

## Sensory Integrative Intervention: Outcomes of Motor, Cognitive and Social Skills among Children with Attention Deficit Hyperactivity Disorders

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### Abstract

**Background:** Attention Deficit Hyperactivity Disorders have widely prevailed among children which affects children's cognitive, motor, and social activities. Sensory integrative intervention is a therapeutic approach focused on empowering sensory processing among children with sensory disorders by engaging them with interesting and attractive activities. **Research design:** A quasi-experimental design was utilized. **Subjects:** The purposive sample included 60 children with attention deficit hyperactivity disorders accompanied by their parents according to specific inclusion criteria. **Setting:** Outpatient Clinics for Children and Adolescents in Abbasia Hospital for Mental Health affiliated to the General Secretariat for Mental Health and Addiction Treatment, Cairo Egypt. **Tools:** 1) a structured interview questionnaire containing three parts a) demographic data of the child, b) demographic data of the parent, and c) Parents' Knowledge about Sensory Integration; 2) The Weiss Functional Impairment Rating Scale Parent Form; 3) Sensory Processing Measure. **Results:** Data analysis presented statistically significant differences before, after, and follow-up of the implementation of sensory integrative intervention regarding parents' knowledge scores ( $f$ -test= 4.19 at  $p < 0.001$ ), functional impairment domains family, school, life skills, social activities, and risky activities ( $t$  test= 3.22, 7.69, 2.14, 3.89, 2.98, and 4.78 respectively with  $P$  value  $\leq 0.05$ ). Also, statistically significant differences were found in sensory process measure domains of social participation, body awareness, balance and motion, and planning and idea mean ( $f$ =21.94, 19.69, 9.93, & 22.89 respectively with  $p < 0.05$ ). **Conclusion:** The sensory integrative intervention had a positive effect on enhancing motor, cognitive, and social skills among children with ADHD through improvements in the scores of functional impairments and sensory processing scales. **Recommendation:** Repetition of the current study with other children with special needs and intellectual disabilities to evaluate the effect of sensory integrative intervention on the child's functions.

**Keywords:** sensory integrative, attention deficit hyperactivity disorders, functional impairment, cognitive, motor, social.

### Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurobehavioral disorder prevalent in childhood, demonstrating a persistent pattern of inattention and hyperactive and/or impulsive behavior (Hebert & McReynolds, 2023). Children with ADHD frequently suffer from impulsive behavior, reduced information-processing capacity, and/or inability to pay attention in the classroom. Thus, they are incapable of completing the homework assigned by their teachers in a timely manner, which may affect their academic achievement. In addition, children with ADHD have limited motor coordination, low sleep quality, poor emotional regulation, and low frustration tolerance, which results in more difficulties in academic and

interpersonal relations. Moreover, they may develop social maladjustment and low self-confidence (Mirzakhani, & Shahriarpour, 2021; Chan, et al., 2022).

Sensory processing is one of the significant brain functions that means recording and regulating sensory inputs. Through this process, a stimulus has occurred to the receptors in the sensory inputs and activates them into messages. These messages are transferred to the brain during the input process, and then the process of cognitive and behavioral organization and integration happens (Pfeiffer, et al., 2015). Children with ADHD have serious sensory integration problems together with the basic symptoms of ADHD, they have difficulties in perceiving and processing sensory stimuli, and in relation to

this, they have difficulty in producing appropriate sensory responses at school, at home, and in social environments (**Bumin, 2023**).

Sensory integration is a process for managing children who have problems in development and behaviors (**Rosenberg, et al., 2015**). It the children with enjoyable activities to regulate their sensory processing functions through improving their sensory inputs. This can be achieved by designing therapeutic and recreational equipment such as brushes, swings, balls, and others. Furthermore, sensory-integrated intervention can also improve a child's accomplishments in daily activities, such as eating, sleeping, and other behaviors related to daily routines (**Case-Smith, et al., 2015; Ianni, et al., 2021**).

The nurse works throughout a multi-disciplinary to address sensory challenges in children with ADHD (with or without comorbidity) and assist families in initiating appropriate therapeutic intervention for the child with sensory issues to function optimally in their daily life. Nurses use clinical reasoning, existing evidence, and outcomes to create a comprehensive, individualized approach for each child, rather than using isolated, specific sensory strategies (**Critz, et al., 2015**).

### **Significance of the study**

ADHD results in sensory integration dysfunction among children. It means that the child has difficulty in perceiving the sensory signals appropriately, leading to deficits in development, learning, and/or emotional regulation. ADHD affects 5–8% of children worldwide, mostly boys, and often lasts into adulthood (**World Health Organization, 2020**). In Egypt, the incidence of ADHD is reaching 9.4–21.8% (**Azzam, et al., 2021**). The development of sensory integration intervention among children with ADHD aimed to increase attention span and regulate the child's behaviors utilizing play-based activities. It also supports the success of the execution of tasks and encourages a child's adaptive behaviors through structured sensory activities to be a part of the child's daily life (**Bumin, 2023**). In working with ADHD children, the essential role of a psychiatric nurse is to support and improve the child's

function and capabilities at home and school, deal with risky behaviors, ensure child safety, promote the emotional status, self-concept, and social interactions through different skills training and occupational interventions (**Ianni et al., 2021**).

### **Aim of the Study**

The study aims to evaluate the effectiveness of the sensory integrative intervention on motor, cognitive, and social skills among children with attention deficit hyperactivity disorder (ADHD) through the following:

- Assess motor, cognitive, and social skills before the implementation of sensory integrative intervention among children with ADHD.
- Develop and implement sensory integrative intervention among children with ADHD accompanied by their parents.
- Evaluate the effect of the sensory integrative intervention on motor, cognitive, and social skills among children with ADHD.

### **Research Hypothesis:**

The sensory integrative intervention may have a positive effect on motor, cognitive, and social skills among children with ADHD.

### **Subjects and Methods**

#### **Research design**

This study is quasi-experimental (one group pre-posttest and follow-up) was utilized in the current study.

#### **Study setting**

The study was conducted at Outpatient Clinics for Children and Adolescents in Abbasia Hospital for Mental Health affiliated to the General Secretariat for Mental Health and Addiction Treatment, Cairo Egypt.

#### **Study subjects**

A purposive sample of 60 children with ADHD accompanied with their parents according to the following inclusion criteria:

##### **A-Regarding the children:**

- School age.

- Both sexes.
- Normal intelligence test.
- Free from co-morbid physical, and neuropsychiatric diseases based on the diagnosis in the child's medical data.
- Children who did not receive any previous sensory integration intervention.

#### B- Regarding the parents:

- Primary caregiver.
- Did not have other children with special needs.
- Did not receive any previous sensory integrative program or psychoeducation regarding sensory processing intervention.

#### Sample size:

A minimum sample size of 50 children was determined using the Fishers' formula  $z2pq/d2$ . The sample size was calculated according to the purposive sample selection, their agreement as a participant, and the statistical calculation formula. So, 60 subjects were enough to estimate a significant mean difference between the pre-and post-test and follow up, as well as by adjusting the power of the test to 80% and the confidence interval to 95% with the significance level at 0.05.

The sample size was estimated by using the following formula:

$$Z\alpha = \text{Standard normal deviation for } \alpha = 1.7800.$$

$$Z\beta = \text{Standard normal deviation for } \beta = 0.7816.$$

$$B = (Z\alpha + Z\beta)^2 = 7.1889.$$

$$C = (E/SA)^2 = 0.1517.$$

$$N = B/C = 49.8662 \text{ (Rosner, 2016).}$$

#### Tools of data collection

Data were collected by using the following tools that was translated into simplified Arabic Language:

##### I- Structured interview questionnaire:

It was developed by the researchers. It is composed of three parts.

- a) **Demographic data of the child** includes age, sex, child order, and parental consanguinity.
- b) **Demographic data of the parents** includes age, sex, marital status, education,

occupation, residence, monthly income, and number of children.

- c) **Parents' Knowledge about Sensory Integration:** six questions were constructed by researchers. It included the meaning of sensory processing, its benefits, and components of sensory processing. Each parent responds to the questions by answering yes= 1 or no= 0. The higher scores indicate more knowledge about sensory integration. 60% or more means parents have satisfactory knowledge.

##### II- The Weiss Functional Impairment Rating Scale Parent Form (WFIRS-P):

It was developed by **Thompson, et al., 2017**, it is a 50-item scale designed to evaluate the extent to which an individual's ability to function that impaired by any emotional or behavioral problems. The scale assesses functional impairment by measuring motor, cognitive, and social skills on six clinically relevant domains: (1) Family (ten items) ex. "makes it hard to give fair attention to all family members", "having problems with brothers and sisters"; (2) School and learning (ten items) ex. "receives grades that are not as good as his/her ability and makes it difficult to keep up with schoolwork"; (3) Life skills (ten items) ex. "keeping clean, brushing teeth, brushing hair, bathing", etc., "excessive use of TV, computer, or video games;" (4) Child's self-concept (three items) ex. "my child is not happy with his/her life", "my child feels bad about himself/herself"; (5) Social activities (seven items) ex. "problems getting along with other children and being teased or bullied by other children", and (6) Risky activities (ten items) ex. "breaking or damaging things and doing dangerous things". Each item is rated on a four-point scale from 0 ('never or not at all') to 3 ('very often or very much') or rated as 'not applicable'.

**Scoring system:** The overall score ranged from 0-150

- 0-50 indicates low impairment in the child's skills.
- 51-100 indicates moderate impairment in the child's skills.
- 101-150 indicates severe impairment in the child's skills.

### **III-Sensory Processing Measure- Home Form**

It was developed by **Parham, et al., (2007)**, and adopted by researchers. It was formulated to assess children aged from 5 to 12 years and can be filled within 15 minutes by parents or caregivers who lived with and observed the child. It consists of 75 items divided into (1) social participation; (2) vision; (3) hearing; (4) touch; (5) body awareness; (6) balance and motion; (7) planning and ideas; and (8) total sensory systems. The total can be calculated from the scores obtained on the five sensory system subscales – vision, hearing, touch, and additional items representing taste and smell processing. Each item is estimated based on the repetition of behavior on a 4-point Likert-type scale, i.e., (Never = 4, Occasionally = 3, Frequently = 2, Always = 1). Raw scores are calculated across eight scales. The overall score is estimated by summing all the subscales. The standard score for each subscale makes it possible to classify the child's functioning into one of three interpretive ranges: Typical (T-score range 40–59); Some Problems (T-score range 60–69); and Definite Dysfunction (T-score range: 70–80).

#### **Validity**

The face validity was revised by 5 specialists from the Psychiatric/Mental Health Nursing Department, Faculty of Nursing, Ain Shams University. Tools in the Arabic language were checked for relevance, clearance, comprehensiveness, and feasibility. The standardized tools were translated into Arabic language and back-translated into the English language by language experts.

#### **Reliability**

Cronbach's Alpha Coefficient test was used to determine the internal reliability of the tools. It was 0.91 for the interviewing questionnaire, 0.88 for knowledge, 0.87 for The Weiss Functional Impairment Rating Scale Parent Form, and 0.98 for Sensory Processing Measure- Home Form.

### **Pilot Study**

The pilot study was carried out on 10% of the studied children and their parents (6 in number) at the previously mentioned setting to test the clarity and applicability of the study. No modification was made, so the pilot sample was included in the study.

#### **Field Work:**

The actual fieldwork of the current study began in January 2023 and was completed by the end of July 2023.

#### **A. Assessment Phase:**

The study objectives were simply emphasized to the parents who agreed to participate with their children who fulfilled the inclusion criteria. After that, 60 children were chosen. Data were collected in the morning during the outpatient clinic in the previously mentioned setting (3 days/week Saturday, Monday, and Thursday). The parents of the studied children filled out the assessment tools within 40-50 minutes. The assessment phase took one month before implementing the program.

#### **B. Planning phase:**

Based on a comprehensive analysis of related literatures, sensory integrative intervention sessions were designed including objectives, teaching content, timing, photos, instructions, explanations, and examples. The intervention program content was reviewed by 5 experts in the Psychiatric/Mental Health Nursing fields to ensure its safety, covering the study objectives, the accuracy of information as well as its organization. The intervention content was also revised for the degree to which studies and theories supported the details of it. The intervention was applied by 6 children with ADHD before conducting the program, to ensure its applicability. No modifications were done and these children were included in the study.

C. Implementation phase:

Session no.	Name	Objective
1	Sensory processing and ADHD	Each parent obtains overview regarding sensory processing, sensory integrative disorder, and its relation to ADHD
2 & 3	Sensory perception	Improve the child's response to external stimuli through his/her vision, hearing, touch, smell, and taste.
4 & 5	Balance and motion	Ensure child safety, balance, and power while limiting impulsivity during balancing activities
6-8	Planning and idea	Enhance child cognition, concentration, and attention span
9	Body awareness	Improve the child awareness about body parts, position, and abilities
10 & 11	Social participation	Interact appropriately by following directions, show respect, and waiting for a turn

In the beginning, the researchers established a therapeutic relationship with the child to encourage and motivate him/her to play and perform activities. Different behavior modification techniques were used for the children while applying the sessions such as role play, shaping, positive reinforcement, premack principle, and token economy to ensure child participation and behavior modification. During each session, researchers provided instructions for developing and improving social skills by giving feedback on inappropriate behavior and social miscues and chaos, and planning play schedules for children with their peers. The session's duration was increased gradually to enhance the child's attention span starting from 30 minutes to reaching up to 60 minutes according to the child's attention span diversity and behavioral regulation.

Each parent obtained booklets and teaching media as a self-learning module. At the end of each session, the researchers provided explanations if needed to the parents and encouraged them to give their feedback, especially in the next session to discuss the children's progress and responses as well as explain any problems faced by the parents when they implement the program.

The first session of the sensory integrative intervention program included providing the parents with an overview of sensory processing and its relation to ADHD using lecture discussion and colored handout. All information given was repeated and illustrated. Then the parents attended with their children the next sessions to be trained on how to carry out the activities within the sessions and other assignments at home that included play-based

activities with enhanced sensation to encourage the child's adaptive behaviors.

The second and third sessions dealt with the *sensory perception* of vision, hearing, touch, smell, and taste, to improve *visual skills* and attention span, simple incomplete pictures or pictures with some changes were presented and the child was asked to discover the changes or missing elements, also the children were asked to find the object that is hidden between similar objects, another activity included the child to play with adding different colors to the jar-filling water and observe the colors inside the jar. The children also were asked to sort colored sticks according to their color. To improve *hearing skills*, The children were exposed to various musical pieces using headphones and were asked to choose their favorite music and explain the reasons, also they were asked to identify the sounds of different animals and transportation. Regarding improving *taste, smell, and touch*, the researchers brought different types of fruits and vegetables and asked the child to taste each type whether the food was sweet, salty, sour, bitter, hard, crunchy, or mushy. Furthermore, the children were encouraged to identify different smells of bottled liquids such as lemon juice, olive oil, and vinegar. The parents were instructed at home to ask their children to close their eyes and offered them simple foods to smell, taste, and guess. The researchers ensured that all children's activities were done successfully, and their parents understood how they could apply them at home.

After applying sensory sessions, the researchers started *balance and motion* sessions to improve child motor outcomes and ensure child safety, balance, and power while

limiting impulsivity during balancing activities the child was placed on a blanket that covered the floor then the blanket was pulled by other children in different directions in funny way. Also, every child was placed in an open box and then pushed by other children in different directions and in a funny way which enhanced the child's motion and balance while developing the skills of social participation and waiting for a turn, after these sessions, parents were informed to make the assignment in form of letting their children share other children during playing teeter-totter, riding swings, and slides.

**Planning and idea** sessions were applied to the children to enhance their cognition, concentration, and attention span by teaching them how to complete tasks with multiple steps as building a copy of models using blocks and puzzles according to the model and imitating demonstrated actions as movement games and songs with motion. They also were asked to create playing ideas, during these sessions the children were asked to put away materials and belongings in their correct places. Parents were asked to follow their children in performing their activities of daily living consistently and tidy their rooms.

Regarding **body awareness** sessions (bouncing on a trampoline or large ball, pushing activities, playing with weights) –That give the child knowledge about his/her body position. The children were asked to pass under a line of chairs that represented a tunnel, then the chairs were replaced with smaller chairs, and the children were asked to pass in a narrower tunnel which helped them know their space. The children were asked to arrange a sum of plastic cups in more than three lines to form a small wall without falling any of them. The parents were instructed to help their children activate their body sensations such as body brushing and massage while the child engaged in personal care activities. Parents were informed that systemic application of body sensations is essential to improve the child's behavioral regulation and decrease hyperactivity and agitation.

Regarding **social participation** sessions, the children were taught to play cooperatively without lots of arguments, follow directions,

show respect, share things with others when asked, and communicate well while maintaining eye-to-eye contact. At home, they were asked to participate appropriately in family outings and family gatherings.

#### **D. Evaluation phase:**

During the evaluation phase, the studied children were evaluated for the effect of sensory-integrative intervention by reassessing the study instruments immediately after implementing the program and after a 3-month follow-up. During the follow-up, the researchers obtained the assessment from the parents whether by phone or by meeting them in the outpatient clinics. So, the three phases of assessment were compared to detect significant changes and the program's effectiveness in the studied children.

#### **Administrative design**

The formal agreement was obtained from the dean of the Faculty of Nursing Ain Shams University to the director of the study hospital for the data collection and applying the program to the studied children.

#### **Ethical consideration**

Research agreement was obtained from the Faculty of Nursing - Ain Shams University Scientific Research Ethical Committee before conducting the study with ethical code 22.09.23. The patients were fully informed about the purpose and the study method, as well as written consent was obtained. They guaranteed that all the gathered data was confidential, anonymous, and used for research purposes only. Parents were informed that they could fall back from studying at any time.

#### **Statistical design**

The collected data was revised, coded, and entered using a personal computer (PC), and Statistical Package for Social Sciences (SPSS) version 25. Number and percentage distributions were used to assess children's characteristics. Pre, post, and follow-up assessments were estimated by the f-test (ANOVA) to estimate the program effects on the studied children by comparing the mean scores between the study variables by testing the P value significance. The Pearson correlation coefficient was used to study the

positive and negative associations between study variables.

### Results:

Table (1) shows that the mean age of the studied children was  $9.75 \pm 2.62$ . 56.7% of them were 6 to less than 8 years old, and 76.6% of them were male. Regarding their order among siblings, 43.3% of them were ranked as middle children. Moreover, 60.1% of them had no parental consanguinity.

Table (2) shows the mean age of the studied parents was  $33.43 \pm 4.22$ , 51.7% of them their age group was  $31 \leq 40$  years old, and 95% of them were mothers. Concerning marital status, less than 70.0% of them were married. Moreover, 61.7, & 65.0% of them finished their university education and were working respectively. As regards type of work, 51.3% of the working parents worked in administrative work. Regarding residence, 78.3% of them lived in urban areas. Also, 88.3% of them, their income wasn't enough. Additionally, 35.0% of them had three children.

Table (3): reveals that there were statistically significant differences regarding

knowledge about sensory integration between pre-, post, and follow-up of sensory integrative intervention among the studied parents ( $f\text{-test} = 4.19$  at  $p < 0.001$ ).

Table (4) shows that there were statistically significant differences between functional impairment domains of family, school, life skills, social activities, and risky activities, as well as total mean scores pre-, post, and follow-up of sensory integrative intervention application among the studied children in which  $f = 17.53, 18.17, 14.13, 11.82, 16.33, \& 22.89$  at  $p < 0.05$  respectively.

Table (5) shows that there were statistically significant differences between sensory process measure domains of social participation, body awareness, balance and motion, and planning and idea mean scores pre-, post, and follow-up of sensory integrative intervention application among the studied children in which  $f = 21.94, 19.69, 9.93, \& 22.89$  at  $p < 0.05$  respectively.

Table (6) shows that there was a weak positive correlation between functional impairment and sensory processing among the studied children with  $r = .315$  at  $p < 0.016$ .

**Table (1):** Frequency distribution of the studied children with ADHD according to their demographic characteristics (n=60).

Items	No.	%
<b>Age</b>		
▪ 6 to less than 8 years old	34	56.7
▪ 8 to less than 10 years old	11	18.3
▪ 10 to 12 years old	15	25
Mean± SD	<b>9.75± 2.62</b>	
<b>Sex</b>		
▪ Male	46	76.6
▪ Female	14	23.4
<b>Order</b>		
▪ 1 <sup>st</sup> child	17	28.3
▪ Middle child	26	43.3
▪ Last child	7	11.7
<b>Parental consanguinity</b>		
▪ Yes	23	38.3
▪ No	37	61.7

**Table (2):** Frequency distribution of the parents of the studied children according to their demographic characteristics (n=60).

Items	No	%
<b>Age</b>		
▪ 20 ≤ 30	24	40.0
▪ 31 ≤ 40	31	51.7
▪ More than 40	5	8.3
Mean± SD 33.43 ± 4.22		
<b>Sex</b>		
▪ Father	3	5.0
▪ Mothers	57	95.0
<b>Marital status</b>		
▪ Separated	4	6.7
▪ Married	42	70.0
▪ Divorced	4	6.7
▪ Widow	0	0.0
<b>Education</b>		
▪ Basic and less	9	15.0
▪ Secondary	4	6.7
▪ University	37	61.7
<b>Occupation</b>		
▪ Working	39	65.0
▪ Not working	21	35.0
<b>Type of work (n=39)</b>		
▪ Free work	13	33.3
▪ Professional	6	15.4
▪ Administrative	20	51.3
<b>Residence</b>		
▪ Urban	47	78.3
▪ Rural	13	21.7
<b>Income</b>		
▪ Enough	7	11.7
▪ Not enough	53	88.3
<b>Number of children</b>		
▪ 1	8	13.3
▪ 2	17	28.3
▪ 3	21	35.0
▪ 4	11	18.3
▪ More than 4	3	5.0

**Table (3):** Comparison between knowledge about sensory integration mean scores pre, post, and follow-up of sensory integrative intervention among parents of the studied children (n=60).

	Pre-intervention Mean±SD	Post-intervention Mean±SD	Follow up-Mean±SD	f-test
Total Knowledge	1.97±0.68	3.88±1.03	4.53.2±0.55	4.19**

\*\*Statistically significant at < 0.001.

**Table (4):** Comparison between functional impairment domains mean scores pre, post, and follow-up of sensory integrative intervention among the studied children (n=60).

WFIRS-P	Pre-intervention Mean±SD	Post-intervention Mean±SD	Follow up-Mean±SD	f-test
Family (max=30)	22.3±5.36	19.3±4.22	16.2±3.61	17.53*
School (max=30)	20.9±5.80	18.8±6.41	16.8±4.41	18.17*
Life skills (max=30)	21.6±4.37	18.7±5.63	16.5±3.78	14.13*
Child's self-concept (max=9)	6.8±2.84	6.2±1.99	5.9±1.61	16.96
Social activities (max=21)	14.2±4.92	12.3±3.34	9.5±2.16	11.82*
Risky activities (max=30)	10.4±2.37	8.7±4.08	7.3±3.98	16.33*
Total (max=150)	96.2±25.66	84±21.59	72.2±19.55	22.89*

\* Statistically significant at p < 0.05.



**Table (5):** Comparison between sensory process measure domains mean scores pre, post, and follow-up of sensory integrative intervention among the studied children (n=60).

SPM-H	Pre-intervention Mean±SD	Post-intervention Mean±SD	Follow up-Mean±SD	f-test
Social participation	67.9±7.03	65.2±6.91	60.1±8.23	21.94*
Vision	61.5±9.4	59.9±10.1	59.3±8.7	15.11
Hearing	59.6±8.2	58.9±7.8	58.2±6.9	16.27
Touch	57.3±11.6	56.8±10.5	56.1±9.8	8.57
Total Sensory System (TOT)	67.5±11.32	67.2±10.67	66.9±11.21	24.13
Body awareness	63.4±7.6	62.9±8.3	61.1±6.1	19.69*
Balance and motion	62.6±10.5	61.9±11.7	59.4±9.6	9.93
Planning and idea	63.41±9.3	61.99±10.2	59.23±7.6	22.89*

\* Statistically significant at  $p < 0.05$ .

**Table (6):** Correlation between sensory processing and functional impairment among the studied children (n=60).

Variables	Sensory processing	
	r	P value
Functional impairment	.315	.016*

\* Statistically significant at  $p < 0.05$ .

### Discussion:

The sensory integration approach is a type of intervention focused on enhancing sensory stimulation and function among children with special needs and behavioral disorders. It helps the children acquire sensory information and skills by providing them with some playing and occupational activities (**The American Academy of Pediatrics, 2012**).

Assessing the demographic characteristics of the studied children, the current results showed that more than half of their age group was from 6 to less than 8 years old, and more than three-quarters of them were males. This may be due to ADHD behavioral symptoms being more prevalent at the time of preschool and school age as well the disorder is more common among boys. These results were supported by **Mohamed, et al., (2016)** and **Mowlem, et al., (2018)** who found that children with ADHD are common in preschool and school age and affected boys more than girls.

Regarding the parents' characteristics of the studied children, more than half of the studied parents' age group was  $31 \leq 40$  years old and almost all of them were mothers. This may be due to the common parents' age based on our culture to have preschool and school children from their thirties to forties years and

caregiving is part of mother roles. These findings were congruent with the study of **Hussein, (2019)** who asserted that many parents with ADHD aged from 31 to 40 years old and were mothers. Furthermore, the present study showed that about two-thirds of the studied parents had universal education and jobs. This may be because ADHD was difficult to detect among the less-educated parents as they considered hyperactivity as a part of normal child development. In addition, this study agreed with the study of **Moawad, et al., (2022)** and found that more than half of studied parents had higher levels of education, while the less educated constituted a low percentage.

Concerning knowledge about sensory integration before, after, and follow-up of applying sensory integrative intervention among the studied children, there was a statistically significant difference in the mean scores between the three phases. It means that parents became more aware of all aspects of the sensory integration approach, its benefits, and its mechanisms. Increasing knowledge among parents of the studied children may be related to parents' interest and hope regarding the good prognosis of their children's conditions. Furthermore, about two-thirds of parents in the current study had universal educational levels that helped the researchers to provide detailed information about sensory

integration and answer any parents' questions and inquiries. The current study agreed by **Faramarzi, et al, (2016)** who assessed "the effect of sensory integration training on executive functions of children with attention deficit hyperactivity disorder" and found statistically significant improvements in parents' knowledge about sensory integration after program implementation and asserted the importance of acquiring information about the importance and techniques of sensory functions for children with ADHD.

In comparison to the ADHD degree of functional impairments before, after, and follow-up of implementing the sensory integrative intervention, the static differences were found in all aspects of the scale after three phases. Before the sensory integrative intervention, children obtained low mean scores of functional impairments as reported by their parents which reflected that the studied children suffered from difficulties in all aspects of sensory integration. The current study was supported by **Jegadeesan, et al., (2020)** who compared the level of sensory processing dysfunction between Children with Attention Deficit Hyperactivity Disorder and Typically Developing Children and found that the majority of children with attention deficit hyperactivity disorders had higher levels of functional impairments and sensory processing problems in contrast to typically developed children. In the current study, the parents of the studied children reported the children's improvement in some aspects of the functional impairment domains after practicing the sensory integration-related activities. Regarding the family domain, the studied children paid better attention to all family members, and they made less trouble and quarrelsome with their siblings at home. Regarding the school, the parents reported although their children were still achieving low grades, they became more responsive to completing their homework. Regarding the studied children's life skills, the parents stated that their children improved their performance of daily activities such as morning care and improved their sleep and eating. Concerning the social activities among studied children, the parents accounted that their children made fewer problems when they played with friends.

Regarding the risky activities, the parents mentioned that their children became less damaged by their toys and other stuff at home as well and they became less engaged in doing dangerous things. These results were supported by **Salami et al., (2017)** who studied "The effectiveness of combination therapy (based on executive function and sensory Integration on symptoms of attention-deficit hyperactivity disorder" and found that the sensory integration approach reduces the symptoms related to inattention and hyperactivity of children with ADHD. The results of the present study were also supported by **Mirzakhani & Shahriarpour, (2021)** who wrote a review of articles studied 41 types of research aimed to assess the effect of sensory integrative approach on children's skills and development among children with autism, ADHD, and learning disabilities. The previous study asserted the benefits of sensory integration intervention in regulating school activities, daily activities, and family and social interactions among the studied children.

Concerning the sensory process measure domains pre-, post, and follow-up of sensory integrative intervention among children with attention deficit hyperactivity disorder, there were statistically significant improvements in the means scores of social participation, body awareness, balance and emotion, and planning and ideas throughout the three phases of assessments. The parents submitted higher scores after implementing the sensory integration intervention in the following aspects of the previously mentioned SPM domains as follows: they accounted for the improvements in the children's social skills such as playing with friends, maintaining appropriate eye contact, and sharing with family conversation during the meal. Regarding body awareness, many parents reported improvements in their children's abilities to grasp objects appropriately such as pencils and spoons. They mentioned also less likely to break their toys and slam doors as well as decreased the times of pushing their siblings and friends. Regarding balance and motion, the parents reported that their children improved their balance with better coordination and maintained standing and sitting down for a longer duration of time. Regarding the

children's abilities to plan and ideas, the parents accounted for improvements in task completion with proper sequence such as homework and organizing their stuff. They mentioned also that their children can deal with new games better than before. It can be observed from the findings of the present study that children with ADHD showed improvements in their motor, cognitive, and social skills as reported by the parents after implementing the sensory integrative intervention. The findings of the present study agreed with **Sanz-Cervera, et al., (2017)** who compared the effect of sensory processing in children with autism spectrum disorder and attention deficit hyperactivity disorder in the home and classroom contexts and found that the children with attention deficit hyperactivity disorder achieved higher scores of functions than the children with autism spectrum disorder regarding the body Awareness and social participation subscales. The findings of the present study also agreed with **Hemant & Ferzand, (2020)** titled "sensory integration for the children with attention deficit hyperactivity disorder (ADHD)" and found improvements in self-care, academics, and interpersonal interactions among children with ADHD after providing the sensory integration program.

Studying the association between sensory processing measure with functional impairment, there was a weak positive correlation between the two variables. It means that a higher level of sensory dysfunction is associated with a greater increase in function problems among children with ADHD. This study was parallel to the study of **Sanz-Cervera, et al., (2015)** who tested "the relationship between sensory processing, and social participation among children with ADHD" and found that sensory processing problems were associated with impaired in social interaction among children with ADHD. The current study was also supported by **Panagiotidi, et al., (2020)** who tested "the relationship between sensory processing sensitivity (SPS) and symptoms of attention deficit hyperactivity disorder", the study found a positive relationship between sensory processing and ADHD characteristics in the general population and asserted ADHD characteristics can expect sensory dysfunction among affected children.

The current study proved that sensory integrative intervention produced admirable effects on the child's cognitive, motor, and social skills throughout the three assessment phases. The parents of the studied children reported obvious improvements in the aspects of functional impairments (family, school, life skills, social activities, and risky behaviors), and sensory processing (social participation, body awareness, balance and motion, and plan and ideas).

### **Conclusion:**

The current study concluded that the sensory integrative intervention had significantly enhanced motor, cognitive, and social skills among children with ADHD through improvements in the functional impairments and sensory processing scales. The parents of the studied children reported lower mean scores of functional impairments and sensory processing measure scales after and follow-up phases of implementing the sensory integrative intervention compared to the pre-assessment phase. Moreover, the current study revealed that there was a positive correlation between the study variables, sensory processing measure, and functional impairments scales.

### **Recommendations:**

- Repetition of the current study with other children with special needs and intellectual disabilities to evaluate the effect of sensory integrative intervention on the child's functions.
- Adapting Sensory Processing Measures as a routine screening tool by psychiatric mental health care practitioners as part of the child's assessment with special needs to develop a comprehensive intervention based on addressing the sensory processing dysfunction.
- Future systemic review research to evaluate the different studies that implemented the various feasible sensory processing techniques to improve the child's quality of life.
- Psychiatric/mental health nurse practitioners as should adopt sensory integration skills and techniques during caring for and dealing with ADHD and other children with special needs in different healthcare settings

as a part of their clinical role in conjunction with the relevant medical team.

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