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Characteristics of Adults With Sensory Differences: An Exploratory Study Using the Multidimensional Assessment of Interoceptive Awareness, Version 2

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ABSTRACT

Interoception was explored in adults with sensory integration and processing differences. Retrospective data were collected from 57 adults. Data included presenting problems, diagnoses, and self-report using the Multidimensional Assessment of Interoceptive Awareness, Version-2 (MAIA-2). Frequencies were computed. Data from the MAIA-2 were described and correlated. One hundred percent of the sample had interoceptive difference from norms. Common presenting problems were emotional regulation, social relationships, activities of daily living, and mental functions. Commonly reported diagnoses were anxiety and depression. This study highlights the importance of interoception and the usefulness of the MAIA-2.

KEYWORDS

Interoception; adults; occupational therapy; mental health; sensory processing

Introduction

Mental health is a critical component of overall wellness. More than one in five U.S. adults are currently living with some type of mental health issue (U.S. Department of Health and Human Services, 2023). Research reveals that individuals with mental illness often experience sensory processing differences impacting daily life (Bailliard & Whigham, 2017). The intersection of sensory integration and processing and mental health is a potential contributing factor to the growing population of adults seeking services for sensory differences. This clinical population comprises adults who report lifelong sensory differences (beginning as children), as well as adults who have no history of childhood sensory-based interventions (May-Benson et al., 2022). Many of these adults are currently living with a mental health diagnosis and report comorbid sensory concerns (Andersson et al., 2021; Bailliard & Whigham, 2017; Hattori et al., 2023). Thus, there is a pressing need to address the health care of this population.

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Advances in neuroscience paired with a rising awareness of the importance of interoception in mental health have spawned an interdisciplinary effort to increase knowledge and generate robust research related to the role of interoception in mental health. Research highlights the vital role interoception plays in self-regulation, decision making, experience of self, and emotion making (Barrett, 2017; Barrett & Simmons, 2015, Fazekas et al., 2020; Ohira et al., 2013). Interoception supports not only meaningful participation in daily life but one's overall health and well-being (Schmitt & Schoen, 2022).

Interoception is the process by which the nervous system senses, interprets, integrates, and regulates signals originating from within the body (Chen et al., 2021). Importantly, interoception is conceptualized as a bidirectional, multisensory system that processes sense data from multiple sensory domains, including (but not limited to) proprioception, vestibular, temperature, pain, and affective touch (Chen et al., 2021; Shinder & Newlands, 2014).

Occupational therapy practitioners with specialized training in sensory-based interventions, beyond their entry-level education, have a unique knowledge and focus on the role of sensory processing in daily life. The recognition of the multisensory nature of interoception and its foundational role in the development of body scheme and sense of self has brought increased awareness and interest in this system. As such, assessment of interoception, particularly because of the link to clients' emotion and regulatory capacities, has become an essential component of a comprehensive occupational therapy evaluation in adults.

This growing interest in interoception is evidenced by the development of occupational therapy specific assessment tools designed to measure interoception (Brown & Dunn, 2023; Mahler, 2017). One assessment is the Comprehensive Assessment of Interoceptive Awareness (Mahler, 2017). It is a nonstandardized, qualitative scale that provides an in-depth examination of interoception through a self-report client interview, with a particular focus on linking interoception with emotions and self-regulation. Another assessment tool currently in development is the Sensory Profile Interoception (SPI) Measure (Brown & Dunn, 2023). This measure is grounded in Dunn's sensory processing framework and includes items that address interoception within sensory experiences embedded in everyday life. Dunn et al. (2022) recently completed a reliability study on the internal consistency and concurrent validity of the scale. First they examined the relationship between the SPI and Dunn's sensory processing framework using the Adolescent/Adult Sensory Profile (Brown & Dunn, 2002) and found significant correlations between sensory pattern subscales on the Adolescent/Adult Sensory Profile and the SPI. Secondly, they

examined the relationship between the SPI and related mental health measures. Correlations were found between the SPI registration and alexithymia; between avoiding, sensitivity, and seeking on the SPI and body awareness; as well as between sensitivity and registration on the SPI and anxiety. However, the SPI is not yet available for clinical use.

Outside of occupational therapy, a variety of additional assessment options exist. There are assessments that measure interoceptive accuracy (Garfinkel et al., 2015) that reflect performance on objective tests such as heartbeat detection. There are also assessments that measure more widely known concepts of interoceptive sensibility and interoceptive awareness (Forkmann et al., 2016). These assessments address not only one's sensibility to body signals but also perception-related regulatory aspects, beliefs, attitudes, thoughts, and emotions. They utilize self-reported appraisal of one's own interoception and reflect how one recognizes, organizes, makes sense of, responds to, and uses interoceptive sensations in their daily life (Bornemann et al., 2014).

One of the most widely used self-report measures is the Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2; Mehling, Acree et al., 2018). The MAIA-2 is a 37 item self-report measure that was designed to capture first-person, subjective assessment of interoceptive sensibility and interoceptive awareness (Mehling, Acree et al., 2018). It is available via open access and has been translated into multiple languages. This measure is unique in that it captures the bidirectional interactions among self-perception, self-awareness, and self-regulation of interoceptive sensations. The design of the MAIA aims for a complex and multidimensional perspective on "body awareness," which includes both interoceptive and proprioceptive signals. It also distinguishes attentional styles such as mindfulness (Mehling et al., 2012). This questionnaire is oriented to experimental interoception research and for the assessment of mind-body therapies (Desmedt et al., 2022). Among the clinical populations that have been studied with the MAIA and MAIA-2 are war veterans with posttraumatic stress symptoms (Mehling, Chesney et al., 2018), persons with disordered eating (Poovey et al., 2022), and individuals with a major depressive disorder (Eggart et al., 2021).

Though the primary focus of this study was on characterizing the interoceptive differences in individuals seeking occupational therapy for sensory integration and processing differences, this study also sought to describe other characteristics of this group. Of interest were the range of presenting problems and the presence of comorbid diagnoses given repeated clinical observation of impairments in occupational performance and the rate of mental health symptoms. This information is critical to better understanding the needs of this population and providing more targeted intervention.

The MAIA-2 was selected for data collection. It can provide clinically relevant data, and as a self-report measure, it facilitates greater ease of data collection across participants. Though it has been widely utilized in research across many populations, there are no published studies showing its use with this specific clinical group.

Thus, the aims of this study were to

1. Characterize the common presenting problems of adults seeking services for sensory integration and processing differences.
2. Characterize the coexisting diagnoses of adults seeking services for sensory integration and processing differences.
3. Explore the interoceptive features of adults receiving occupational therapy services for sensory integration and processing differences.

Rationale for the study

Public poll and health care cost reporting are both exposing that Americans' mental health is at a new low and more people are seeking intervention (Brenan, 2022; Cantor et al., 2023). Research has established a significant link between mental health and sensory processing, spurring Harrison et al. (2019) to call for inclusion of a sensory processing domain within the National Institute of Mental Health's Research Domain Criteria framework (U.S. Department of Health and Human Services, n.d.). In addition, occupational therapy practitioners commonly use sensory processing assessment tools and intervention strategies. There is a growing population of adolescents and adults seeking sensory-based interventions and/or reporting comorbid mental health concerns (McGreevy & Boland, 2020; D. C. Miller et al., 2023; van den Boogert et al., 2022). A gap in the literature exists demonstrating the contributions of interoceptive sensory processing assessment and intervention strategies for this clinical population. The methods and procedures of this study aim to document the self-reported interoceptive processing differences and thus contribute to the evidence base for the association between mental illness and sensory processing.

Methods

This study is a retrospective, exploratory examination of data acquired from a chart review. All procedures were reviewed and approved by the Rocky Mountain University Institutional Review Board.

Population

The sample for this study included 57 adults attending occupational therapy at a private sensory-based clinic in Colorado. The sample included 43 female adults, 13 male adults, and one non-binary adult. The mean age was 33 with an *SD* of 12.

Procedures

Data were extracted from client charts and entered into a database. The criteria for inclusion were charts of adult clients ages 18 and above who completed a comprehensive occupational therapy evaluation at a private clinic in Colorado between 2019 and 2022. Exclusion criteria were clients who only participated in an intake meeting or presented to the clinic with a neurological impairment or physical disability. All clients in the sample had evidenced the presence of sensory processing differences. Comprehensive evaluations included administration of the Sensory Processing 3 Dimensions Assessment (L. J. Miller et al., 2018), the Adult Adolescent Sensory Profile-2 (Brown & Dunn, 2002), or the Sensory Processing Measure-2 (Parham et al., 2021) and clinical observations in the therapy gym.

Demographic characteristics, diagnoses, and presenting problems were compiled from an intake form and the client's self-reported form: the MAIA-2.

Measures

The MAIA-2 is an eight-subscale, 37-item state–trait self-report questionnaire designed to measure multiple dimensions of interoceptive awareness (Mehling, Acree et al., 2018). In 2018, five new items were added to the original 32-item MAIA (Mehling et al., 2012), which resulted in the 37-item MAIA-2, which has been shown to have strong psychometrics (Mehling, Acree et al., 2018). The MAIA-2 has been translated into 30 languages and used in numerous studies worldwide (UCSF Osher Center for Integrative Health, n.d.) Normative data were reported from 1,090 individuals who were visitors at the Science Museum of London, UK. Means and standard deviations by subscale are presented for English-speaking individuals between 18 to 69 years old. Factor analysis confirmed the eight-factor solution. Cronbach's alphas for the updated version ranged from .64 to .83.

The eight subscales are as follows:

- Noticing: Awareness of uncomfortable, comfortable, and neutral body sensations
- Not Distracting: Tendency not to ignore or distract oneself from sensations of pain or discomfort

- Not Worrying: Tendency not to worry or experience emotional distress with sensations of pain or discomfort
- Attention Regulation: Ability to sustain and control attention to body sensations
- Emotional Awareness: Awareness of the connection between body sensations and emotional states
- Self-Regulation: Ability to regulate distress by attention to body sensations
- Body Listening: Active listening to the body for insight
- Trusting: Experiences one's body as safe and trustworthy

Each subscale is scored between 0 to 5, where 0 represents *never* and 5 represents *always*. Items for Not Distracting and Not Worrying are reverse scored (i.e., 0 = *always* and 5 = *never*). Higher scores suggest more interoceptive awareness and lower scores suggest less interoceptive awareness. Correlations within subscales for the normative sample were highest for (a) Body Listening and Emotional Awareness, (b) Body Listening and Self-Regulation, and (c) Attention Regulation and Self-Regulation.

Data analysis

Demographic data were collected to characterize the sample, including age, gender, presenting problems, and comorbid diagnoses. Presenting problems were organized and summarized using the *Occupational Therapy Practice Framework* fourth edition (OTPF-4; American Occupational Therapy Association, 2020). The procedure for categorizing presenting concerns entailed starting with a table listing each concern expressed by clients. The authors then grouped similar concern areas. Finally, the OTPF-4 was introduced as a structure for organizing the list of grouped concern areas. For example, the list initially separated items such as challenges with decision making, problem solving, efficiency, organization, time management, and setting up routines. These items were grouped together under Mental Functions, specifically related to executive functioning, based on definitions in the OTPF-4. Similarly, Health Management included concerns related to emotion regulation and emotional control as well as stress and anxiety.

Diagnoses were self-reported. Percentages were computed for each category of the practice framework represented by the presenting problems as well as for diagnoses.

Data from the MAIA-2 were analyzed in the following manner:

1. Scores from the sample were compared to normative data collected by Mehling, Acree et al. (2018). These normative data were reported by

- 1,090 individuals who were visitors at the Science Museum of London, UK. Means and standard deviations by subscale are presented in Mehling, Acree et al. (2018) for English-speaking individuals between 18 to 69 years old.
2. Interoceptive differences of the present sample were characterized based on the individuals' scores in comparison to the published means of each subscale. A difference score was defined as a score that was at least 1 *SD* above or below the mean. Data were intended to be descriptive with no particular clinical significance assigned to a difference score.
 3. Summary data were reported that reflect the total percentage of the sample that scored at least 1 *SD* above or below the mean, the percentage of those who only scored 1 *SD* above the mean, and the percentage score of those who only scored 1 *SD* below the mean.
 4. Data were also correlated between the subscales to describe relationships within the constructs of the MAIA-2. Particular attention was paid to scores that were significant at the .01 level. Due to the preliminary and exploratory nature of the analyses, a correction for multiple comparisons was not made (Lee & Lee, 2018).

Results

Demographic data are provided in Table 1. The majority of the sample was female, with the most common age range between 18 and 24 years, followed by 25 to 34 years.

Presenting problems are reported in Table 2. Ninety-five percent of the sample had two or more presenting concerns. The top four most frequently reported presenting problems, organized by categories from the OTPF-4, were (a) emotion regulation (within Mental Functions/Emotional), (b) social relationships (within Social Participation Occupation), (c) activities of daily living, and (d) mental functions related to attention and cognition, each of which occurred in over 50% of the sample. Sensory processing followed at 46%.

Comorbid diagnoses are reported in Table 3. Forty-nine individuals reported having multiple diagnoses. Eighty-four percent ($n = 48$) of the sample had received a formal diagnosis versus only 18% ($n = 10$) who reported symptoms but no formal diagnosis. The most frequently reported

Table 1. Demographics.

Gender	<i>N</i>	%	Mean age	<i>SD</i>	Age range				
					18–24	25–34	35–44	45–54	55–64
Female	43	75	33	12	14	10	9	8	2
Male	13	23	31	11	5	3	3	2	0
Non-binary	1	2	31	N/A	0	1	0	0	0
Total	57	100	33	12	19	14	12	10	2

Table 2. Presenting problems.

Primary concern	N	%	OTPF-4
Emotions (identifying emotions, communicating emotional states)	29	51	Mental Functions: Emotional
Social interaction/relationships (social isolation, communication, getting along with family/coworkers/friends)	29	51	Social Participation: Occupation
Cognitive processes (decreased focus/concentration, task completion, self-understanding, awareness, goal setting, executive functions)	29	51	Mental Functions: Higher-level cognitive
ADL/iADL (finances, dog care, driving, home maintenance, basic needs)	29	51	Occupations: Activities of daily living
Sensory processing (modulation, praxis)	26	46	Sensory functions
Health-related issues (stress/anxiety, stomach issues, fatigue, lack of exercise)	18	32	Occupations: Health management
Leisure activities (limited ability to identify/engage in enjoyable activities)	10	18	Occupations: Leisure
Work issues (job satisfaction, work fatigue/endurance)	9	16	Occupations: Work
Rest/sleep (falling asleep/being well rested)	7	12	Global Mental Functions: sleep/occupations: rest and sleep

Note. ADL = activities of daily living; iADL = instrumental activities of daily living.

Table 3. Comorbid diagnoses.

	Diagnosis		Symptoms/Self-report	
	N	%	N	%
Anxiety/GAD	33	58	7	12
Depression	28	49	8	14
Attention disorders	22	39	1	2
PTSD/trauma	12	21	0	–
Intestine/IBS	10	18	3	5
ASD	10	18	2	4
GERD	10	18	0	–
SPD/SOR	9	16	8	14
Bipolar disorder	9	16	0	–
Migraines	8	14	0	–
Eating disorders	7	12	0	–
Sleep disorders	7	12	0	–
OCD	6	11	3	5
Chronic pain	6	11	0	–
Thyroid disease	6	11	0	–
RLS	4	7	0	–
Addiction(s)	3	5	0	–
History of concussion(s)	3	5	0	–
EDS	3	5	0	–

Note. GAD = generalized anxiety disorder; PTSD = posttraumatic stress disorder; IBS = irritable bowel syndrome; ASD = autism spectrum disorder; GERD = gastroesophageal reflux disease; SPD = sensory processing disorder; SOR = sensory overresponsivity; OCD = obsessive-compulsive disorder; RLS = restless leg syndrome; EDS = Ehlers-Danlos syndrome.

diagnoses were anxiety disorders, followed by depressive disorders, attention disorders, and trauma.

Interoceptive differences based on the scores for each of the subscales of the MAIA-2 are shown in Table 4. One hundred percent of the sample had at least one subscale (1 *SD* below or above the mean) that differed from the normative sample (i.e., 52 individuals had at least one below-average score). Within each subscale from 42% to 58% had scores that differed from the normative sample. The majority of differences were noted to be

Table 4. Percentage different from normative sample.^a

Subscale	Total difference		≥1 SD above		≥1 SD below	
	N	%	N	%	N	%
Trusting	32	58	4	7	28	49
Not Distracting	30	53	6	11	24	42
Not Worrying	29	51	10	18	19	33
Emotional Awareness	27	47	10	18	17	30
Attention Regulation	29	51	7	12	22	39
Self-Regulation	27	47	2	4	25	44
Body Listening	24	42	4	7	20	35
Noticing	29	51	11	19	18	32

Note. ^aFrom Mehling, Acree et al. (2018).

Table 5. Correlation matrix (N = 58).

	Not Noticing	Not Distracting	Not Worrying	Attention Regulation	Emotional Awareness	Self-Regulation	Body Listening	Trusting
Noticing	.126	-.007	.591**	.575**	.326*	.358**	.481**	
Not Distracting		-.068	.260*	.250	.225	-.093	.297*	
Not Worrying			.088	-.315*	.006	-.058	.045	
Attention Regulation				.609**	.561**	.523**	.593**	
Emotional Awareness					.547**	.536**	.398**	
Self-Regulation						.491**	.445**	
Body Listening							.386**	

Note. *Correlation significant at the .05 level. **Correlation significant at the .01 level.

below the mean, with the exception of the category Noticing and Emotional Awareness, for which the scores were more equal both above and below the mean.

Subscale-to-subscale correlational data with the MAIA-2 are provided in Table 5. Interestingly, Not Worrying and Not Distracting had the weakest correlations with other subscales on the MAIA-2. Attention Regulation had the strongest correlations with the most subscales, including Emotional Awareness, Trusting, Self-Regulation, and Body listening. Other clusters based on significant correlations include (a) Noticing with Attention Regulation and Emotional Awareness, (b) Emotional Awareness with Self-Regulation and Body Listening, (c) Body Listening with Attention Regulation and Emotional Awareness, and (d) Self-Regulation with Attention Regulation and Emotional Awareness.

Discussion

This study adds to the growing body of literature about the importance of interoception in adults with sensory concerns. A commonly used self-report measure was employed to explore and investigate the nature of interoceptive processing in this sample of adults seeking intervention for sensory integration and processing challenges. Characterization of the sample

revealed presenting problems across four major areas of relevance including Emotion Regulation, Social Participation, Activities of Daily Living, and Mental Functions (cognition and attention) as well as a range of diagnostic features most commonly anxiety and depression. The entire sample reported interoceptive differences (compared to a normative sample) on at least one subscale of the MAIA-2, reflecting scores that were both below and above the mean. Additionally, domains of interoception were correlated with one another, suggesting the multidimensional nature of interoceptive functions. Thus, it is recommended that an assessment of interoception be added to comprehensive occupational therapy evaluations of adults who are seeking services for sensory integration and processing differences.

Importantly, the majority of scores on the subscales of the MAIA-2 were lower than the normative sample. This finding suggests that adults seeking intervention for sensory integration and processing challenges display differences in interoceptive sensory processing. The domains for which this differed were Noticing and Emotional Awareness, which had relatively more equal distributions of individuals who scored lower than the norm and those who scored higher than the norm. This finding suggests two patterns: individuals who tend to lack physiological and emotional awareness of bodily sensations versus individuals who have an increased physiological and emotional awareness of bodily sensations. It is hypothesized that individuals with lower noticing and emotional awareness may have less responsiveness to where and when body sensations occur, contributing to a less well-developed sense of self and emotional meaning-making based on reduced body responsiveness or body scheme. Below-average noticing of sensation might be seen in a client who finds it difficult to perceive sensation within their body and struggles with emotion meaning-making, which may impact not only emotion regulation but also social engagement. Alternatively, it is hypothesized that individuals with higher noticing would indicate an increased awareness (of where in the body sensations occur and when changes in body sensation occur), which might present as hypervigilance to physiological and emotional responsiveness to sensation. This pattern has been linked to the experience of anxiety, panic, hypochondriasis, and somatization (Domschke et al., 2010), which Mehling, Acree et al. (2018) suggested is a significant health risk. It is possible that these patterns parallel sensory processing patterns of underresponsivity and overresponsivity described in the literature (L. J. Miller et al., 2007). Correlations with other measures are needed to confirm this hypothesis.

The top four subscales that scored lower than the normative sample include Trusting, Attention Regulation, Self-Regulation, and Not Distracting. Lower scores on Trusting indicate that the person does not feel safe in their body or that they cannot trust their bodily signals. Lower

scores on Attention Regulation indicate that the person does not pay attention to body signals, has difficulty directing attention to bodily sensations, and/or has difficulty sustaining attention to body sensations, especially in the presence of distraction. Lower scores on Self-Regulation indicate difficulty in using sensation to regulate or minimize distress. Lower scores on Not Distracting indicate that the person attempts to ignore or distract and engages in behaviors aimed at avoiding feeling discomfort or pain. These interpretations have implications for both daily life functions as well as for intervention. The practitioner must take into account the client's history, diagnoses, and presenting problems to determine whether these lower scores represent adaptive behaviors or whether intervention might support change that allows the individual to move toward their goals.

The sample in this study was similar and different from other reports of adults with mental health concerns and challenges in sensory integration and processing. Unlike previous studies with children (Crasta et al., 2020), this sample included a higher percentage of females. This appears to be consistent with the mental health literature that cites a higher number of females who tend to seek intervention (Terlizzi & Norris, 2021). This literature finds that women are 20% more likely to consider seeking care than men. Additionally, men are reported to have negative attitudes toward seeking help, which means they tend to consult experts less often than women. Men are reported to prefer medication, find therapy less helpful, and seem to ascribe shame or blame to being in need of care (Pattyn et al., 2015).

Interoceptive processing is increasingly recognized as an important component of different mental health conditions, including anxiety disorders, mood disorders, eating disorders, addictive disorders, and somatic symptom disorders (Khalsa et al., 2018). The findings in this study with respect to the most commonly reported comorbid diagnoses and mental health concerns are consistent with this mental health literature. Interestingly, the sample in this study reported a high rate of depression and anxiety along with their sensory integration and processing challenges. Though research shows that women and men have similar rates of mental health problems, their diagnoses tend to differ (Pattyn et al., 2015). Specifically, women are more prone to depression and anxiety than men. In fact, research suggests that women experience depression and/or anxiety twice as often as their male counterparts (U.S. Department of Health and Human Services, 2023). Although the diagnostic information in this study was based on self-report, it suggests that a relationship exists between anxiety or depression with sensory processing and interoceptive functions. Thus, incorporating a sensory measure in traditional mental health clinics might facilitate earlier identification of adults who might benefit from collaborative interventions from both psychologists and occupational therapy practitioners.

A relationship between anxiety and interoceptive functions has also been reported in the interoceptive literature. Garfinkel and Critchley (2013) suggested that interoceptive processing can influence an individual's emotional state as reflected in expressions of anxiety or depression. Mehling et al. (2012) also described altered interoceptive processing in individuals with anxiety. Further, Paulus and Stein (2010) suggested that individuals with higher levels of anxiety are more acutely aware of interoceptive signals. Laughter et al. (2020) also found an association among anxiety, atypical sensory processing, and interoceptive awareness in a nonclinical sample and expanded this association to include sensory modulation differences.

Collaboration between occupational therapy and psychology is not new to the occupational therapy literature. A recent study demonstrated the benefits of collaborative assessment and intervention between psychology and occupational therapy (Berthiaume et al., 2023). Authors have advocated for this method of service delivery in order to achieve a more comprehensive understanding of adolescents residing in a treatment facility (Berthiaume et al., 2023). Other examples of interdisciplinary teamwork are evident in the treatment of trauma (Courtenay et al., 2013), dementia (Keough & Huebner, 2000), and early intervention (Muhlenhaupt et al., 2015). Though some mental health professionals may be aware of the role of interoception in psychopathology and employ mind-body approaches in their interventions (Khalsa et al., 2018), occupational therapy practitioners possess knowledge and interventions that capture the unique contribution of interoception to overall multisensory integration within the context of participation in daily life.

Noteworthy are the aspects of the *Occupational Therapy Practice Framework*, fourth edition (American Occupational Therapy Association, 2020) that were impacted in this sample. In this framework, the relationships between client factors, process skills, performance skills, and occupational performance are delineated. When integrated into practice, the occupational therapy practitioner evaluates the individual and hypothesizes the contribution of client factors and/or process skills impacting the performance of occupations in daily life. For example, clients in this study reported relationships as a primary concern. Occupational therapy practitioners hypothesized that sensory factors were producing withdrawal and social isolation, impacting social participation. Intervention focused on the engagement in body-based sensory activities within the context of preferred activities as well as educating clients on their sensory differences and discussing ways to self-advocate.

The impairments most commonly reported in this study were emotional regulation, social participation, cognitive functions, and activities of daily living. Surprisingly, these areas are similar to parent-identified priorities of

children seeking sensory integration intervention (Cohn et al., 2014). As in this research, that qualitative study identified self-regulation and social interaction as two of the three highest priorities for their children. However, as children move into adulthood, issues related to functional life, health, and quality of life have been described (Costa-López et al., 2021; Kinnealey et al., 2011). Thus, it is not surprising that mental functions and activities of daily living emerged as increasingly important in this adult sample.

This study also explored relations between dimensions of interoception measured by the MAIA-2. Emotional regulation was one of the most common presenting problems identified in this study. This finding is consistent with Price and Hooven (2018), who found that individuals with reduced interoceptive functions had difficulty with emotional awareness and emotional regulation (Price & Hooven, 2018).

Other meaningful associations were found between Self-Regulation and Body-Listening, between Emotional Awareness and Body-Listening, as well as between Attention Regulation and Self-Regulation. These related clusters were similar to those reported in the normative sample (Mehling, Acree et al., 2018). One proposed interpretation suggests that when persons actively listen to their body for insight, the result is an increased awareness of the connection between sensation and emotion (Barrett & Simmons, 2015). However, when unable to obtain insight from bodily sensations, the ability to connect sensations with emotions may be unavailable or inaccessible. Individuals with a more precise detection of internal bodily signals experience emotions more intensively and are better able to process such signals and to regulate them (Fischer et al., 2017). Additionally, the ability to listen and to direct, sustain, and control one's attention to internal sensation provides the opportunity to utilize these sensations as a way to actively self-regulate. So, if body listening and attending are compromised, the tools that are necessary for managing or engaging in self-regulation may not be accessible. Interoception operates at the preconscious level wherein a person is primarily unaware of their bodily processes, but these processes can enter consciousness when top-down attentional resources are directed to the process (Balconi et al., 2017). Designing intervention strategies to enhance interoceptive functions can build attention and body listening skills as well as potentially impact self-regulation and emotional challenges common in this population (Schuette et al., 2020). Additionally, research suggests that mind-body integration can be measured by emotional awareness, self-regulation, and body listening (Hanley et al., 2017).

Clearly, interoceptive sensory capacity is an important contributor to both physiological and psychological health and wellness (Farb et al., 2015; Schmitt & Schoen, 2022). Interoceptive sensation processing results in a

moment-to-moment, personalized, internal body map (Craig, 2002). This sensory map informs both a sense of wellness and can contribute to a person's perception of underlying conditions that may indicate illness or disease. In fact, interoception is increasingly recognized as an important component of different mental health conditions, as discussed above, including anxiety disorders, mood disorders, eating disorders, addictive disorders, and somatic symptom disorders (Khalsa et al., 2018). These results suggest that awareness of bodily sensations and the evaluative or regulatory tendencies applied to such sensations are important determinants of emotional health (Hanley et al., 2017).

This study contributes valuable information for allied and mental health providers/practitioners about the importance of interoception and the usefulness of interoceptive assessment using the MAIA-2. The benefit of the MAIA-2 is that it provides a means of understanding the complexity of interoception and its impact on various aspects of function. This is the first time that a clinical population representing individuals who have sensory integration and processing challenges is represented in this way. This research suggests a preliminary interpretation for clinicians on how to use the subscale scores to plan intervention. The MAIA-2 has been used quite extensively in research, is free and easily accessible, and has been translated into as many as 30 languages, making it useful for a wide range of health care providers (and occupational therapy practitioners in particular) worldwide.

Overall, this study suggests that when working with a clinical population that reports emotional, social, cognitive, or attention challenges, it is vital to add an interoceptive assessment measure to a comprehensive occupational therapy evaluation. It is clear that interoception is a complex system that has an important impact on function in daily life, health, wellness, and well-being. It has a pervasive influence on many aspects of adaptive functioning, including maintaining homeostasis, overall self-awareness, and informing critical aspects of our emotional experience (Craig, 2002). This knowledge supports clinicians in considering the functional impact of interoceptive processing on a client's meaningful participation in daily life as well as in planning targeted interventions. Expanding research on sensory approaches in mental health care should be a high priority to better understand the association among mental illness, sensory processing, and occupational engagement (Bailliard & Whigham, 2017).

Limitations

This preliminary study had several limitations. The sample size was small and obtained from only one clinic providing services for adults with

sensory integration and processing differences. Data were solely based on self-report, including diagnoses, presenting problems, and dimensions of interoception. Thus, data may be biased or inaccurate based on the participant. Findings need to be replicated and should not be considered generalizable. Additionally, these findings may not describe other samples of adults seeking services for sensory integration and processing differences.

Future studies should include a larger, more diverse sample with additional measures of sensory integration/processing, interoception, and occupational performance. Observational measures should be included to enhance the understanding of the relation between interoception and other aspects of sensory integration and processing. Inclusion of mental health documentation would help verify diagnostic findings.

Conclusion

This study was designed to assess the characteristics of adults seeking services for sensory integration and processing differences and to explore interoceptive functions in this sample. Data were collected retrospectively for 57 adults on self-reported presenting problems, comorbid diagnoses, and a measure of interoception (e.g., MAIA-2). The data revealed that 100% of the population had an interoceptive processing difference on one or more subscales. The most common presenting problems were emotion regulation and mental functions, particularly in the area of attention and cognition. Occupation-based challenges included social relationships and participation in activities of daily living. The most commonly reported mental health concerns were anxiety, depression, and posttraumatic stress disorder/trauma. Findings suggest the need for further study of the link between interoceptive sensory processing in mental and emotional health and the impact on meaningful participation in daily life. Future research should include a larger, more diversified sample with additional measures to assess sensory integration and processing as well as occupational performance.

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No potential conflict of interest was reported by the authors.

Author contributions statement

CMS, LG, and SAS participated in all aspects of this study from conception and design to analysis and interpretation. Each author contributed to drafting of the article and revising critically for intellectual content. All authors agree to be accountable for all aspects of the work.

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