ORIGINAL ARTICLE

EFFECTS OF SENSORY INTEGRATION THERAPY ON SELECTED FITNESS SKILLS IN AUTISTIC CHILDREN

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ABSTRACT

Introduction: Autism is a pervasive developmental disorder characterised by abnormal development in the first two years of life and impairment with respect to the following three areas: social interactions, communication, and behaviour. The disorder is more common in males than females.

The aim: The study was conducted to assess the effects of sensory integration therapy on selected fitness skills in autistic children.

Material and methods: The study assessed a group of 20 children (15 boys and 5 girls) aged 3 to 10 years. All children were diagnosed with autism and underwent 2-year therapy. The children showed impaired sensory modulation with abnormal stimulus reception and processing in the tactile, auditory, vestibular (balance), olfactory, and gustatory sensory systems. The study assessed fitness skills and their correlations with sensory integration therapy used in the children. The assessment used the Sensorimotor Development Questionnaire developed by Zbigniew Przyrowski and selected tests from "Obserwacja Kliniczna" as well as history-taking conducted with the parents. The following aspects were analysed: muscle tone, static balance, dynamic balance, jumping on two legs, jumping on one leg, catching and throwing a ball, and self-care activities, such as putting on shoes.

Results: Sensory integration therapy contributed to an improvement in motor, sensory, cognitive, emotional, communication, and social development in the study patients.

Conclusion: The use of sensory integration effectively supports sensory processes in autistic children.

KEY WORDS: autism, treatment, sensory integration

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INTRODUCTION

Autism is seen as a developmental disorder, probably determined by biological causes, and manifesting itself in various aspects of a child's functioning [1-6].

Eric Fombonne [7] reviewed 43 population-based studies from different countries and found a prevalence rate of classic autism ranging from 0.7/10,000 to 72.6/10,000, with the disorder being 3 to 4 times more common in males than in females.

Autism is a pervasive developmental disorder whose onset occurs in early childhood, usually in the first two years of life. Its symptoms may vary in degrees and severity and affect the basic aspects of functioning, mainly the following three areas: social interactions, communication, and behaviour. Autistic children often receive, process, and experience sensory stimuli (visual, auditory, tactile, olfactory, and gustatory stimuli) differently. Autistic children ignore certain sounds and over-react to other sounds. They avoid visual stimuli and have very limited eye contact. Sensory integration problems are common, manifesting themselves mostly as various types of auditory, tactile, visual, gustatory, or olfactory hypersensitivity or hyposensitivity. An estimated 40% of autistic children have some form of sensory sensitivity abnormalities [2-15]. Sensory modulation disorders are the most common disorders in autistic children; they can be divided into two main groups, namely hyperactivity and hypoactivity.

Hyperactive children show a high level of stimulation, are often irritable, loud, and overactive. Hypoactive autistic children show a low level of stimulation, are passive and withdrawn, do not respond to attempts at communication, instructions, and situations around them. Sensory integration disorders make autistic children unable to appropriately process the stimuli received by their nervous system.

THE PRINCIPLES OF SENSORY INTEGRATION THERAPY

Dr A. J. Ayres, who was a psychologist, occupational therapist, and faculty member at the University of California, is considered to be the author of the sensory integration method.

Sensory integration is a neurological process that organises sensations from the body and the environment so that they can be used to perform intentional actions. Senses provide us with information about the physical condition of our body and the environment. The role of the brain is to locate, sort, and organise the stimuli. When sensations flow in a well-organised and integrated manner, the brain is able to use them to form perceptions, behaviours, and to learn [16, 17, 19-22].

A. J. Ayres based the concept of sensory integration on the development of sequencing and described it in four stages. Stage 1 includes foetal development and infancy;

Stage 2 refers to the first year of life, when the most important processes consist in combining vestibular and tactile stimuli with proprioception as well as the development of perception of one's own body. Stage 3 starts after the first year of life of the child and ends at the age of three years; in this period, the child integrates vestibular, tactile, and proprioceptive stimuli with visual and tactile stimuli as well as develops visual and auditory perception and object manipulation abilities (eye-hand coordination). Stage 4 encompasses kindergarten and early school education and is associated with the development of interhemispheric communication and hemispheric specialisation.

Diagnosing sensory integration processes in an autistic child is a difficult task that requires the therapist to observe the child's activity very closely.

SENSORY INTEGRATION THERAPY: SELECTED EXERCISES

Every autistic child has their own individual sensory profile, with abnormalities whose extent and severity may vary. The sensory integration method is a type of treatment used to work with autistic children. The therapy is adjusted to the needs and mental and physical abilities of each patient. Sensory integration therapy used in autistic children includes the integration of basic postural responses and stimulation of the development of balance reflexes, praxis, spatial orientation, and lateralisation of superficial and deep sensation (Fig. 1). Exercises are selected to improve fine and gross motor skills, concentration, and self-awareness; they become a way to play and learn (Fig. 2).

The following types of equipment are used for the therapy: various types of swings, hammocks, platforms, balance beams, sensory balls, rolling pins, skateboards, spinning plates, helicopters etc. During the therapeutic sessions, children perform appropriately selected sensorimotor exercises not to learn specific exercises, but to improve the function of their sensory systems.

THE AIM AND RESEARCH METHODS

The study was conducted to assess the effects of sensory integration therapy on selected fitness skills in autistic children.

1. Did study patients show improvements in their emotional, social, cognitive, motor, sensory, and communication development during 2-year sensory integration therapy?
2. Are there correlations between the severity of autism and improvements in fitness skills in children?
3. Are there correlations between age and improvements in fitness skills in children?

Mean values and standard deviation ($\bar{x}\pm SD$) were calculated to compare changes in cognitive, emotional, social, and motor development after sensory integration therapy. The significance of the data was tested with Student's t-test for independent samples. The same calculations were performed to analyse the separate areas of psychomotor development and to verify the efficacy of each study method. The significance level was set at $p<0.05$. The results are presented in tables and figures. The data was assessed with Student's t-test for independent samples. A chi-square test was also used to explore correlations between two variables. The study evaluated the effects of sensory integration therapy on fitness skills in children.

The study used a modified version of the survey questionnaire developed by Zbigniew Przyrowski [18]. The questions were designed to make it easy for parents to answer whether and how sensory integration therapy influenced selected fitness skills in their children. The study was conducted between 2017 and 2019. The study group consisted of 20 children (15 boys and 5 girls) diagnosed with early infantile autism, aged 3 to 10 years. The children underwent sensory integration therapy at the Psychological and Pedagogical Counselling Centre in Staszów and its branch in Połaniec as part of early development support in young children.

MATERIAL AND RESULTS

The study enrolled 15 boys and 5 girls (Tab. I). The largest age group consisted of children aged 6 years (25%); the age of 3 years was reported in 20% of study patients, 8 and 9 years in 15% each, 7 and 10 years in 10% each, and 5% of study patients were aged 4 years (Tab. II).

In the study group, 25% of children had severe autism, 40% were diagnosed with moderate autism, and 35% had mild autism (Tab. III).

At the time of the study, 5% of study patients had been undergoing therapy for a month, 15% for 6 months, and 80% for more than 2 years (Tab. IV)

Study patients underwent therapy twice a week (30%), once a week (55%), or every two weeks (15%) (Tab. V).

The duration of a single therapeutic session was 60 minutes (60%) or 45 minutes (40%) (Tab VI).

In the study group, some children calmed down and focused (10%), most were happy to perform the activities (60%), some were distracted and unable to focus (25%), and some participated in the sessions with reluctance (5%) (Tab VII). Sensory integration therapy had a low (15%), moderate (60%), or high (25%) impact on improvements in balance (Tab. VIII). Sensory integration therapy had a low (20%), moderate (45%), or high (35%) impact on improvements in motor planning (Tab. IX) Sensory integration therapy had a low (20%), moderate (35%), or high (45%) impact on improvements in eye-hand coordination (Tab. X). Sensory integration therapy had a low (10%), moderate (40%), or high (50%) impact on improvements in fine motor skills and lateralisation. (Tab. XI)

In the study group, after sensory integration therapy 10% of children seemed weaker than other children of the same age, 5% seemed to be stronger than other children, 10% had a normal posture and normal grip strength, and 75% were much better at controlling their body posture (Tab. XII). .

All children (100%) showed improvements with respect to the motor and sensory parameters. Social aspects were improved in 95% of study patients, emotional and cognitive aspects in 90% of cases, and communication in 85% of study patients.

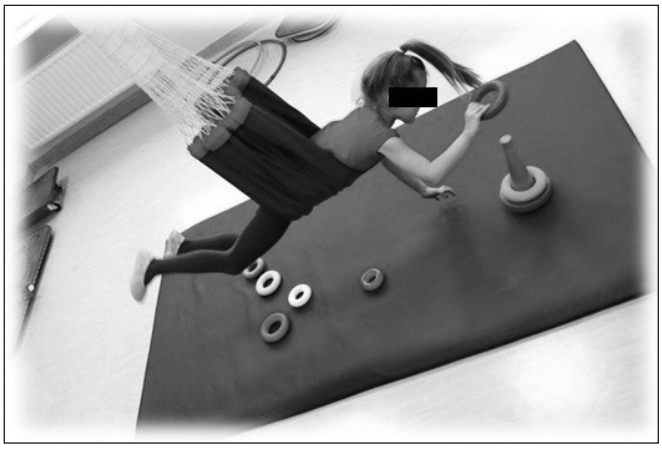

Fig. 1. Stimulation of the vestibular system in a hammock, combined with putting rings on a cone

Fig. 2. Stimulating the proprioceptive system by wrapping a child in a sleeping mat

The study evaluated the effects of sensory integration therapy on fitness skills in children; a chi-square test for independence was used (Tab. XIII).

Based on the test (p=0.3025), no significant difference was found between the values obtained before and after therapy with respect to the ability to stand on one leg (Tab. XIV)

Based on the test (p<0.0001), a significant difference was found between the values obtained before and after therapy with respect throwing and catching a ball; the therapy significantly increased the number of children able to perform this activity (Tab. XV).

Based on the test (p<0.0001), a significant difference was found between the values obtained before and after therapy with respect to jumping on two legs; the therapy significantly increased the number of children able to perform this activity (Tab. XVI

Based on the test (p=0.3474), no significant difference was found between the values obtained before and after therapy with respect putting on shoes.

The study assessed the impact of the severity of autism on improvements in fitness skills; a chi-square test for independence was used (Tab. XVII)..

Based on the test (p=0.4522), no significant correlation was found between improvements in fitness skills and the severity of autism. (Tab. XVIII).

Table I. Gender of study patients

Gender of study patients	Number	[%]
Boy	15	75%
Girl	5	25%

Table II. Age of study patients

Age of study patients	Number	[%]
3 years	4	20%
4 years	1	5%
6 years	5	25%
7 years	2	10%
8 years	3	15%
9 years	3	15%
10 years	2	10%

Table III. Degree of autism

Degree	Number	[%]
Severe	5	25%
Moderate	8	40%
Mild	7	35%

Table IV. Duration of therapy

Duration of therapy	Number	[%]
A month	1	5%
Six months	3	15%
More than 2 years	16	80%

Table V. Session frequency

Session frequency	Number	[%]
Twice a week	6	30%
Once a week	11	55%
Every two weeks	3	15%

Table VI. Therapeutic session duration

Therapeutic session duration	Number	[%]
45 minutes	8	40%
60 minutes	12	60%

Table VII. Child's behaviour during therapeutic sessions

Child's behaviour during therapeutic sessions	Number	[%]
Calm and focused	2	10%
Happy to perform the activities	12	60%
Distracted and unable to focus	5	25%
Participates with reluctance	1	5%

Based on the test (p=0.2835), no significant correlation was found between improvements in fitness skills and the severity of autism (Tab. XIX).

Table VIII. Impact of sensory integration therapy on balance improvements

Impact of sensory integration therapy on balance	Number	[%]
Low	3	15%
Moderate	12	60%
High	5	25%

Table IX. Impact of sensory integration therapy on improvements in motor planning

Impact of sensory integration therapy on motor planning	Number	[%]
Low	4	20%
Moderate	9	45%
High	7	35%

Table X. Impact of sensory integration therapy on improvements in eye-hand coordination

Impact of sensory integration therapy on eye-hand coordination	Number	[%]
Low	4	20%
Moderate	7	35%
High	9	45%

Table XI. Impact of sensory integration therapy on improvements in fine motor skills and lateralisation

Impact of therapy on improvements in fine motor skills and lateralisation	Number	[%]
Low	2	10%
Moderate	8	40%
High	10	50%

Table XII. Impact of sensory integration therapy on improvements in muscle tone

No.	Impact of sensory integration therapy on improvements in muscle tone	Number	[%]
A	Seems to be weaker than other children, with abnormal posture when sitting, standing	2	10%
B	Seems to be stronger than other children, with excessive grip strength	1	5%
C	Has a normal posture and normal grip strength	2	10%
D	Much better at controlling posture, stumbles less often, has a better grip strength, objects do not fall out of his/her hands	15	75%

Table XIII. Improvements in individual aspects after therapy

Aspects	Number	[%]
Social	19	95%
Emotional	18	90%
Cognitive	18	90%
Motor	20	100%
Sensory	20	100%
Communication	17	85%

Table XIV. Standing on one leg

Standing on one leg	Before	After	Total
Able	1	3	4
[%] column	5%	15%	
Unable	19	17	36
[%] column	95%	85%	
Total	20	20	40

Table XV. Throwing and catching a ball

Throwing and catching	Before	After	Total
Able	0	16	16
% column	0%	80%	
Unable	20	4	24
% column	100%	20%	
Total	20	20	40

Table XVI. Jumping on two legs

Jumping on two legs	Before	After	Total
Able	2	14	16
[%] column	10%	70%	
Unable	18	6	24
[%] column	90%	30%	
Total	20	20	40

Table XVII. Putting on shoes

Putting on shoes	Before	After	Total
Able	15	17	32
[%] column	75%	85%	
Unable	5	3	8
[%] column	25%	15%	
Total	20	20	40

Based on the test (p=0.2096), no significant correlation was found between improvements in fitness skills and the severity of autism (Tab. XX)

Based on the test (p=0.0275), a significant correlation was found between improvements in fitness skills and the severity of autism; the lower the severity of the disorder, the higher the probability of improvements (Tab. XXI).

Table XVIII. Standing on one leg

Autism	No improvement	Improvement	Total
Severe	4	1	5
[%] column	22%	50%	
Moderate	8	0	8
[%] column	44%	0%	
Mild	6	1	7
[%] column	33%	50%	
Total	18	2	20

Table XIX. Jumping on one leg

Autism	No improvement	Improvement	Total
Severe	4	1	5
[%] column	24%	33%	
Moderate	8	0	8
[%] column	47%	0%	
Mild	5	2	7
[%] column	29%	67%	
Total	17	3	20

Based on the test (p=0.2096), no significant correlation was found between improvements in fitness skills and the severity of autism (Tab. XXII)

Student's t-test for independent samples was used. The test did not show any significant correlation between age and improvements in fitness skills in children as a result of sensory integration therapy (Tab. XXIII).

DISCUSSION

Recently, autism has been one of the most commonly diagnosed developmental disorders in children. The first manifestations of autism can be seen very early, in the first two years of a child's life. People with autism spectrum disorders are different in terms of behaviour, thought processes, and everyday functioning. They withdraw into their own world, which is often impossible to understand for others. They detect sensory stimuli from the environment differently from non-autistic people, and their nervous system is unable to appropriately process the stimuli. Consequently, their behaviour may be difficult to understand: they may shake their hands, jump in place, walk on their toes, scream, screech, hit their own head with their hands etc. Their speech may be incomprehensible, with an incorrect accent. Autistic people often have difficulty establishing normal relations with others. Early detection of the disorder and management supporting the psychomotor development of autistic children are very important. Moreover, it is important to adjust the therapy to each patient. An assessment of the effects of sensory integration therapy in the study patients showed that the motor performance of these children improved significantly after treatment.

Table XX. Throwing and catching a ball

Autism	No improvement	Improvement	Total
Severe	2	3	5
[%] column	50%	19%	
Moderate	2	6	8
[%] column	50%	38%	
Mild	0	7	7
[%] column	0%	44%	
Total	4	16	20

Table XXI. Jumping on two legs

Autism	No improvement	Improvement	Total
Severe	3	2	5
[%] column	38%	17%	
Moderate	5	3	8
[%] column	63%	25%	
Mild	0	7	7
[%] column	0%	58%	
Total	8	12	20

Table XXII. Putting on shoes

Autism	No improvement	Improvement	Total
Severe	3	2	5
[%] column	19%	50%	
Moderate	6	2	8
[%] column	38%	50%	
Mild	7	0	7
[%] column	44%	0%	
Total	16	4	20

Table XXIII. The impact of age on improvements in fitness skills.

Impact of age on fitness improvements	No improvement		Improvement		T	P
	Mean	SD	Mean	SD		
Standing on one leg	6.3	2.4	8.5	0.7	-1.2426	0.2299
Jumping on one leg	6.4	2.5	7.3	1.5	-0.6099	0.5495
Throwing and catching a ball	6.3	3.8	6.6	2.1	-0.2758	0.7859
Jumping on two legs	7.0	2.9	6.3	2.0	0.6828	0.5034
Putting on shoes	6.1	2.3	8.5	1.7	-1.9727	0.0641

The study enrolled 20 children aged 3 to 10 years., including 15 boys and 5 girls, with mild to moderate autism, and assessed their fitness skills before and after sensory integration therapy. The following aspects were analysed: standing on one leg, jumping on two legs, eye-hand coordination improvement, throwing and catching a ball, tying up shoelaces, improvements in fine motors skills and lateralisation, and improvements in muscle tone.

The present study showed that after two years of sensory integration therapy, autistic children had improved social, emotional, cognitive, sensory, and communication functioning. The children were very happy to participate in the sessions, which were conducted using play techniques.

An assessment of the results of sensory integration therapy in study patients revealed significant differences in such fitness skills as jumping on two legs and catching and throwing a ball. However, there were no significant differences in standing on one leg or jumping on one leg. This could be explained by the low baseline values of motor skills in the study group, or the severity of autism; 40% of the children had moderate autism and 25% were diagnosed with severe autism. Their motor developmental deficits (of the vestibular and proprioceptive systems) may be so severe that they do not allow for achieving higher values.

CONCLUSIONS

1. Sensory integration therapy contributes to an improvement in motor, sensory, cognitive, emotional, communication, and social development in the study patients.
2. Sensory integration therapy improves such fitness skills as throwing a ball, jumping on two legs, and catching a ball.
3. Motor function improvements in autistic children depend on early initiation of therapy.

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Conflict of interest

Authors declare no conflict of interest

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