Correlation of Different Items in SSP**

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

**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 scores - (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 have indicated that disorders

such as sensory, accompanies Cerebral Palsy children, perceptual, cognitive and behavioural due to the lesions in white matter, present in almost 45% of the children<sup>24</sup>. Furthermore, it was advocated that sensory impairments might co-exist with motor deficits in children with developmental disabilities that may manifest as activity limitation, slow information processing and impair adaptive<sup>25</sup>. 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<sup>26</sup> 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 the 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 positions in relation to space. This information is used by the brain to generate movement and correct posture according to activity and environment demands<sup>25-26</sup>. Thus, addressing sensory modulation difficulties should be identified and addressed at early stages. A study conducted by Lane, Molloy and Bishop<sup>27</sup> concluded that children of a younger age have sensory hyperactivity that may serve as an indicator of intellectual impairments in the future. Moreover, atypical sensory reactivity either hyperactive and/or hypo active 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 early childhood interplay<sup>24-27</sup>. 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<sup>27</sup> performed model based cluster analysis to classify individuals on the type of pattern difference to evaluate most sensitive areas 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 populations, therefore; generalisability 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 of 4-15 years. However,

few studies were found to explore the use of SSP on Cerebral Palsy children with a similar age group. In addition to this, a study revealed that 57% children have a problem in functional abilities and sensory modulation. The sensory processing disorders were categorised into definite difference in comparison with the children who typically have a healthy performance. However, others fall in the category of the probable and typical difference. Thus, it was concluded that a strong variation in the sensory integration is associated with children having functional disabilities<sup>28</sup>. 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, limited studies reported to assess the variable on Cerebral Palsy children<sup>29</sup>. Furthermore, Pollock, Metx and Barabash<sup>30</sup> stated that significant number of individuals with eliminating disorder were found to be associated with sensory integration problem and it was found with the help of the 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 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 tools is needed to be analysed among various developmental disorders of children to strategise an effective treatment strategy. Despite the fact that several studies reported sensory issues in various disability group, the results of these studies are doubted due to differing characteristics of population and questionnaire reliability.

#### **Strength And Limitations**

To the best of the author's knowledge, this cross-sectional survey is the first to assess the sensory processing abilities in Cerebral Palsy children. In this 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 the 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 a particular disability. Moreover, one of the limitations of the study is the 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 occurred. Furthermore, a few studies have been conducted to assess the sensory processing issues while demonstrating a varying spectrum of questionnaires in which most of the sensory profiles were caregiver reported questionnaires. Therefore, the 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 lead to future investigations based on the subjective experiences of children and their families affecting their quality of life.

#### Future 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 adequate knowledge of the sensory processing impairments that may indulge 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 that the selected participants of the study have 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 be established. Further studies are required to evaluate the usefulness of the 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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