

Adaptation and psychometric properties of the Polish version of the Short Sensory Profile 2

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Abstract

The article presents findings from the validation of the Polish version of the Short Sensory Profile, 2nd edition (SSP-2-PL).

A total of 1230 participants were recruited: 310 diagnosed with autism spectrum disorder (ASD), 264 with nonspectrum neurodevelopmental disorders, and 656 typically developing (TD). The reliability and validity of the questionnaire were estimated using several methods, including internal consistency, test-retest, and factor analysis.

Exploratory factor analysis identified a unidimensional solution in both the TD and ASD groups. The structure of SSP-2 seems to be homogeneous; therefore, the findings support the validity of calculating the SSP-2 overall score. Cronbach alphas and intraclass correlation coefficients exceeded 0.90 for overall total in all study groups. The Social Communication Questionnaire total score correlated moderately with SSP-2 scores. A 1-way analysis of variance yielded statistically significant differences at $P < .001$ between groups on all scales/quadrants and the overall score. Our results indicate greater severity of sensory processing problems among children with ASD and non-ASD disorders than among TD peers. Among children with ASD, 85% experienced problems with sensory processing. Scores in SSP-2-PL were not affected by the children's age, gender, informant, and informant's level of education.

To the best of our knowledge, this is the 1st study on non-English participants using a revised version of the SSP-2. The results confirm the prevalence of sensory processing problems among children with neurodevelopmental disorders, especially with ASD. SSP-2-PL has high reliability in terms of both internal consistency and stability of scores. The results suggest that SSP-2 overall score could be used for screening purposes, namely to identify sensory processing and behavioral problems combined into one factor. Further analyzes of the SSP-2 factor structure are needed to confirm the findings of the present study.

Abbreviations: ASD = autism spectrum disorder, df = degrees of freedom, M = mean, P = probability value, SD = standard deviation, SSP-2 = Short Sensory Profile, 2nd edition, SSP-2-PL = Polish version of Short Sensory Profile, 2nd edition, TD = typically developing.

Keywords: autism spectrum disorder, cross-cultural adaptation, factor structure, Short Sensory Profile, sensory processing, validity

1. Introduction

Difficulties in receiving and processing of sensory input are a substantial feature in the clinical picture of many developmental disabilities, including autism spectrum disorder (ASD).^[1] The diagnostic criteria for ASD given in the Diagnostic and Statistical

Manual of Mental Disorders, 5th edition^[2] include hyper- and hyporeactivity to sensory stimuli as well as unusual interests in sensory aspects of the environment. Nevertheless, the relationship between sensory processing problems and core symptoms of ASD remains unclear and merits further exploration.^[3]

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The authors contributed equally to the work.

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All procedures in studies involving human participants were conducted in accordance with the ethical standards of the relevant institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The project was approved by the [Ethics Committee of the University of Warsaw Faculty of Psychology] Ethics Committee. The anonymized SSP-2-PL questionnaire along with a demographics survey was completed by parents/legal guardians. According to local regulations, obtaining written consent from adult participants in studies that do not involve any invasive or potentially stressful/harmful procedures is not required, and so written consent was not sought. Participants were informed about the voluntary nature of their participation.

The authors have no conflicts of interest to disclose.

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One of the most widely used instruments for evaluating sensory processing is Winnie Dunn's Sensory Profile family of questionnaires^[4] (for review see: Jorquera-Cabrera et al.^[5]). It has been employed in multiple studies of individuals with autism^[6–8] and other developmental difficulties.^[9] The theoretical framework underlying the structure of these questionnaires takes into account the detection thresholds in the child's processing of sensory input (i.e., the amount of stimuli needed for the nervous system to notice or to react) and self-regulation strategies (i.e., one's behavioral responses to sensory stimuli), ranging from passive to active.^[10] These 2 continua comprise four sensory processing patterns: Seeking; the degree to which a child obtains sensory input (high threshold and active self-regulation); Avoiding; the degree to which a child is bothered by sensory input (low threshold and active self-regulation); Sensitivity; the degree to which a child detects sensory input (low threshold and passive self-regulation); and Registration; the degree to which a child misses sensory input (high threshold and passive self-regulation).

Sensory Profile, 2nd edition^[11] includes, among others, the Short Sensory Profile 2 (SSP-2). The revised SSP-2 offers a brief evaluation of children aged 3 to 14 years mainly for screening and research purposes. The questionnaire was adapted from the Child Sensory Profile 2 by retaining 34 items with the greatest discrimination power.

The way parents perceive and evaluate their child's behavior and notice health or developmental problems depends on multiple factors, including social and cultural ones.^[12] Batista and colleagues^[13] showed cross-cultural differences in parental perception of some early symptoms of ASD. Differences may also be present in the perception of the child's response to sensory stimuli, for example, pain.^[14] Therefore, it seems worthwhile to heed the recommendation of the International Test Commission^[15] to investigate the properties of diagnostic instruments in the context of particular language and culture. This paper presents the psychometric characteristics of the Polish version of the SSP-2 verified on a relatively large sample of Polish children aged 3 to 14 years. To the best of our knowledge, this constitutes the 1st attempt at adapting SSP-2 to non-English-speaking linguistic and social circumstances, with the aim of addressing potential differences in parent reports across countries and differences in distribution of scores as well as developing specific norms according to the standards for norm development.^[15] Thus, its results could be of interest for researchers outside of Poland.

For our assessment, we developed the following hypotheses:

1. Good to excellent internal consistency and stability of the SSP-2-PL scores would be observed.
2. The discriminant validity of the SSP-2-PL would be sufficient with higher scores among individuals with ASD and non-ASD disorders than typically developing (TD) participants.
3. No age and gender differences would be observed.

2. Methods

2.1. Participants

The study included 1,230 participants satisfying the following criteria: age from 3 to 14 years; no disorders such as deafness, blindness or low vision, or motor disorders; clinical diagnosis of autism spectrum disorder or another diagnosis in the case of participants with nonspectrum disorders based on the International Statistical Classification of Diseases and Related Health Problems, 10th edition diagnostic criteria,^[16] and in the control

Table 1
Study group demographics.

	ASD group	Non-ASD group	TD group	Total
Number of participants	310	264	656	1230
Gender				
Males % (females %)	80 (20)	62 (38)	43 (57)	57 (43)
Age in years (%)				
3–5	34.84	21.59	18.60	23.33
6–8	44.52	37.88	38.57	39.92
9–11	15.80	29.55	32.47	27.64
12–14	4.84	10.98	10.36	9.11
Place of residence, %				
Village	28.4	17.4	19.7	21.4
Town to 500,000	36.8	60.3	61.4	55
City >500,000	31.6	15.5	14.2	18.9
N/A	3.2	6.8	4.7	4.7
Number of siblings, %				
Only child	24.19	29.17	27.59	27.07
One	50.65	49.62	55.18	52.85
Two	14.84	14.39	12.20	13.33
Three or more	9.35	4.92	3.51	5.28
N/A	0.97	1.89	1.52	1.46
Birth order (%)				
1st	56.45	56.44	55.49	55.93
2nd	27.10	29.55	28.81	28.54
3rd or more	11.61	9.09	7.47	8.86
N/A	4.84	4.92	8.23	6.67
Level of education:				
mother % (father %)				
Primary/basic vocational	11.0 (24.5)	14.8 (23.5)	9.1 (18.3)	10.8 (21.0)
Secondary	33.2 (34.5)	27.7 (40.5)	31.6 (37.7)	31.1 (37.5)
Higher	55.5 (38.7)	56.8 (33.3)	59.3 (39.9)	57.8 (38.2)
N/A	0.3 (2.3)	0.7 (2.7)	0 (4.1)	0.3 (3.3)
SSP-2-PL informant (%)				
Mother	76.8	85.6	81.4	81.1
Father	14.5	5.0	6.3	8.0
Both parents	4.8	3.0	5.6	4.9
Other	2.6	1.9	2.8	2.6
N/A	1.3	4.5	3.9	3.4

ASD=autism spectrum disorder, N/A=data not available, SSP-2-PL=the Polish adaptation of the short sensory profile, 2nd edition; TD=typical development.

group consisting of TD individuals, no diagnosed developmental disorders, neurologic, or psychiatric conditions or suspected developmental problems. The demographics of the sample in the study are shown in Table 1.

There were three groups of participants: diagnosed with ASD ($N=310$, ASD group), diagnosed with nonautism developmental disorder ($N=264$, non-ASD group), and TD ($N=656$, TD group). In the ASD group, there were individuals with childhood autism ($n=201$) and with pervasive developmental disorders, unspecified or Asperger syndrome ($n=109$). The non-ASD group included mostly children with language development and/or learning disorders ($n=230$), attention-deficit hyperactivity disorder ($n=10$), global developmental delay, and intellectual disability ($n=24$). The sex ratio in the ASD group was 1:4 and reflected the actual ratio in this population.^[17] In the ASD and non-ASD groups, clinical diagnoses were made by multidisciplinary teams consisting of a psychiatrist, psychologist, and special educator, and were based on developmental interview, observations, and standardized testing.

2.2. Instruments and procedure

The Short Sensory Profile, 2nd edition is a part of the recently revised Sensory Profile family of questionnaires.^[11] Compared

with the previous version, the upper age limit of SSP-2 has been increased from 10 years 11 months to 14 years 11 months. The questionnaire has been reduced from 38 items to 34. The SSP-2 contains new items referring to socioemotional and/or behavioral problems (e.g., deficits in developing social interactions with peers). In turn, a number of SSP items directly associated with sensory input processing have been omitted from SSP-2 (e.g., withdraws from splashing water).

The questionnaire consisting of 34 items is completed by the child's parent or legal caregiver, who assesses the frequency (severity) of a given issue on a 5-point scale (5: almost always; 1: almost never). There is also a not applicable option, scored 0 points. Scores can be calculated for the Sensory Processing (Sensory) and Behavioral Responses Associated With Sensory Processing (Behavioral) scales. In addition, scores are calculated for the four quadrants according to the theoretical model by Dunn^[10] described in the introduction. In the original version of the instrument, scores in each quadrant are interpreted assuming a normal distribution of the measured variables. Scores lower/higher than the arithmetic mean by at least 1 standard deviation (SD) are interpreted as "less/more than others," while those lower/higher by 2 SD as "much less/much more than others."

The adaptation of the instrument was made possible with the kind approval of the copyright owner, Pearson's Clinical Assessment Group, and the author, Professor Winnie Dunn. The 1st step was to translate the instrument into Polish, preserving the structural equivalence of the protocol including the layout, as well as item content, grammatical structure of questions, difficulty of terms, and lexical similarity of questions.^[15] The initial version of the translation, prepared by psychologists fluent in English and experienced in sensory integration theory and practice, was submitted for evaluation by competent raters: 2 sensory integration therapists with multiple years of experience. They assessed whether the expressions used would be completely understandable to individuals completing the questionnaire and consistent with the instrument's theoretical framework. The version with revisions suggested by the therapists was proofread by a professional translator and then blindly back-translated into English by an independent translator unfamiliar with the original version of the instrument, as recommended by the International Test Commission.^[15] Next, the original and the back translated versions were compared by a native speaker of English. Corrections concerned only minor phrases that did not significantly alter the meaning of the items. The back translation was approved for use in scientific research by the copyright owner. Besides the scores calculated in the original version, the Polish version of SSP-2 (SSP-2-PL) includes the overall total score, which is a sum of all scores recorded in the questionnaire.

2.3. Design and analysis

The project was approved by the Ethics Committee of the [Ethics Committee of the University of Warsaw Faculty of Psychology]. The anonymized SSP-2-PL questionnaire along with a demographics survey was completed by parents/legal guardians. According to local regulations, obtaining written consent from adult participants in studies that do not involve any invasive or potentially stressful/harmful procedures is not required, and so written consent was not sought. Participants were informed about the voluntary nature of their participation. The obtained data was only subjected to collective analysis, thus participants were not informed about their individual results on SSP-2-PL.

Recruitment was conducted as part of a research evaluation. Parents were contacted through kindergartens and schools, diagnostic and therapeutic centers, associations and foundations advocating for people with developmental disabilities. The research was conducted all across Poland. Out of 1494 sets of questionnaires received, those submitted by individuals not meeting the sample selection criteria and incomplete questionnaires were rejected (a total of 264 questionnaires).

To evaluate the uniformity of items within the questionnaire, internal consistency was assessed by calculating Cronbach alpha. Stability of measurements across time was verified using the test-retest method. Twenty-four participants were retested 2 to 4 weeks after the 1st assessment.

To analyze the factor structure of the instrument, we conducted exploratory factor analysis using IBM SPSS 24.0 software. As the factor structure of the questionnaire before revision was analyzed for TD children and children with ASD,^[18-20] in the present study principal component analysis was performed separately for the ASD and TD groups.

Discriminant validity of the Polish version of SSP-2 was checked by comparing the results of the ASD, non-ASD, and TD groups using 1-way analysis of variance (ANOVA) followed by tests of contrasts.

Construct validity of SSP-2-PL was determined by conducting Pearson *r* correlation with the Social Communication Questionnaire (SCQ).^[21] The Polish version of SCQ is characterized by good psychometric properties (Pisula, Chojnicka, & Kawa, unpublished manuscript). The severity of ASD symptoms as measured by SCQ was expected to be positively correlated with sensory processing dysfunction (based on DSM-5 diagnostic criteria and numerous empirical findings with respect to sensory processing difficulties in individuals with ASD).

The correlations between SSP-2-PL items and scores with the participants' age and gender were also checked in the Polish sample (Pearson *r* coefficients). Additionally, the effect of the person completing the questionnaire on SSP-2 PL scores (independent 2-sample *t* test) and the informant's level of education and participant's number of siblings and birth order (1-way ANOVA) were checked. Computations were done using the IBM SPSS Statistics 17.0 suite.

3. Results

3.1. Reliability analyses

Precision and consistency of the SSP-2-PL were high. Table 2 shows the Cronbach alpha reliability coefficients and the Intraclass Correlation Coefficients between scores in SSP-2-PL scales in 2 successive measures. All intraclass correlation coefficients were excellent for all scales (0.95-0.98) and overall total (0.97). Cronbach alphas, the internal consistency coefficients, were also high for all scales (0.76-0.94) and overall total (0.94-0.96) in all study groups.

3.2. Factor structure of the SSP-2-PL

High Cronbach alpha values were obtained for the overall score of the SSP-2-PL: 0.96 and 0.94 for the TD and ASD groups, respectively. As none of the SSP-2-PL items significantly diminished the alpha coefficients, we assumed that SSP-2-PL items and the measure as a whole were reliable.

The Kaiser-Meyer-Olkin measure values of 0.95 for TD and 0.91 for ASD groups indicated that the sample sizes were

Table 2
Cronbach α reliability and intraclass correlation coefficients for the Polish version of the Short Sensory Profile, 2nd edition.

SSP-2-PL scales	Internal consistency			Test-retest Intraclass correlation coefficient <i>r</i> n=24
	Cronbach alpha			
	ASD	Non-ASD	TD	
Sensitivity	0.83	0.88	0.87	0.97
Avoiding	0.85	0.90	0.91	0.94
Seeking	0.76	0.81	0.81	0.98
Registration	0.82	0.84	0.85	0.96
Sensory	0.86	0.89	0.89	0.97
Behavioral	0.91	0.94	0.94	0.95
Overall total	0.94	0.96	0.96	0.97

ASD=autism spectrum disorder, non-ASD=other than ASD neurodevelopmental disorders, SSP-2-PL=Polish version of the Short Sensory Profile, 2nd edition, TD=typical development.

adequate to consider the data suitable for factor analysis. Bartlett test of sphericity was significant (approximate $\chi^2=12,747.67$, $df=561$, $P<.001$ for TD group; $\chi^2=4925.42$, $df=561$, $P<.001$ for ASD group), meaning that there were adequately strong correlations between the SSP-2-PL items in both samples.

Basing on the shape of the scree plots (Fig. 1), a unidimensional solution was applied for both groups. The solution explained 42.7% and 34.5% of the variance for the TD and ASD groups, respectively. All item loadings were greater than 0.46 (range 0.47–0.79). High Cronbach alpha coefficients were also indicative of the questionnaire’s homogeneity.

3.3. Analysis of group differences in SSP-2-PL and correlations with SCQ, age, and gender

Analysis yielded only statistically significant ($P<.001$) positive correlations (range 0.35–0.49) with SCQ total score, both in the case of scales/quadrants and the SSP-2-PL overall score ($r=0.477$ in the case of overall total).

A 1-way ANOVA yielded statistically significant differences between groups on all scales/quadrants and the overall score (Table 3). The following groups were compared by way of tests of contrasts: ASD group vs TD group; ASD + non-ASD vs TD group; non-ASD vs TD group; and ASD vs non-ASD group. Statistically significant results at $P<.001$ were found for each analyzed scale/quadrant and the total score for all comparisons. The mean values in the TD group were lower than those obtained in the ASD and/or non-ASD groups. The mean values in the ASD group

were higher than the mean values in the non-ASD group. The procedure yielded only statistically insignificant, weak correlations with age and gender in all groups.

3.4. The effect of the informant and his/her level of education on SSP-2-PL scores

No effect of the informant on the score was found in the case of the non-ASD and ASD groups. The one exception was the registration quadrant in the ASD group, where the scores of questionnaires completed by mothers ($M=16.97$, $SD=7.78$) were higher compared to questionnaires completed by fathers ($M=14.31$, $SD=7.39$, $t=2.05$, $df=257$, Cohen’s $d=0.36$, $P=.04$). No significant relationships were found in the TD group except for the sensitivity quadrant, where the scores based on information from fathers ($M=14.00$, $SD=6.53$) were higher compared to questionnaires completed by mothers ($M=11.27$, $SD=7.48$, $t=-2.16$, $df=512$, $d=0.39$, $P=.03$). Analysis of the effect of the informant’s level of education on scores in SSP-2-PL yielded no significant differences in any of the study’s samples.

3.5. The effect of the number of siblings and birth order on SSP-2-PL scores

No statistically significant relationships between the number of siblings and the order of birth and SSP-2-PL scores were found in any of the groups.

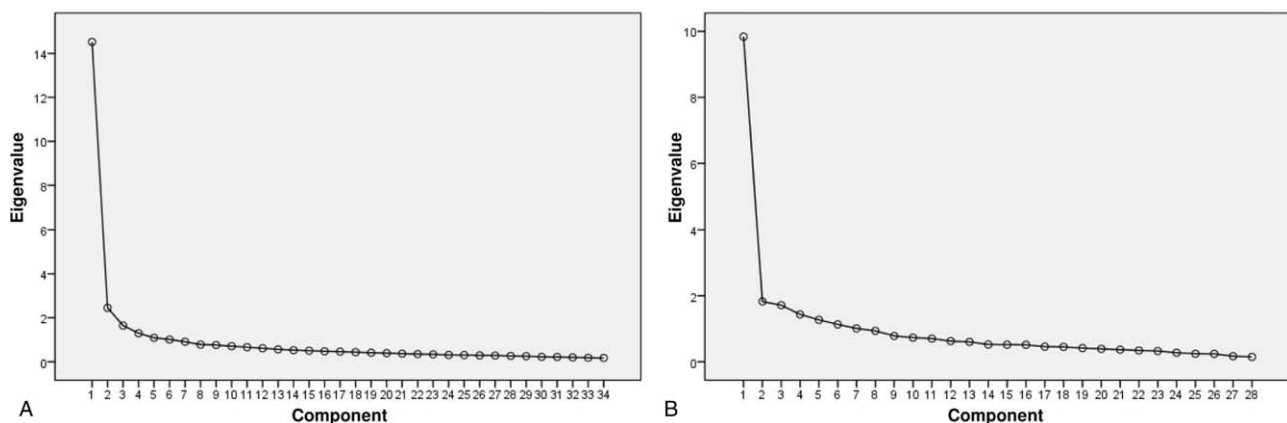


Figure 1. Scree plots of the Polish version of Short Sensory Profile, 2nd edition factor components. (A) Typical development. (B) Autism spectrum disorder.

Table 3
Mean values with standard deviations M (SD) of SSP-2-PL scores and group comparison results.

	ASD	Non-ASD	TD	F(3,1081)	η^2
Sensitivity	29.78 (8.93)	18.37 (9.31)	11.51 (7.42)	315.49*	0.47
Seeking	18.01 (6.73)	10.90 (6.85)	7.19 (5.70)	193.43*	0.35
Registration	16.44 (7.71)	9.29 (6.92)	5.44 (4.85)	201.20*	0.36
Avoiding	27.70 (7.73)	17.15 (8.97)	11.33 (7.50)	271.88*	0.43
Sensory	34.34 (12.57)	20.53 (11.71)	13.54 (9.38)	237.30*	0.40
Behavioral	57.59 (16.24)	35.19 (18.61)	21.93 (14.67)	315.41*	0.47
Overall total	91.90 (27.59)	55.71 (29.19)	35.47 (23.00)	308.23*	0.46

ASD = autism spectrum disorder, *F* = test statistics, non-ASD = other than ASD neurodevelopmental disorders, SSP-2-PL = Polish version of the Short Sensory Profile, 2nd edition, TD = typical development.
 * $P < .001$.

4. Discussion

We aimed to adapt SSP-2 by addressing potential differences in parent reports in non-English-speaking linguistic and social circumstances, to analyze psychometric characteristics of the Polish version of SSP-2, and to develop specific norms according to the standards for norm development.^[15] We investigated the psychometric properties of the Polish version of the Short Sensory Profile 2^[11] on a relatively large sample of children aged 3 to 14 years. The sample included TD children and children with neurodevelopmental disorders, particularly ASD. To the best of the authors' knowledge, this is the 1st study on the psychometric characteristics of a non-English version of SSP-2. The paper also presents the 1st analysis of the SSP-2 factor structure.

As SSP-2-PL preserves content equivalence with the original version, we aimed to address potential differences in parent reports across countries and differences in distribution of scores, as well as to develop specific norms (percentiles and stens in SSP-2-PL). Our findings suggest that SSP-2-PL has high reliability in terms of both internal consistency and stability of scores. The test-retest reliability results may have important implications for using the SSP-2-PL as an intervention outcome measure. However, time to retest was rather short (2-4 weeks), therefore the results should be interpreted with caution.

Factor analysis was conducted separately for the TD sample and ASD samples. The scores in both groups unequivocally supported a unidimensional solution. With no other studies describing the factor structure of the SSP-2, our findings for the Polish version cannot be compared with data reported by other researchers. The results may indicate a substantial difference in terms of the factors measured between the previous version of the instrument, that is, the SSP, and the revised version. The authors have identified 6,^[18] 7,^[20,22] or even 9 factors in the SSP.^[23] Our findings suggest that the data obtained is best reflected by a single factor, indicating the homogeneous character and internal consistency of the questionnaire. The 1-factor structure was confirmed for both samples: TD children and children with ASD. In this regard, the revised version (SSP-2) appears to differ significantly from the SSP. However, it should be borne in mind that SSP was intended for testing younger children, that is, aged 3 to 10 years. The SSP-2 is also suitable for older children aged up to 14 years 11 months. Moreover, the textual contents and structure of the 2 versions are different. Items in the SSP-2 referring to individual senses (taste/smell sensitivity, tactile/movement sensitivity, visual/auditory sensitivity, and auditory filtering) are no longer distinguished; instead there is a division into 4 quadrants, compatible with Dunn's theory of sensory

processing.^[10] The revised version retains only 13 items from the previous version; the remaining 21 items in the SSP-2 include a number of behaviors associated with the core symptoms of autism spectrum disorder, for example, "Resists eye contact from me or others," "Struggles to interpret body language or facial expressions," "Interacts or participates in groups less than same-aged children," "Is distressed by changes in plans, routines, or expectations." Further research is necessary to determine how closely these behavioral problems are connected to the processing of sensory data.^[7]

When interpreting the results of the performed factor analysis, it should be taken into account that the theoretical assumptions in Dunn's model of sensory processing^[10] make no mention of "separation" between the behavioral and sensory scales. These 2 scales assess 2 levels of the same phenomenon rather than represent 2 independent dimensions. Similarly, according to those assumptions the quadrants described in the model need not be reflected in the factor analysis. Dunn's theoretical model of sensory processing was not reflected in the results of performed factor analysis.

Due to the lack of other standardized instruments for measuring sensory processing available in Polish, the SCQ was used to assess the severity of social communication deficits typical of ASD in construct validity analysis. As expected, the intensity of symptoms characteristic for ASD correlated moderately with the severity of sensory processing problems. These findings may indirectly confirm the validity of the measure and suggest that, in line with the assumptions, the 2 instruments measure different constructs.

The scores of children on the autism spectrum and non-ASD disorders indicated greater severity of sensory processing problems than those of their TD peers. This was consistent with predictions based on multiple previous reports^[24] and suggests good validity of the instrument. In addition, children with ASD scored higher than children with other neurodevelopmental disorders. This could suggest a greater magnitude of difficulties with sensory processing in individuals with ASD. However, this result could also mean that SSP-2 measures not only behaviors associated with sensory processing, but also those typically seen in ASD. Compared with the previous version, SSP-2 contains new items that directly refer to deficits characteristic of ASD, that is, abnormalities in eye contact, deficits in understanding and use of facial expressions and body language, and deficits in developing social interactions with peers. In turn, a number of SSP items directly associated with sensory input processing have been omitted from SSP-2 (e.g., "Doesn't seem to notice when face and hands are messy," "Withdraws from splashing water").

Differentiating between behaviors resulting from sensory processing problems and those caused by difficulties typical for autism is a complex issue still in need of a resolution.

Research on the SSP-2-PL has confirmed the prevalence of problems with sensory processing in the population of children with ASD. In the study sample, 85% of children with ASD experienced problems with sensory processing (scores beyond 1 SD from the mean), which is consistent with findings previously reported in the literature.^[24]

The majority of questionnaires in the study sample were completed by mothers (81%). However, we found no effect of informant on scores in the SSP-2-PL in any of the scales or the total score, except for registration in the ASD group and sensitivity in the TD group. There are no reports in the literature on the effect of informant on scores in the sensory profile/sensory profile 2 battery. Since no consistent relationships of this type were found, we may conclude that the results of the questionnaire are not affected by whether it is the mother or the father that provides information. No such effect was also found with respect to the informant's level of education. Scores in the SSP-2-PL were also not affected by the children's age and gender, which is consistent with the findings reported for the original version of the questionnaire.^[11] While male gender as a risk factor for difficulties in sensory input processing was reported in research on very preterm children (born <30 weeks' gestation),^[25] the correlation was not confirmed in other studies on premature children.^[26] Our results indicate that sensory processing problems affect both boys and girls born at term with similar severity regardless of their age.

Although parents are asked in the SSP-2 for information about the number of the child's siblings and birth order, no significant differences in that respect were found in the SSP-2-PL scores. Therefore, the information regarding the number of siblings and birth order does not allow us to draw straightforward conclusions.

4.1. Strengths and limitations

The study assessed a relatively large Polish sample of TD children and children with neurodevelopmental disorders, including ASD. It demonstrated that the Polish version of SSP-2 has good psychometric parameters. The reliability and validity of the questionnaire were estimated using several methods. Our results provide an empirical basis for using the instrument in screening and scientific research in Poland. According to our findings, age has no significant effect on scores in the SSP-2-PL. However, the low number of children aged 3 and 11 to 14 years old should be born in mind. The number of children who were retested was also small.

The structure of the sample diverged from the demographic structure of the general Polish population, particularly in terms of place of residence. Participants living in rural settings accounted for 21% of the sample, while in the general population they make up over 39%.^[27]

Limitations also include the lack of behavioral measures to validate all parent-reported information about sensory processing due to the unavailability of another standardized instrument in Polish to measure that processing at the time of the study. Parent-based information is associated with certain limitations in diagnosing the child's difficulties. The number of sources of information should be expanded in the future studies.

5. Conclusion

The present study investigated the psychometric properties of the Short Sensory Profile 2 questionnaire devised by Winnie Dunn, on an independent Polish sample. To the best of our knowledge, this is the 1st study on non-English-speaking participants using a revised version of the instrument and the 1st study on the factor structure of the SSP-2.

The SSP-2-PL is characterized by high reliability, both in terms of internal consistency and stability of scores, and it discriminates well between children with neurodevelopmental disorders and those exhibiting typical development. Sensory processing patterns as measured by SSP-2-PL (i.e., the amount of stimuli needed for the nervous system to notice or to react to stimuli and one's behavioral responses to sensory stimuli) do not vary in terms of individuals' age and sex.

Based on the factor analyzes of the SSP-2-PL in the sample of TD children and children with ASD, a unidimensional structure was suggested. This may indicate that the structure of the SSP-2 and its resultant measurements differ from those of the previous version of the questionnaire. In addition, the results provide a rationale for distinguishing the SSP-2 Overall score as a separate measure within the questionnaire. Further analyzes of the SSP-2 questionnaire's factor structure are necessary, as they could shed more light on its usefulness as a screening tool and a method for determining patterns of sensory processing and sensory subtypes among children from the general population and those with neurodevelopmental disorders.

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