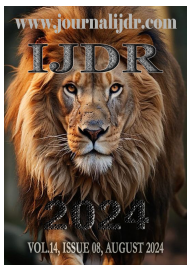
ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 14, Issue, 08, pp. 66420-66424, August, 2024
https://doi.org/10.37118/ijdr.28620.08.2024



RESEARCH ARTICLE OPEN ACCESS

COMPARATIVE STUDY OF EVALUATION OF SENSORY PROCESSING DISORDER WITH THE ATLAS.TI

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ARTICLE INFO

Article History:
Received 11th May, 2024
Received in revised form
26th June, 2024
Accepted 18th July, 2024
Published online 30th August, 2024

Key Words:
Sensory, Sensory processing Disorder, Occupational Therapy.

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ABSTRACT

Sensory Processing Disorder (SPD) is reflected in unexpected actions and inappropriate behavior for no apparent reason. It is a complex condition that involves the central nervous system and is not evident in clinical examinations. Introduction: Identifying the patient's reactions to everyday situations helps health professionals to recognize sensory integration difficulties and establish a treatment plan, which begins with assessment. Objective: To identify the assessment most commonly adopted by SPT researchers. Method: A systematic review was carried out looking for articles dealing with research related to SPT. Results: The most frequently cited assessments were the Sensory Integration and Praxis Test (SIPT), the Sensory Profile and the Sensory Processing Measure (SPM), which are generally used in conjunction with each other and with other instruments to complement the assessment. Studying the assessments aimed at this disorder, as well as those adopted in a complementary way, allows us to uncover the nuances and singularities found in this context. Conclusion: Although there is a gold standard for diagnosing SPD, none of the existing instruments is sufficient to be adopted as a single standard.

Citation*: *Thais Caroline Pereira, Dilmeire Sant'Anna Ramos Vosgerau and Claudia Maria Cabral Moro Barra. 2024. *"Comparative study of Evaluation of sensory processing disorder with the Atlas.Ti". International Journal of Development Research*, 14, (08), 66420-66424.

INTRODUCTION

Sensory processing refers to the recording, organization and interpretation of information received from the environment, carried out by the central nervous system (1,2) with reactions to these stimuli(3,4), which, when they do not correspond to the stimulus received, denote Sensory Processing Disorder (SPD)(5). Identifying the reactions (motor action, emotional reaction, cognitive process, interpersonal interaction or communicative emission)(6) that are not consistent with the stimuli received helps the health professional to establish a treatment plan, in order to adapt them and, consequently, intervene so that the patient understands the stimuli to be offered, optimizing the treatment time. There are different instruments for assessing SPT, with different and sometimes complementary approaches. Assuming that the one most commonly adopted by researchers in this field is the most appropriate, it is important to identify which assessment is the most common. To do this, a systematic review is necessary, and the use of a computer tool, such as ATLAS.ti, can help in this process. ATLAS.ti is research software that allows a wide variety of possibilities for using it to explore documents, which can be in the form of text, images, audio recordings and video clips (7), through qualitative analysis of its data(8), allowing up to four documents to be explored simultaneously (7). Assuming that the therapeutic procedure involves diagnostic identification (assessment), therapeutic intervention and results (outcomes), it is important to identify good assessment tools, which will be useful at the time of diagnosis and as an outcome measure. The aim of this study was therefore to identify, using the ATLAS.ti tool, the most frequently cited assessment in the literature for measuring SPT.

METHODOLOGY

The research was carried out in four stages: 1) identification of the search terms; 2) identification of the database; 3) identification of the articles; 4) and identification of the evaluations.

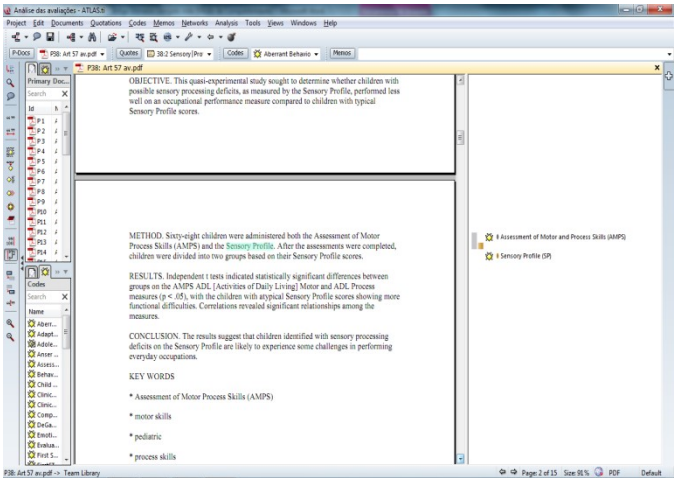
Identification of search terms: In order to identify the terms to be adopted to carry out the search by subject, a search began, using the term "sensory integration" in Portuguese and English, where it was observed that the largest reference is in English, in addition to having identified the term "sensory processing" used as a synonym.

Identifying the database: Next, an advanced search by subject was carried out on the CAPES Periodical Portal, using the terms "sensory and integration and processing". The date of publication was established using any year as a criterion, since the number of articles searched from the last 2 and 20 years (minimum and maximum times offered by the Portal) was exactly the same, 548 articles. The database containing the largest number of articles was identified, Gale Cengage Learning, with 32.

Identification of articles: In order to identify the assessment most commonly adopted by researchers of this disorder, a systematic review was carried out. To this end, the search was carried out in the identified database, Gale Cengage Learning, using the terms "sensory and integration and processing" in the first field and, thinking of terms related to forms of evaluation, "test and observation and evaluation and checklist" in the second field. 79 articles were found. To select these, we read the methodologies adopted, where it would be possible to identify the evaluation instruments used. A total of 47 articles were excluded, which only dealt with treatments and treatment results, but did not mention the evaluations adopted. In the end, 32 articles were selected.

Identification of evaluations: The 32 articles selected were entered into ATLAS.ti and explored by coding with the name of the assessment identified in the text passages containing this information, as shown in Figure 1:

Figure 1. Exploring the document in the ATLAS.ti software



Twelve (12) articles cited only SPT assessments, but the majority, twenty (20), cited these in association with other complementary assessments. The articles that used a greater variety of assessments in their research, where the criterion was more than five, are shown in Table 1, where the titles of the articles are shown in the first column, the number of assessments cited in each article in the second, and the year of publication in the third, indicating that research in this area is recent.

Table 1. Articles citing the greatest variety of assessments

Articletitle	N° of evaluation	Year
Occupational therapy using sensory integration to improve participation of a child with autism: a case report.	5	2012
Sensory Overresponsivity and Anxiety in Typically Developing Children and Children With Autism and Attention Deficit Hyperactivity Disorder: Cause or Coexistence?	5	2012
Sensory-processing disorder in children with cochlear implants.	5	2009
A randomized controlled pilot study of the effectiveness of occupational therapy for children with sensory modulation disorder.	6	2007

The SPT assessments most commonly found in this research are shown in Table 3, where the first column shows the SPT assessments themselves, the second column shows the variations in the way these assessments are presented, according to different demands, and the third column shows the number of articles in which they were cited.

Table 2. Most widely used SPT assessments

Evaluation	FORMS OF PRESENTATION	Nº. Articles
Sensory Profile	*Adolescent/AdultSensory Profile (AASP)*	1
	Infant/ToddlerSensory Profile	3
	Sensory Profile (SP)	12
	Sensory Profile (SP) Care-giver Questionnare	1
	Sensory Profile Questionnaire (SPQ)	2
	Sensory Profile School Companion	1
	Short Sensory Profile (SSP)	7
Sensory Integration and Praxis Tests (SIPT)	*Sensory Integration and Praxis Tests (SIPT)*	6
	PostrotaryNystagmus Test (PRN)	1
	Southern California Post Rotary Nystagmus Test (PRN)	1
	Southern California Sensory Integration Tests ou Sensory Integration and Praxis Tests	1
	Vestibulo-ocular reflex (VOR)	1
SensoryProcessingMeasure (SPM)	*SensoryProcessingMeasure (SPM)*	2
	Sensory Processing Measure (SPM) Home Form	1

As mentioned above, most of the articles researched presented SPT assessments accompanied by other assessments, which are aimed at other factors but which, depending on the focus of the article, are adopted in a complementary way. Table 3 shows the SPT assessment instruments most frequently cited in the articles, followed by the instruments to which they are associated in more than one article, and the number of articles that associated them.

Chart 3. Combinations of assessments identified in the review

EVALUATION	ASSOCIATED ASSESSMENTS	N° ARTICLES
Sensory Profile	*Sensory Experience Questionnaire*	2
	SIPT	3
	SPM	2
Sensory Integration and Praxis Tests (SIPT)	*Sensory Profile*	3
	SPM	2
Sensory Profile Measure (SPM)	*SIPT*	2
	Sensory Profile	2

Next, the combinations of evaluation instruments were analyzed, considering the most recurrent ones and those that provide information and discussions that can contribute to expanding the view of sensory integration and its wealth of application possibilities.

RESULTS

In the review carried out, the most recurrent assessment tool was the Sensory Profile, cited in 12 articles. This instrument is presented in various forms: Sensory Profile, Infant/Toddler Sensory Profile, Adolescent/Adult Sensory Profile, and Sensory Profile School Companion(9).In second place, the assessment that appeared most often was the Sensory Integration and Praxis Tests (SIPT) and, in third place, the Sensory Processing Measure (SPM). It was also possible to identify that, in general, sensory integration assessments are combined with other instruments adopted in a complementary way, such as the Sensory Profile, which was accompanied by the Preschool Behavior Questionnaire and the Revised Children's Manifest Anxiety Scale, among others. The Sensory Profile makes it possible to assess the child's reactions to everyday situations, which are determined by sensory processing and the impact this has on functional performance(10). It is a questionnaire to be answered by

caregivers, describing 125 behaviors that can be observed in the child. Caregivers should mark those that they identify, using a five-point Likert scale to distinguish the frequency with which they are observed. For its development, 1,037 children aged between 3 and 10 were studied, considering sensory processing, modulation and behavioral and emotional responses (11). It isassociated with the following assessment instruments:

1) *Sensory Experience Questionnaire:* identifies sensory processing patterns, which can be hyper- or hyporesponsive(12);
2) *Vineland Adaptive Behavior Scales:* identifies adaptive behaviors(13) and investigates the development and functional performance of people with and without disabilities(14);
3) *Pervasive Developmental Disorder Behavioral Inventory:* aimed at identifying the responsiveness to treatment of children with Pervasive Developmental Disorder(15);
4) *Electrodermal Response Measure:* assesses the sympathetic nervous system's responses to sensory stimuli(16);
5) *Revised Children's Manifest Anxiety Scale:* used to measure anxiety levels in children(17), it investigates aspects such as social anxiety, worry, physiological anxiety, defensiveness and unconscious response index(18);
6) *Salivary Cortisol:* measures stress response levels(19);
7) *Sensory Oversponsiveness Inventory:* a specific instrument for measuring high tactile, auditory, visual, movement, taste and olfactory sensory responses,
8) gustatory and olfactory responses (hyper-response)(20);
9) *Clinical Test of Sensory Interaction and Balance:* developed to investigate the influence of visual, vestibular and somatosensory inputs (stimuli received from the environment) on maintaining balance(21);
10) *Preschool Behavior Questionnaire:* aimed at identifying behavioral aspects (identified as hostility-aggressiveness, anxiety, hyperactivity-distractibility) of preschool children between the ages of 3 and 6(22);
11) *Wechsler Preschool and Primary Scale of Intelligence:* aimed at children aged between 3 years and 11 months and 6 years and 7 months, it assesses aspects such as cognition, verbalization and functional performance(23);
12) *Assessment of Motor Process Skills:* assesses the quality of performance in everyday personal and domestic activities and interventions for individuals over 3 years of age(24);
13) *Draw a Person Test:* used to measure the integration of oculo-motor skills, involving tests such as drawing a person(25);
14) *Developmental Test of Visual Motor Integration:* measures visual-motor integration for children between 2 and 15 years old, involving copying shapes, considering aspects such as visual perception (shape, size and position in space) and motor coordination (drawing within the established limit)(26);
15) *Evaluation Tool of Children's Handwriting (ETCH):* evaluates writing skills(27);
16) *Sensory Profile School Companion:* evaluates the sensory processing of students and its effect on their behavior, both in the classroom and in the school environment (28). It is a questionnaire containing 62 items corresponding to the student's reactions to sensory experiences specific to the school context, to be answered by teachers. Since it should be applied in conjunction with the Sensory Profile, it is presented in the same evaluation format, via a 5-point Likert scale(29);
17) *SIPT:* is the gold standard in terms of assessing sensory integration and praxis, aimed at children aged 4 years to 8 years and 11 months. It assesses sensory integration in terms of perception, spatial actions and motor planning(30);
18) *SPM:* evaluates behavioral responses to sensory stimuli in children aged between 5 and 12 years, with the aim of identifying sensory integration problems (31).

The Sensory Integration and Praxis Tests (SIPT) are accompanied by:

1) *Sensory Profile, as mentioned above;*
2) *Short Sensory Profile: short version of the Sensory Profile. Also aimed at identifying sensory processing difficulties and associated behavioral problems. It differs from the Sensory Profile in that it contains 38 items and focuses only on sensory events, disregarding the social, emotional and motor skills present in the latter, discriminating tactile sensitivity, sensitivity to taste and smell, sensitivity to movement, sensory search or hyporesponse, auditory filtering, low strength or energy, auditory and visual sensitivity(12).*
3) *Sensory Experience Questionnaire;*
4) *VinelandAdaptiveBehaviorScales;*
5) *SPM.*
6) Miller Assessment for Preschoolers (MAP): aimed at assessing children with developmental delays, aged between 2 years and 9 months and 5 years and 8 months. It enables the assessment of motor skills resulting from sensory processing, identified through the performance of sensory-based activities(32);
7) First STEP: aimed at identifying developmental delays in children aged 3 (33).
8) Finally, the Sensory Profile Measure (SPM) appears alongside the SIPT and the Sensory Profile.

DISCUSSION

In order to discuss the diagnostic instruments for sensory integration and their use in conjunction with others, the three most common will be separated didactically, and then we will explain the relevance of using them together.

Sensory Profile: It was possible to observe that the Sensory Profile assessment instrument, when used in association with different sensory processing measures, such as the Sensory Experience Questionnaire and the SIPT, aims to discriminate the deficiency in integrating sensations as coming from sensory modulation and/or praxis , as well as its impact on functional performance. Sensory modulation consists of the ability to regulate and control, in a gradual and adaptive way, responses to sensory stimuli. In the initial models proposed by Dunn (1997), sensory modulation was presented in four forms: 1) sensory sensitivity, presenting behaviors of distancing the sensory stimulus associated with anguish; 2) avoids sensation, seeking to control and restrict the type of sensation and quantity to be received; 3) low registration, limited or absent awareness of sensations; 4) sensory search, where there is interest and pleasure in increasing sensations (34). Praxis consists of the ability to carry out ideation, where we abstractly imagine what we want, followed by planning, imagining how to accomplish what we want, ending with execution, where we put into practice what we want and the way we previously planned to execute it; a simple example is the act of taking a glass of water to your mouth, where you think “I want to put the glass of water to your mouth”, we imagine the upper limb reaching out to pick up the glass, bending to take the hand with the glass to the mouth, and the glass spilling into our mouth, so that we can then carry out the action as we planned. Deficient or absent praxis may be the result of altered sensory modulation, where it is essential to identify sensory processing patterns. This, when hyper-responsive, allows us to observe what Dunn (1997) describes as sensory sensitivity and avoidance of sensation; when hyporesponsive, it allows us to observe behaviors of lack or low perception of sensory stimuli or excessive interest in certain sensory stimuli. In this way, by analyzing the pattern of sensory processing, we can identify when praxis is the result or not of a deficiency in sensory modulation. For example, when we observe that the child has difficulty picking up a ball under the table, hitting his head on the top of the table when trying to pick up the ball, and that he avoids being touched, does not like hugging and being hugged, we may think that the difficulty observed in relation to tactile stimuli interferes with their body and spatial awareness, so that they are unable to adequately calculate how much they need to lower their head in relation to the top of the table to pick up the object.

When adopted in conjunction with the Electrodermal Response Measure, Revised Children's Manifest Anxiety Scale, Salivary Cortisol, Sensory Oversponsiveness Inventory, this is due to the fact that anxiety is a common characteristic of individuals with deficient sensory modulation described by Dunn (1997) as sensory sensitivity and sensation avoidance, so means of assessing anxiety have been adopted, from its molecular and chemical aspect to its reflection in human behavior, as well as means of assessing the modulation of these sensations. For example, when an individual with high sensory modulation of auditory stimuli hears a bell ringing, he puts his hands to his ears in an attempt to minimize the perceived sound and becomes agitated and anxious. The fact that it was adopted together with the Preschool Behavior Questionnaire and the Wechsler Preschool and Primary Scale of Intelligence is due to the fact that the difficulty in integrating sensory information affects the perception and understanding of these stimuli, which can interfere with learning and anxiety, aggression and attention behaviors, which are also related to schooling and the school context. So, when it comes to preschoolers, it's worth using tools that allow you to discriminate between what is due to SPD, learning difficulties and/or the child's behavior, so that you can know how to help them, which requires a rapid identification and approach to favor the educational process and school life. When used in association with the Draw a Person Test, the Developmental Test of Visual Motor Integration and the Evaluation Tool of Children's Handwriting, it is because sensory modulation, identified by the Sensory Profile, can lead to writing difficulties. For example, individuals with high tactile modulation may find it difficult to hold a pencil properly, in terms of strength and grip, in order to write, draw or paint, affecting their performance.

SIPT: The SIPT, as mentioned above, is a tool for assessing sensory integration problems and their impact on praxis, i.e. its focus is functional. However, also as already mentioned, the difficulty in integrating sensory information can be interfered with by sensory modulation, which refers to the perception of sensation by the central nervous system and which is perceived in the sensory responses emitted by the individual, which are reflected in motor actions, emotional reactions, cognitive processes, interpersonal interactions or communicative emissions(35, 36), and in order to identify this it is necessary to use other instruments, such as the Sensory Profile, its short version, the Short Sensory Profile, the Sensory Experience Questionnaire and the Sensory Processing Measure. An example of this was mentioned in relation to writing performance. The Vineland Adaptive Behavior Scales is an instrument that, like the SIPT, identifies adaptive behaviors. Although both consider the behavioral aspect, they differ in their considerations. The latter considers the result of integrating sensory information into praxis, focusing on functional performance; whereas the former considers adaptive behaviors as a set of conceptual skills (referring to communication, cognitive and academic aspects, such as language), practical skills (skills involved in autonomy, such as carrying out activities of daily living) and social skills (interpersonal skills, responsibility) revealed in everyday situations (37).

SPM: The adoption of the Sensory Profile alongside the Sensory Profile Measure is noteworthy, since both focus on sensory modulation. So why use them together? Although the focus is the same, as mentioned above, the first has different formulations, considering different ages (children, adolescents) and contexts (home, school); and the second has two parts, one aimed at the school context, to be answered by teachers, and one aimed at the home, to be answered by parents, and the age covered always considers the same range (5 to 12 years). Thus, it can be seen that, when used together, the former is used to target age and sensory modulation, while the latter is used to add information about the school context.

CONCLUSION

The systematic review made it clear that, although there is a gold standard for diagnosing SPD, none of the existing instruments is sufficient to be adopted as a single standard. Proof of this was seen in the fact that the largest combinations of assessment instruments involved the diagnostic instruments specifically aimed at this disorder. This may be due to the fact that it is a rather unique and even recent condition. It was in the 1970s that Ayres began to disseminate his studies on sensory integration, which deals with a subjective dysfunction that cannot be identified through clinical examinations, which generates discomfort and strangeness, especially on the part of health professionals. However, the difficulty of sensory integration is closely associated with autism (38), and this is a diagnosis that has been growing rapidly all over the world(39,40,41), so much so that, in 2013 alone, the Brazilian federal government launched two documents on Autism Spectrum Disorder, via the Ministry of Health, one dealing with lines of care within public health and the other with information and guidelines for all those who come into contact with these people in some way. In this way, it is necessary to bear in mind that there are resources so that these difficulties can be identified quickly and which help clinical reasoning so that these individuals can be adequately and satisfactorily attended to in all their needs. This statement is made considering that adapting sensory perception and favoring the integration of this information in a balanced way provides support for all day-to-day situations, which involves functional, academic and therapeutic performance.

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