Tactile Defensiveness and Fine Motor Skills in Children with Attention Deficit Hyperactivity Disorder

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ABSTRACT

Background: A lot of attention deficit hyperactive disorder children suffer from associated tactile defensiveness which affects their daily living activities and school development. **Purpose:** To examine relation between tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder. **Methods:** Twenty five children with attention deficit hyperactivity disorder and tactile defensiveness, aged from 6 to 10 years of both sexes were participated in this study. They were selected from Abo-El-Reesh Children Hospital. Tactile defensiveness was assessed by Touch Inventory for Elementary-School-Aged Children and sensory profile and fine motor skills were assessed by Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). **Results:** There was statistically non-significant correlation between tactile defensiveness and fine motor skills in children with attention deficit hyperactivity ($P > 0.05$).

Conclusion: There was a weak negative relationship between tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder.

Keywords: Attention deficit hyperactivity disorder, Tactile defensiveness, Fine motor skills.

INTRODUCTION

Attention Deficit Hyperactive Disorder (ADHD) is a complex syndrome of impairments in developmental unfolding of the unconscious self-management system of the brain that affects significant numbers of children, adolescents, and adults. Attention deficit hyperactivity disorder affects between 3 and 12% of elementary school children with behavioral symptoms being characterized by hyperactivity, impulsivity and inattention1.

Several studies have found that children with ADHD perform poorly on motor skills tests, encounter difficulties in their daily living such as participation at school with a higher risk of school failure and more difficulties in social life. In fact, they are more often excluded by peers and show poor self-esteem and may demonstrate difficulties in activities that require motor coordination2.

Sensory integration disorders term was introduced to identify a field of study focusing upon individuals who demonstrated atypical behavioral responses to sensory stimulation including tactile and motor planning deficits, visual perception and visual praxis deficits, tactile defensiveness with hyperactivity and distractibility, vestibular, postural, bilateral integration, and sequencing deficits3.

Ayers first described children who have difficulty regulating sensory input for purposeful use, and her findings included children with tactile defensiveness or an over responsiveness to tactile input4. According to Ayres , tactile defensiveness is the response that occurs, when dorsal column-medial lemniscus (DCML) system fails to exert inhibitory influence over anterolateral system. Due to this child exhibits strong emotional response and escape-like behaviour and strong emotional response. In this condition non-standard neural messages are being sent to the motor cortex which in turn, overly stimulates the brain activity that is disorganized. This overstimulation can cause individual difficult to organize the behavior5.

Hand skills are patterns that normally rely on both tactile-proprioception and visual information for accuracy. However, the child can accomplish these skills without visual feedback if somatosensory functions provide adequate information.The patterns include reach, grasp, carry, and voluntary release, as well as the more

complex skills of in-hand manipulation and bilateral hand use6.

Conclusive findings on altered perceptual functions in individuals with ADHD compared to typically developing individuals, however, could not be derived from research so far. Hence, understanding perceptual functioning in ADHD may contribute to a clearer conception of the pathophysiology of ADHD and is thus of theoretical and clinical importance7. Therefore, purpose of the current study was to examine relation between tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder.

MATERIALS AND METHODS

I. Study Design

The present study was an observational (correlation) study.

Participants

Twenty five children with ADHD, from both sexes, aged from 6 to 12 years, were eligible to be enrolled in this study if they had a confirmed diagnosis of ADHD with tactile defensiveness and were able to understand and follow instructions. Children were excluded from this study if they had surgical interference in upper extremities; IQ was less than 80; and visual or hearing impairments.

Ethical committee approval of the Faculty of Physical Therapy, Cairo University as well as a written consent from children's parents were obtained before starting the study.

II. Procedures:

1. Assessment for tactile defensiveness:

a) For selection:

Touch inventory scale (TIE) was used as a screening tool to detect the children who have tactile defensiveness to be included in the present study.

The 26 -item questionnaire were designed for use with children aged 6 - 12years. The criteria for administration were that the child needed to have the language competence of at least a 6 -year-old, an IQ of at least 80, no presence of physical disabilities. The test required minimal training to use, took approximately 10 minutes to administer and had a straightforward calculation of test scores.

The response cards are (no, a little, and a lot). The higher a child's score, the more his or her self-reported behaviors are associated with behaviors indicative of tactile defensiveness.

b) For evaluation:

Sensory profile was used for assessment of tactile defensiveness for the children participating in this study.

The criteria of the questions including the 18 statements were demonstrated. The modulation section

contains five item categories that monitor and regulate information to generate an appropriate response to the situation (almost always, frequently, half the time, occasionally, almost never).

Then the total point raw score will be interpreted through specific criteria of measuring provided with the test.

2. Assessment of fine motor skills:

Bruininks - Oseretsky Test of Motor Proficiency (-2nd Edition) was used to assess the fine motor skills for all children in this study. Fine Motor Precision, Fine Motor Integration and Manual Dexterity subtests were assessed for all children.

a- Subtest 1: Fine motor precision: This subtest contains 7 items:

1. Filling in shapes (circle).
2. Filling shapes (star).
3. Drawing lines through paths (crooked).
4. Drawing lines through paths (curved).
5. Connecting dots.
6. Folding paper.
7. Cutting out a circle.

b- Subtest 2: Fine Motor Integration: This subtest contains 8 items:

1. Coping shapes:
2. Circle
3. Square.
4. Overlapping circles.
5. Wavy line.
6. Triangle.
7. Diamond.
8. Star.
9. Overlapping pencils.

c- Subtest 3: Manual dexterity: This subtest contains 5 items:

1. Making dots in circles.
2. Transferring pennies.
3. Placing pegs into a pegboard.
4. Sorting cards.
5. Stringing blocks.

Scoring:

The total point score was calculated for each subtest. The total point scores for each subtest was converted to scale scores using the appropriate tables provided in the manual, taking into account gender and age.

III. Data analysis:

Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Numerical data were tested for the normal assumption using Kolmogorov Smirnov test. Correlation between various variables was done using Pearson moment correlation equation for linear relation of normally distributed variables and Spearman rank correlation equation for non-normal variables/non-linear monotonic relation. Two sided *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows.

RESULTS

Subjects characteristics:

Twenty-five children with ADHD participated in this study. The mean ± SD age of the study group was 7.7 ± 1.43 years with minimum of 6 years and maximum of 12 years. Nine (36%) of children were girls and sixteen (64%) were boys.

Tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder:

The mean values of tactile defensiveness and fine motor skills of the study sample is presented in table 1 and figure 1. Mean values of tactile defensiveness was 52.8 ± 3.731. The mean values of fine motor integration, fine motor precision and manual dexterity were 9.6 ± 2.67, 7.64 ± 2.54 and 6.4 ± 3.12 respectively.

Table 1. Mean values of tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder:

	Tactile defensiveness	Fine motor precision	Fine motor integration	Manual dexterity
Mean	52.80	7.64	9.6	6.4
SD	3.731	2.54	2.67	3.12
Minimum	45	4	5	3
Maximum	59	12	17	15

SD, Standard deviation

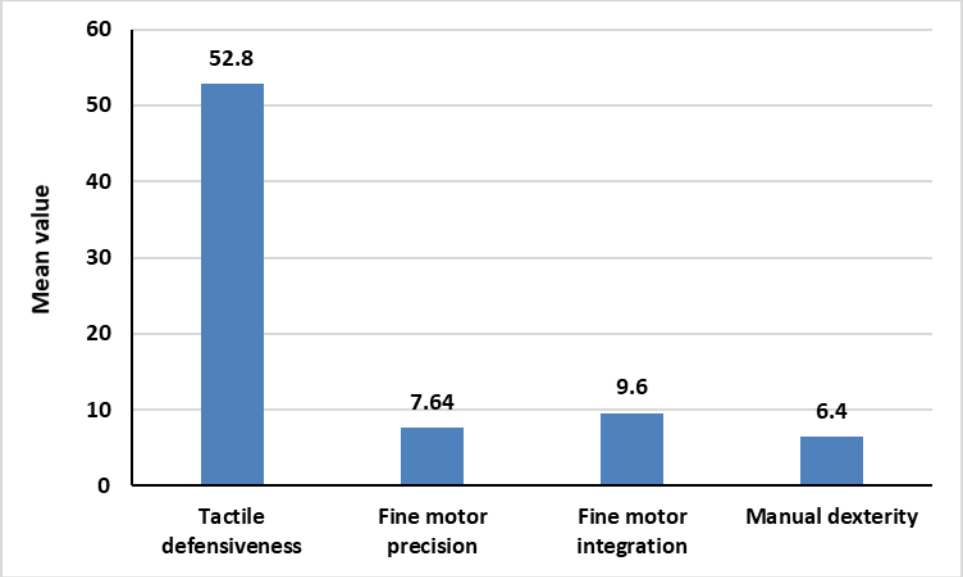

Figure (1): Mean tactile defensiveness and fine motor skills of the study group.

Correlation between tactile defensiveness and fine motor skills in children with attention deficit hyperactivity disorder:

Table (2) and figures (2- 4) clarify the correlation between tactile defensiveness and fine motor skills in children with ADHD. There was a weak negative non-significant correlation between tactile defensiveness and fine motor precision (r = -0.28, p = 0.17), between tactile defensiveness and fine motor integration (r = -0.22, p = 0.28) and also between tactile defensiveness and manual dexterity (r = -0.26, p = 0.19).

Table 2. ***Correlation between tactile defensiveness and fine motor skills:***

		r value	p value
Tactile defensiveness	**Fine motor precision**	-0.28	0.17
	Fine motor integration	-0.22	0.28
	Manual dexterity	-0.26	0.19

r value, Pearson Correlation coefficient value; p-value, Probability value

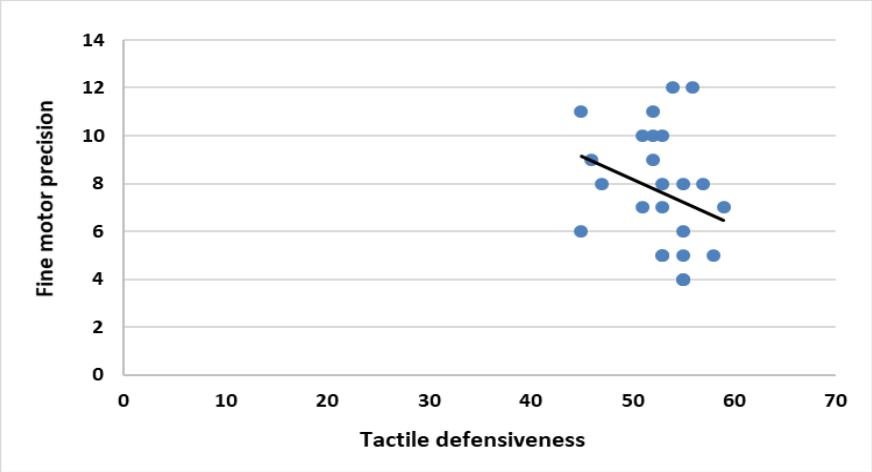

Figure (2): Correlation between tactile defensiveness and fine motor precision of the study sample.

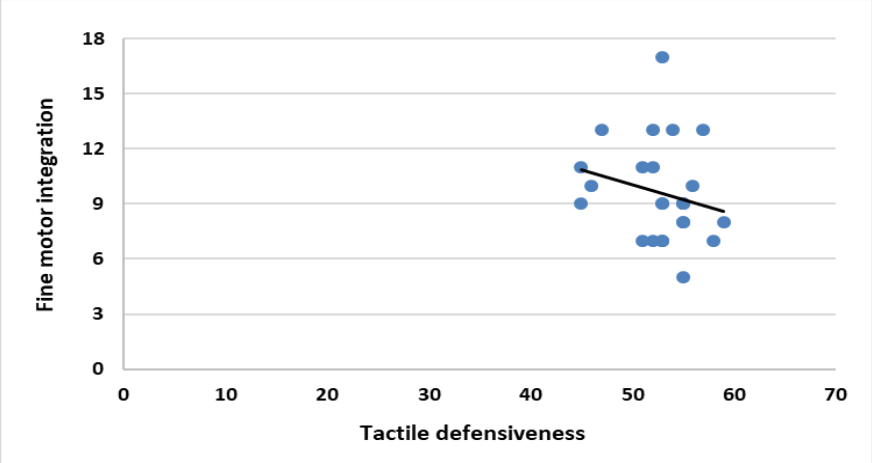

Figure (3): Correlation between tactile defensiveness and fine motor integration of the study sample.

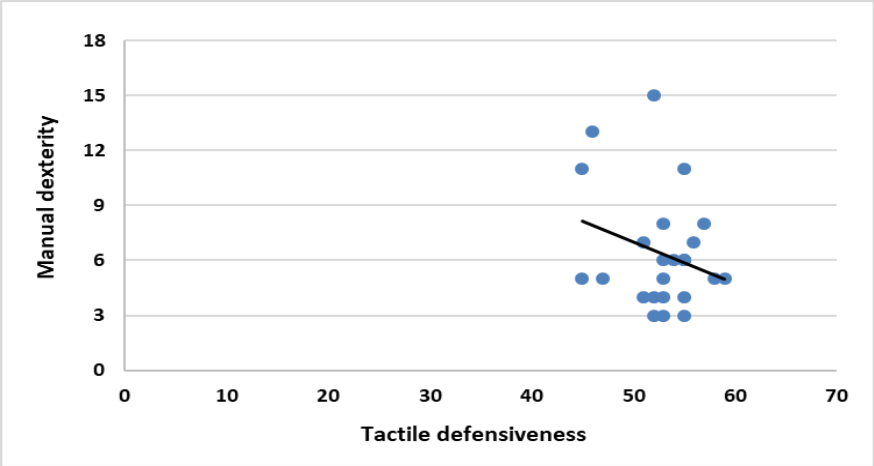

Figure (4): Correlation between tactile defensiveness and manual dexterity of the study sample.

DISCUSSION

The current study aimed to assess the relation between tactile defensiveness and fine motor skills in children with ADHD. The results of this study indicated that there was weak negative non-significant correlation between them.

Miller et al.8 confirmed findings that difficulties in modulating sensory input are rare in typically-developing and are found in approximately half of the children with ADHD. They added that daily function difficulties in children with ADHD are significantly more common when there are comorbid sensory modulation difficulties. These observations held when a modified SSP was used.

Also they reported that children with a clinical referral by an expert clinician for both SMD and ADHD (Dual Referral group) had significantly more sensory problems than did children with a clinical diagnosis of only ADHD. Thus, as expected significant sensory problems were noted in individuals with SMD as well as individuals who were diagnosed with both SMD and ADHD. However, sensory problems were also found in children referred with ADHD alone, who demonstrated significantly more impairment than typically developing children on the SSP in tactile Sensitivity, visual Sensitivity, low energy/weak, seeks sensation, and auditory filtering8.

Cermak & Osten 9 approved that one of the known comorbidities, which are identified in 40%–60% of children with ADHD is difficulties in processing sensory input. These difficulties include three sub-categories: (1) Sensory Over-Responsivity (SOR); this pattern of

hypersensitivity is associated with an intense response to non-aversive sensory input and with behaviors such as avoidance of sensation, irritability, rigidity and controlling, (2) Sensory Under-Responsivity (SUR), and (3) Sensory Seeking/Craving (SS).

Mayes & Calhoun 10 agreed that learning disabilities (LDs) commonly occur in children who have ADHD. The researchers found that LDs (defined by predicted achievement) occurred in 71% of the children with ADHD (combined type), and about 63% is for written expression.

Children with ADHD have more difficulties in tactile processing. Tactile defensiveness is not due to tactile perception impairment but the impairment of central processing of somatosensory information. Sensory over-responsivity in ADHD is associated with anxiety. These children have a higher level of anxiety than those ADHD children without sensory overresponsivity 11. So maybe there is another stronger underlying factors in ADHD children affecting fine motor skills more than tactile defensiveness.

Another explanation of the results of the present study was mentioned as they tested for deficits in somatosensory function in boys with ADHD and tactile defensiveness (TD), with two groups as follows (ADHD+,TD-) and (ADHD+, TD+). No significant differences were found between the two ADHD subgroups. The results support claims that TD is related to central processing of somatosensory information, but not to anomalous tactile perception, with the exception of Finger Identification11.

Findings of BrÖring et al.12 study who examined whether TD is comparable in males and females with ADHD found that tactile defensiveness in girls with ADHD is more than boys with ADHD. In the current study, the most tested children were boys, who might have mild TD impairment; thus, weak correlation was observed between TD and fine motor skills.

Sensory processing problems in children with ADHD is not a well studied area. There are many reported limitations for the published studies. So, it is difficult to reach a firm conclusion due to the limitations. However, it is reported that the sensory processing problems are more common in children with ADHD than in typically developing children13 .

Kaiser et al.2 answered what were the explanations for motor problems associated with ADHD?, When deficits in motor skills deficits persisted? . Three main hypotheses were retained. The first was that comorbidity could be the cause of the motor skills deficits among ADHD children. The second hypothesis stated that the deficits in motor skills were due to a lack of attention. The third postulated that a lack of

inhibition interferes with motor control.

Meyer and Sagvolden14 investigated if there were an association between symptoms of ADHD and fine motor skills, by measuring manual dexterity, complex coordination and movement speed; The performance of all groups with symptoms of the three ADHD subtypes was significantly poorer. Deficits in motor control in ADHD had been reported especially when more complex motor sequences had to be performed. The results of the study showed that the groups with ADHD symptoms were less impaired on the speeded task than on the more complex Coordination Task which required more control, stability, and motor planning. This study showed that children with ADHD symptoms had poorer motor control, accuracy and speed when the tasks are fairly complex like. There was no observable difference when the task consists of a simple motor movement, like in the Finger Tapping Test. This deficiency in motor functioning was found in all ADHD subtypes, with the group with symptoms of ADHD inattentive type most severely affected. The study also explained their results by regarding this to dysfunctional higher-order cognitive processes such as planning and behavioral organizing, involved in the more complex motor tasks.

However, not all researchers share this opinion. According to Johansen et al.15 the neurobiological basis is predicted to be a hypo-functioning nigro-striatal dopaminergic system. Neuropsychological studies indicate that the areas involved in ADHD includes the basal ganglia, as well as the cerebellum and the prefrontal cortex. A strong link between inattentiveness and motor dyscontrol has been reported in most studies.

Brossard-Racine et al.16 stated that preliminary evidence suggests that children with ADHD may exhibit handwriting difficulties. However, the exact nature of these difficulties and the extent to which they may relate to motor or behavioural difficulties remains unclear.

Muro et al.17 suggested that there was a significant difference between the two groups of children with ADHD on the SSP touch subtest. Children with inattention ADHD scored a significantly higher mean score than children with hyperactivity ADHD, which indicates a unique sensory processing pattern for each diagnosis.

As reported from the previous studies, there were some articles which support the relation between tactile defensiveness and fine motor skills in ADHD, however some of them suggested that this wasn’t the only reason for poor hand skills as mentioned before.

The study may be limited secondary to factors that contribute to research bias. The first limitation of this study included that ADHD tends to have other related diagnoses, which may influence scores on the measures. Another factor was the small sample size represented in one geographical area.

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