

ORIGINAL ARTICLE

Sensory processing patterns, coping strategies, and quality of life among patients with unipolar and bipolar disorders

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Objective: To compare sensory processing, coping strategies, and quality of life (QoL) in unipolar and bipolar patients; to examine correlations between sensory processing and QoL; and to investigate the relative contribution of sociodemographic characteristics, sensory processing, and coping strategies to the prediction of QoL.

Methods: Two hundred sixty-seven participants, aged 16-85 years (53.6 ± 15.7), of whom 157 had a diagnosis of unipolar major depressive disorder and 110 had bipolar disorder type I and type II, completed the Adolescent/Adult Sensory Profile, Coping Orientations to Problems Experienced, and 12-item Short-Form Health Survey version 2. The two groups were compared with multivariate analyses.

Results: The unipolar and bipolar groups did not differ concerning sensory processing, coping strategies, or QoL. Sensory processing patterns correlated with QoL independently of mediation by coping strategies. Correlations between low registration, sensory sensitivity, sensation avoidance, and reduced QoL were found more frequently in unipolar patients than bipolar patients. Higher physical QoL was mainly predicted by lower age and lower sensory sensitivity, whereas higher mental QoL was mainly predicted by coping strategies.

Conclusion: While age may predict physical QoL, coping strategies predict mental QoL. Future studies should further investigate the impact of sensory processing and coping strategies on patients' QoL in order to enhance adaptive and functional behaviors related to affective disturbances.

Keywords: Major affective disorders; sensory processing disorders; coping strategies; quality of life

Introduction

Existing studies have suggested a role of sensory perception in emotional deficits of higher-order processes.^{1,2} Specifically, sensory intolerance, also known as sensory processing disorder (SPD),³ encompasses difficulties in registering and modulating sensory information as well as organizing sensory input to execute successful adaptive responses to situational demands.^{4,5} SPDs are expressed as hyper- or hyposensitivity to non-aversive stimuli⁶ and may lead to maladaptive behaviors and impaired functioning.⁴ SPDs were found to be associated with emotional and arousal processes⁷ based on behavioral and neurophysiological studies. SPDs have been consistently linked to mood disorders and affective temperaments.^{8,9} Several

decades ago, researchers¹⁰ already used the term sensory affective disorder.

Similarly, cognitive capacities and coping strategies are able to significantly influence quality of life (QoL) in patients with unipolar and bipolar disorders. Cognitive deficits may persist beyond the acute stages of illness even in euthymic patients with both major depressive disorder (MDD)¹¹ and bipolar disorder (BD).¹² It has been reported that, compared with healthy controls, euthymic MDD patients were characterized by poorer cognitive function, particularly concerning inhibitory control. Bourne et al.¹² found relevant impairments in several neurocognitive domains in bipolar patients even after controlling for age, intelligence quotient, and gender. Interestingly, these impairments were unrelated to psychoactive treatment and may indicate illness progression, trait-like cognitive alterations related to affective disorders, or residual symptoms. Furthermore, cognitive dysfunctions, both occurring as acute symptoms during depressive episodes or as residual symptoms persisting during affective remission, have a significant impact on the course of affective illness, are powerful predictors of illness outcome, and are significantly

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related to QoL and functioning.^{13,14} Given the detrimental consequences associated with major affective disorders, researchers are encouraged to identify factors that may help to better predict illness trajectories as well as assist the early management, adequate treatment, and improvement of patients' QoL.

QoL is defined as one's subjective feelings about environmental situations and illness, level of functioning, and ability to feel pleasure from life activities.¹⁵ Patients with unipolar and bipolar disorders alike suffer from poor QoL even after the severity of affective symptoms has been alleviated.¹⁶ It has been suggested that depression and anxiety, multiple aspects of the social network, and – only partially – external life conditions are major determinants of subjective QoL in individuals with major affective disorders. Generally, QoL improvement has been universally recognized as a fundamental component of mental health care. Nevertheless, whether and to what extent other factors may be implicated in determining QoL in major affective disorders is a matter of debate.¹⁷ Our current understanding of affective disorders and our present focus on affective symptomatology seem to be insufficient to restore QoL in these patients beyond symptomatic remission, as exemplified by persisting depression-associated cognitive difficulties in remitted patients, which significantly impair QoL despite reduction of affective symptoms.¹⁸ Therefore, we need to identify new endophenotypes in affective disorders in order to explore those phenomena which may be related to the achievement of functional and QoL-related remission.

Sensory processing refers to the ability to register, modulate sensory information, and organize this sensory input to respond to situational demands.⁵ The inability to modulate and process incoming sensory input may lead to either hyper- or hyposensitivity to sensory input, and result in maladaptive behaviors and difficulties in everyday life.¹⁹

According to Dunn's model for sensory processing,²⁰ hyper- or hyposensitivity are determined by the individual's neurological threshold. Yet, behavioral responses to various sensory stimuli are based on the interaction between this threshold and coping strategies that individuals commonly use to deal with this threshold and function in daily life. Based on this model, individuals who use passive strategies allow stimuli to occur, while those who use active strategies act to control the amount and type of sensory input.²⁰ This interaction between sensory sensitivity and coping strategies led to the development of four sensory processing patterns, with the first two referring to hyposensitivity (high neurological threshold): 1) individuals with low registration who fail to detect sensation and do not actively seek sensory input; 2) sensation seekers - individuals who enjoy/experience pleasure from stimulating sensory environments and activities. The other two patterns refer to subjects with hypersensitivity (low neurological threshold): 3) sensory sensitive – individuals who feel discomfort with regular sensations, but do not actively limit their exposure to uncomfortable stimuli; 4) sensation avoiders – individuals who actively limit exposure to sensations.²¹

SPDs have been proposed as factors able to characterize individuals with psychiatric disorders, as they

may be related both to psychiatric symptoms and QoL. Extreme sensory processing patterns have been reported, mainly in schizophrenia,⁶ major depression, and anxiety.²² Since SPDs may decrease functioning and QoL,⁹ individuals with major affective disorders may be more prone to SPDs and impaired QoL. Hence, they might need to exert more efforts in terms of coping mechanisms to deal with daily-life demands, especially when these demands become more complex.

Different coping strategies result from the combination of personality and temperamental factors as well as previous experiences and learned components; overall, they determine the individual's reaction to complex environmental events and stressors. Understanding and identifying the type of coping strategies used by patients with major affective disorders may help to better address their burden of disease and guide management of symptom severity.²² Different types of coping strategies, and their preferential employment, play a crucial role in adaptation as well. Coping strategies may be categorized as problem-focused – known to contribute to positive psychological states²³ and lower levels of depression²⁴ – and emotion-focused or avoidance coping, usually related to elevated levels of distress²⁵ and negative affect.²⁶ Although coping strategies play a central role in the development of affective disturbances and are an important target of psychotherapeutic interventions, they generally do not receive enough attention in the management of affective disorders. In addition, to our knowledge, no data on sensory input and coping strategies in patients with major affective disorders in general, or separately for subjects with MDD and BD, exist in the current literature.

Therefore, although sensory processing, cognitive dysfunctions, and coping strategies are significantly related to QoL and may provide important advances for the treatment of affective disorders, a more in-depth understanding of their role as well as of their implications for disease progression is still lacking. Unfortunately, existing studies on SPDs among individuals with major affective disorders were mainly performed in laboratory settings.¹ The unique SPD characteristics of individuals with both unipolar and bipolar disorders, as well as their coping strategies and impact on QoL, have yet to be established. Moreover, there are no studies in the literature about the differential association between sensory profiles and specific coping strategies in individuals with unipolar MDD and BD, respectively.

Within this context, the purpose of the present study was to: 1) compare unipolar and bipolar patients with regard to their sensory processing patterns, coping strategies, and QoL; 2) analyze the correlations between sensory processing patterns (dependent variable) and QoL (independent variable) in the total sample and among unipolar and bipolar patients, while referring to coping strategies as a mediator variable; and 3) investigate the relative contribution of sociodemographic variables, groups (unipolar/bipolar), sensory processing patterns, and coping strategies in predicting QoL. Our main hypothesis is that different sensory processing profiles and specific coping strategies may account for most of the variance related to QoL in patients with unipolar and BD, and that coping strategies may be a mediator between sensory processing and QoL in these patients.

Methods

Participants and procedure

Our sample included 267 participants, with ages ranging from 16 to 85 years (mean \pm standard deviation [SD] = 53.6 ± 15.7). Among these, 58.8% were diagnosed with unipolar MDD and 41.2% with BD type I (BD-I) and type II (BD-II). Bipolar patients were diagnosed as follow upon admission: BD-I, manic or mixed episode, 27.3%; BD-I, depressive episode, 14.5%; BD-II, hypomanic episode, 6.4%; BD-II, depressive episode, 40%; cyclothymia, 11.8%. All participants were outpatients who were consecutively recruited from the Department of Neuroscience, Section of Psychiatry, University of Genoa (Italy), between July and December 2014, who had been attending our hospital for at least 6 months and whose medication regimens had been stable for at least 6 months prior to recruitment.

The inclusion criterion was a diagnosis of MDD, BD-I, or BD-II. Exclusion criteria were any condition affecting the ability to complete the assessment, including delirium, dementia, or any severe neurological diseases, or denial of informed consent. Diagnostic criteria were based on the DSM-IV-TR.²⁷ Psychiatric histories were carefully collected by clinical psychiatrists and were later verified using the Mini International Neuropsychiatric Interview.²⁸ All patients agreed to participate in the study voluntarily and provided informed consent. The study design was approved by the local ethics committee. Table 1 summarizes participants' sociodemographic information, both

for the overall sample and separately for unipolar and bipolar patients.

Psychometric instruments

Sociodemographic questionnaire

In this self-report questionnaire, respondents answered questions about health status, sociodemographic status, and psychoactive and non-psychoactive medications. This questionnaire was also initially used in combination with the inclusion criteria to screen for study eligibility.

The Adolescent/Adult Sensory Profile (AASP)⁶ is a 60-item, self-report psychometric tool that includes items pertaining to each of the sensory systems. The items are sorted equally into four patterns reflecting Dunn's model: low registration (e.g., "I miss the street, building, or room signs when trying to go somewhere new"), sensation seeking (e.g., "I like to go to places that have bright lights and that are colorful"), sensory sensitivity (e.g., "I'm uncomfortable wearing certain fabrics..."), and sensation avoiding (e.g., "I avoid elevators and/or escalators because I dislike the movement"). Participants indicate the frequency of their behavioral responses to sensory experiences in daily life on a five-point Likert scale ranging from 1 (almost never) to 5 (almost always). Norms exist for various age groups (11-17; 18-64; 65 and above). This questionnaire has good psychometric properties.²⁹ In the present study, the five ranges for each sensory processing pattern, as presented in the AASP manual, were merged as follows:

Table 1 Sociodemographic profile

	Overall sample (n=267)	Unipolar (n=157)	Bipolar (n=110)
Gender			
Male	93 (34.8)	49 (31.2)	44 (40.0)
Female	174 (65.2)	108 (68.8)	66 (60.0)
Level of education			
Elementary school	18 (6.7)	11 (7.0)	7 (6.4)
Junior high school	90 (33.7)	49 (31.2)	41 (37.3)
Secondary school	126 (47.2)	81 (51.6)	45 (40.9)
Higher education	25 (9.4)	10 (6.4)	15 (13.6)
Missing data	8 (2.9)	6 (3.8)	2 (1.8)
Living situation			
Alone	48 (18.2)	33 (21)	15 (13.6)
With family	200 (74.9)	112 (71.3)	88 (80.0)
With friend	16 (6.9)	9 (5.7)	6 (5.5)
Missing data	4 (1.1)	3 (1.9)	1 (0.9)
Employment			
Employed	120 (44.9)	64 (40.8)	56 (50.9)
Unemployed	64 (24.1)	37 (23.6)	27 (24.5)
Retired	70 (26.2)	44 (28.0)	26 (23.6)
Student	8 (3.0)	7 (4.5)	1 (0.9)
Missing data	5 (1.8)	5 (3.2)	0 (0.0)
Socioeconomic status			
Below average	109 (40.8)	61 (38.9)	48 (43.6)
Average	129 (48.3)	81 (51.6)	48 (43.6)
Above average	25 (9.4)	12 (7.6)	13 (11.8)
Missing data	4 (2.2)	3 (1.9)	1 (0.9)

Data presented as n (%).

Table 2 Clinical and psychometric characteristics of the overall sample and comparison between unipolar and bipolar patients

	Overall sample (n=267)	Unipolar (n=157)	Bipolar (n=110)	
Disease duration	13.57±15.88	13.14±22.13	16.98±19.58	<i>t</i> = -2.09
Age at onset	43.08±17.33	48.06±16.81	36.18±15.68	<i>t</i> = 5.78***
HARS	4.81±4.55	5.49±4.53	4.07±4.51	<i>F</i> = 0.11
BD-I, BD-II	22.82±13.06	22.45±12.61	23.35±13.71	<i>F</i> = 1.22

Data presented as mean ± standard deviation.

BD-I, BD-II = bipolar disorder types I and II; HARS = Hamilton Anxiety Rating Scale.

*** $p \leq 0.001$.

1) "Less than most people" represents approximately 16% of the population (1 SD below the mean); 2) "Similar to most people" represents the normal range, found among approximately 68% of the population (between -1 SD and +1 SD); 3) "More than most people" represents approximately 16% of the population (or more than 1 SD above the mean). The Italian-language version of the AASP is currently under validation.

Coping Orientations to Problems Experienced (COPE)

Patients were administered the Italian version of COPE,²¹ a self-report questionnaire that measures 15 coping strategies: five scales that measure problem-focused coping (active coping, planning, suppression of competing activities, restraint coping, and use of instrumental social support); six scales that measure emotion-focused coping (use of social-emotional support, positive reinterpretation and growth, acceptance, humor, focusing on and venting of emotions, and turning to religion); four scales that measure potentially disadaptive strategies/less useful coping responses (denial, behavioral disengagement, alcohol and drug disengagement, and mental disengagement). Two general scores may be also provided: problem-focused coping and emotion-focused coping. This questionnaire is usually used in medical settings.²¹ The COPE can be used as a measure of dispositional coping or as a situational measure of coping with a specific stressful event.

12-Item Short-Form Health Survey version 2 (SF-12)

Overall mental and physical health functioning was assessed by the Medical Outcomes Study SF-12, from which a Mental Component Summary (MCS) score and Physical Component Summary score (PCS) can be derived.³⁰ The SF-12 is a widely used generic health-related QoL (HRQoL) measure including 12 questions to measure functional health and well-being from the patient's point of view. It collects information on eight functioning domains: social functioning, general health, vitality, physical functioning, physical role, mental health, emotional role, and body pain; the theoretical ranges of the subscale and summary scores are 0-100, with higher scores indicating better HRQoL. The SF-12 has shown adequate statistical properties in the general population.³⁰ This standardized questionnaire measures both physical and mental health.

Statistical analyses

All analyses were performed using SPSS version 20.0. Chi-square tests and *t* tests were used to examine sociodemographic differences between unipolar and bipolar

patients. Multivariate analyses were carried out to compare the unipolar and bipolar groups concerning variables related to coping, sensory processing, and QoL, and controlling for age. Specifically, differences in dependent study variables between the two groups, including measures of coping, sensory processing, and QoL, were examined in a multivariate analysis of covariance (MANCOVA) model using age as a covariate.

Correlations between dependent variables were examined by Pearson coefficients. To better investigate whether coping mechanisms may serve as a moderator factor between sensory processing patterns and QoL, partial correlation was performed between AASP and SF-12 scores while eliminating the variance explained by the coping scores. Moreover, a stepwise regression analysis was performed to elucidate the relative contribution of sociodemographic variables, groups (unipolar vs. bipolar), sensory processing patterns, and coping strategies to the prediction of QoL. *P*-values ≤ 0.05 were considered statistically significant.

Results

Sociodemographic background of patients

Table 2 summarizes the clinical characteristics of the overall sample and in comparison between the unipolar and bipolar groups. Mean age in the unipolar group was 44.5±15.4 years vs. 51±15.8 in the bipolar group. This difference was significant ($t_{265} = 2.72$, $p = 0.02$). Apart from age, no significant differences in sociodemographic parameters were found between unipolar and bipolar patients (Table 1).

Comparison of sensory processing patterns, coping strategies, and QoL between unipolar and bipolar patients

MANCOVA with age as a covariate indicated no significant differences in terms of sensory processing patterns, coping strategies, and QoL measured by SF-12 scores between unipolar and bipolar patients, as presented in Tables 3, 4, and 5.

Table 3 Means and standard deviations of AASP scores among unipolar and bipolar patients

	Unipolar (n=156)	Bipolar (n=108)
Low registration	31.71±9.96	31.22±9.87
Sensation seeking	35.87±9.33	36.49±11.04
Sensory sensitivity	37.75±11.71	36.67±11.41
Sensation avoiding	36.07±11.53	35.71±10.65

Data presented as mean ± standard deviation.

AASP = Adolescent/Adult Sensory Profile.

Table 4 COPE scores among unipolar and bipolar patients

	Unipolar (n=134)	Bipolar (n=96)
Problem-focused coping		
Active coping	2.51±0.61	2.57±0.74
Planning	2.51±0.72	2.52±0.81
Suppression of competing activities	2.37±0.64	2.36±0.77
Restraint coping	2.52±0.64	2.28±0.53
Use of instrumental social support	2.46±0.82	2.57±0.85
Emotion-focused coping		
Use of social-emotional support	2.27±0.86	2.44±0.83
Positive reinterpretation and growth	2.47±0.71	2.47±0.81
Acceptance	2.51±0.71	2.43±0.71
Humor	1.66±0.69	1.79±0.74
Venting of emotions	2.52±0.64	2.58±0.66
Turning to religion	2.21±1.04	2.27±1.12
Potentially disadaptive strategies		
Denial	1.93±0.68	1.96±0.72
Behavioral disengagement	2.15±0.73	2.22±0.73
Alcohol and drug disengagement	1.23±0.53	1.42±0.75
Mental disengagement	2.27±0.63	2.37±0.69
General scores		
Problem-focused coping	3.75±2.44	2.46±0.61
Emotion-focused coping	3.32±2.18	2.25±0.43

Data presented as mean ± standard deviation.

COPE = Coping Orientations to Problems Experienced.

Correlations between sensory processing patterns and coping strategies in the overall sample and among unipolar and bipolar patients

First, the existence of significant correlations between sensory processing patterns and coping strategies was investigated. As presented in Table 6, weak to moderate correlations were found. Most significant correlations were identified in the overall sample and unipolar group, but not in bipolar patients. Among the unipolar patients, significant correlations occurred mainly between elevated sensory seeking and greater use of coping strategies (e.g., problem-focused, $r = 0.27$, $p = 0.002$; emotion-focused, $r = 0.32$, $p \leq 0.0001$). In the group of bipolar patients, more significant correlations were found among participants with greater low registration and sensory seeking than in those with sensory sensitivity and avoidance.

Table 5 SF-12 scores among unipolar and bipolar patients

SF-12 subdomain	Unipolar (n=134)	Bipolar (n=96)
General health	56.69±35.58	55.55±35.41
Physical functioning	60.86±37.01	62.25±39.91
Role functioning (physical)	31.10±43.06	27.12±40.48
Bodily pain	56.89±32.21	53.18±33.68
Vitality	15.17±32.18	23.23±34.67
Social functioning	55.65±31.21	51.71±34.49
Role functioning (emotional)	18.88±23.02	24.48±23.81
Mental health	38.53±28.54	42.12±32.98
Physical health composite	52.32±27.08	51.75±28.65
Mental health composite	37.19±21.63	38.95±22.46

Data presented as mean ± standard deviation.

SF-12 = 12-Item Short-Form Health Survey version 2.

Correlations between sensory processing patterns and QoL in the overall sample and among unipolar and bipolar patients

To explore whether coping strategies may serve as a mediating factor between sensory processing patterns (dependent variable) and QoL (independent variable), partial correlations were computed between AASP and SF-12 scores while controlling for problem- and emotion-focused coping strategies, both in the overall sample and among the unipolar/bipolar groups.

As presented in Table 7, significant correlations of weak to moderate strength were found between sensory processing and QoL, indicating that these variables are related independently of coping strategies. Most correlations were found in the total sample and among unipolar patients when compared with bipolar patients, mainly in regard to lower registration, sensory sensitivity, and sensation avoidance. A greater tendency to these sensory processing patterns among the unipolar group correlated with reduced QoL related to bodily pain ($r = -0.43$, $p \leq 0.0001$), vitality ($r = -0.48$, $p \leq 0.0001$), and mental health ($r = -0.38$, $p = 0.001$).

Prediction of QoL by sensory processing patterns and coping strategies

Given the significant correlation between age and physical QoL ($r = -0.27$, $p \leq 0.001$), age was included in the regression analysis.

As presented in Table 8, age accounted for 9% of the variance in physical health, whereas sensory sensitivity accounted for 6% and denial coping strategy accounted for an additional 4% of this variance. In addition, the

Table 6 Significant correlations between AASP and COPE scores in the overall sample, unipolar patients, and bipolar patients

	Low registration			Sensation seeking			Sensory sensitivity			Sensation avoiding		
	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar
Problem-focused coping												
Active coping				0.24 [‡]	0.24 [†]	0.31 [†]						
Suppression of competing activities		0.22 [*]			0.24 [†]		0.26 [†]	0.31 [‡]				
Restraint coping		0.24 [†]			0.22 [†]							
Use of instrumental social support												
Emotion-focused coping												
Use of social-emotional support				0.24 [†]	0.24 [†]	0.25 [†]						
Positive reinterpretation and growth			-0.24 [*]	0.22 [†]								
Humor				0.24 [‡]	0.28 [†]							-0.22 [*]
Venting of emotions	0.32 [‡]	0.34 [†]	0.30 [†]		0.24 [†]	0.21 [*]	0.29 [‡]	0.36 [‡]	0.21 [*]	0.27 [‡]	0.31 [‡]	
Turning to religion												
Potentially disadaptive strategies												
Denial		0.31 [‡]							0.31 [‡]			
Behavioral disengagement	0.38 [‡]	0.42 [†]	0.32 [†]				0.33 [‡]	0.41 [‡]	0.22 [†]	0.26 [‡]	0.32 [‡]	
Alcohol and drug disengagement			0.21 [†]					0.22 [*]			0.21 [*]	
Mental disengagement		0.22 [*]			0.33 [‡]							
General scores												
Problem-focused coping	0.25 [‡]	0.33 [‡]		0.25 [‡]	0.27 [†]							0.21 [*]
Emotion-focused coping				0.24 [†]	0.32 [‡]		0.24 [‡]	0.32 [‡]				

AASP = Adolescent/Adult Sensory Profile; COPE = Coping Orientations to Problems Experienced.

* p ≤ 0.05; † p ≤ 0.01; ‡ p ≤ 0.001.

Table 7 Significant partial correlations between sensory processing patterns and quality of life (problem- and emotion-focused coping were controlled) in the overall sample, unipolar, and bipolar patients

	Low registration			Sensation seeking			Sensory sensitivity			Sensation avoiding		
	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar	Overall sample	Unipolar	Bipolar
SF-12 scales												
Physical functioning												
Bodily pain	-0.41 [‡]	-0.28 [*]	-0.38 [*]			0.44 [†]	-0.25 [†]	0.26 [*]		-0.26 [†]	-0.25 [*]	
Vitality	-0.32 [‡]	-0.43 [‡]	-0.48 [‡]				-0.35 [‡]	-0.31 [†]		-0.22 [*]	-0.37 [‡]	
Social functioning								-0.44 [‡]			-0.32 [†]	
Role functioning (emotional)	-0.22 [*]	-0.32 [†]					-0.23 [*]	-0.27 [†]				
Mental health	-0.31 [‡]	-0.39 [‡]					-0.24 [†]	-0.33 [†]		-0.24 [†]	-0.34 [†]	
Physical health composite	-0.21 [*]	-0.27 [*]						-0.37 [‡]				
Mental health composite	-0.29 [†]	-0.36 [‡]					-0.30 [‡]	-0.43 [‡]	0.44 [†]	-0.21 [*]	-0.36 [‡]	

SF-12 = Short-Form 12 Health Survey version 2.

* p ≤ 0.05; † p ≤ 0.01; ‡ p ≤ 0.001.

Table 8 Prediction of quality of life by sensory processing patterns and coping strategies

Variable	Model 1			Model 2			Model 3			Model 4		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Physical quality of life												
Age	-0.52	0.11	-0.29 [†]	-0.48	0.11	-0.29 [†]	-0.45	0.11	-0.26 [†]	-0.45	0.11	-0.26 [†]
Sensory sensitivity				-0.58	0.15	-0.25 [†]	-0.49	0.15	-0.21 [†]	-0.49	0.15	-0.21 [†]
Denial coping strategy							-7.35	2.41	0.19 [†]	-7.35	2.41	0.19 [†]
R ²		9	15					19				
F _{1,214} for change in R ²		21.19 [†]	15.31 [†]					9.34 [†]				
Mental quality of life												
Venting of emotions coping strategy	-12.34	2.16	-0.36 [†]	-11.71	2.01	-0.35 [†]	-9.58	2.07	-4.64 [†]	-9.84	2.06	-0.29
Positive reinterpretation and growth coping strategy				10.09	1.74	0.34 [†]	9.07	1.72	5.26 [†]	8.98	1.71	0.31
Low registration							-0.48	0.14	-3.36 [†]	-0.42	0.14	-0.18
Age												
R ²		13	25		25	30		29			30	
F for change in R ²		32.65 [†]	33.74 [†]					11.27 [†]			4.07*	

SE = standard error.

* p ≤ 0.05; † p ≤ 0.001.

venting of emotions coping strategy accounted for 13% of the variance in mental health, positive reinterpretation and growth coping strategy accounted for 12%, low registration accounted for 4%, and age accounted for an additional 1% of this variance.

Discussion

This is, to our knowledge, the first study designed to provide an exploratory analysis of the correlations between sensory processing patterns and QoL in patients with unipolar and BD while referring to coping strategies as a mediator variable. The study also aimed to investigate the relative contribution of age, group (unipolar vs. bipolar), sensory processing patterns, and coping strategies in predicting QoL. No significant differences were found between unipolar and bipolar patients concerning coping profiles, sensory processing, or QoL; however, important differences emerged regarding the relationship of these factors in unipolar and bipolar patients, indicating a closer interrelatedness for unipolar patients.

Specifically, a greater tendency to low registration, sensory sensitivity, and sensation avoidance correlated with reduced QoL among unipolar as compared with bipolar patients. Furthermore, coping strategies were found to play no role in mediating sensory processing and QoL in patients with major affective disorders; however, physical QoL was predicted by age and lower sensory sensitivity, while mental QoL was predicted by coping strategies.

We found several significant (weak-to-moderate) correlations between our investigated measures related to coping strategies, sensory processing, and QoL. However, more significant correlations were found in our unipolar sample compared to bipolar patients, which indicated a closer interrelatedness of the investigated factors in unipolar patients compared to bipolar patients. Although correlations were identified in the overall and unipolar samples, mainly between elevated sensory seeking and greater use of coping strategies (indicating a greater effort, when considering coping strategies as a mediating factor between sensory processing patterns and QoL), the relationship between these variables appeared to be independent of – i.e., not mediated by – coping strategies.

Evidence has suggested the existence of a link between sensory sensitivity and various psychological difficulties.²⁹ SPDs refer to a constellation of disturbances concerning how the brain processes and interprets sensory information (e.g., visual, auditory, movement-related, or tactile input).^{20,31,32} SPDs may be associated with difficulties in performance of the activities of daily living, self-confidence, coping mechanisms, and social skills.^{20,31-35} However, they represent only one of the facets of a broader problem regarding information integration, which may predispose subjects to a variety of occasionally maladaptive coping strategies as a way of balancing the disequilibrium derived from the inability to integrate information.³⁶ Coping strategies may be differentially involved in the psychopathology of unipolar and bipolar conditions in specific circumstances. As previously mentioned, according to Dunn's model,

individuals commonly use different coping strategies to deal with their level of reactivity to sensory information. In our sample, bipolar patients reported more correlations with greater low registration and sensory seeking as compared to those with sensory sensitivity and avoidance. A greater tendency to low registration, sensory sensitivity, and sensation avoidance, which correlated with reduced QoL, was also found in unipolar patients. These characteristics, which interact significantly with environmental factors,³⁷ represent a specific disposition that may help clinicians to distinguish between subgroups of patients.

The relationship between SPDs and coping strategies has been previously investigated in different populations of patients (e.g., school-aged boys with fragile X syndrome). Here, the authors found that uses of avoidant vs. independent behaviors in children may reflect different self-regulatory or coping strategies that potentially mediate the relationship between sensory processing deficits and occupational behaviors. To date, existing studies on SPDs among individuals with major affective disorders were mainly performed in children^{36,37} and young adolescents,³⁸ and referred to specific sensory modalities (such as auditory and visual). In particular, sensory processing sensitivity has been found to predict both anxiety and depression, as assessed by the Spielberger Trait Anxiety Inventory and Beck Depression Inventory, in a sample of 213 college students.³⁸ An interesting interaction has been suggested between sensory processing sensitivity and parental care when measuring depression. The authors concluded that highly sensitive individuals may be particularly sensitive to uncaring parents.

However, the unique SPD characteristics of individuals with major affective disorders, together with their expressions in all sensory modalities of daily life, need further investigation, and clinical interpretations should be formulated with caution until further validation and replication studies have been conducted.

Concerning the contribution of sociodemographic characteristics, sensory processing, and coping strategies to the prediction of QoL in both groups, elevated scores on the PCS of QoL were mainly predicted by lower age and lower sensitivity, whereas higher scores on the MCS were mainly predicted by coping strategies. It is important to note that SPDs may impair functional abilities and QoL to a substantial degree. Pfeiffer et al.³⁹ examined the relationship between different sensory processing patterns, community participation, and recovery-oriented outcomes in 95 adults with serious mental disorders and found that individuals with more self-reported sensory sensitivity reported lower QoL than did their peers with processing patterns within typical ranges.

Some avoidance attitudes may be interpreted as an attempt to cope with elevated levels of arousal, defensiveness, or fear of new sensory experiences, which are predominant in a subgroup of patients with major affective disorders who develop more maladaptive coping strategies and poorer psychosocial adjustment/participation in the activities of daily living.

It is also possible that, in some cases, sensory processing vulnerability may act by enhancing other adaptive coping strategies towards a better autonomy, more pronounced

intellectual abilities, as well as the choice of a more protective environmental context in these subjects. This is in line with our results, supporting the assumption that coping strategies accounted more for the prediction of mental QoL than physical QoL.

The present study needs to be considered in light of the following limitations. The relatively small sample size, together with the mixed nature of the selected sample (e.g., both unipolar and bipolar subjects), may limit the generalization of the main findings. The cross-sectional nature of this study is an additional shortcoming. Moreover, the exploratory nature of the analyses suggests that these data should be considered preliminary. The fact that patients with BD-I and BD-II were included in the same diagnostic group may further limit the main results. Furthermore, no psychometric instruments have been used to detect signs and symptoms of mania/hypomania and depression. In addition, we did not recruit a control sample for comparison with the included individuals.

Moreover, we were not able to analyze the confounding effect of the psychoactive medications (e.g., antidepressants, mood-stabilizers, and benzodiazepines) taken by our participants. Further longitudinal studies using larger samples are needed to overcome these caveats and ascertain the generalizability of the mentioned findings. Importantly, although the assessment of cognitive impairments could have exerted a significant role in SPDs and individual coping strategies for patients with major affective disorders, the present study did not investigate the presence and relevance of cognitive deficits in this sample. This lack of measurement of cognitive impairments should be considered an additional limitation. Finally, another relevant shortcoming is that all the indicated factors were investigated using self-reported measures potentially biased by social desirability.

Overall, the present study found that coping strategies did not mediate the relationship between sensory processing patterns and QoL in patients with major affective disorders. Lower age and lower sensitivity were predictors of elevated scores on the physical domain and coping strategies were predictors of higher scores on the mental domain.

Individuals with major affective disorders may experience consistent difficulties in processing sensory input. Clinicians should seriously consider patients' sensory profiles and their behavioral/functional impact on clinical conditions throughout the evaluation process, as sensory processing profiles may closely reflect fundamental needs and form the basis for the manifestation of temperament and personality.³¹

Investigating these aspects may help to better characterize evaluation and intervention processes for individuals with major affective disorders, enhance the use of adaptive and functional behaviors in the effort to optimize QoL, and clarify the specific role of coping strategies and sensory processing in the achievement of functional recovery from depression.

In conclusion, lower age and lower sensory sensitivity were able to explain most of the variance in physical functional health while emotion-focused coping strategies, reduced use of venting of emotions, and elevated use of positive reinterpretation and growth explained most

of the variance in mental health. In this sample, better ability to register sensory input was only minimally able to explain this variance. According to another of our recently published studies,⁴⁰ these findings also suggest that the inclusion of measures of coping strategies and sensory processing patterns provides a more thorough understanding of the multiple determinants involved in the psychopathology of major affective disorders.

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References

- Van Rheeën TE, Rossell SL. Auditory-prosodic processing in bipolar disorder; from sensory perception to emotion. *J Affect Disord.* 2013; 151:1102-7.
- Leitman DI, Laukka P, Juslin PN, Saccente E, Butler P, Javitt DC. Getting the cue: sensory contributions to auditory emotion recognition impairments in schizophrenia. *Schizophr Bull.* 2010;36:545-56.
- Taylor S, Conelea CA, McKay D, Crowe KB, Abramowitz JS. Sensory intolerance: latent structure and psychopathologic correlates. *Compr Psychiatry.* 2014;55:1279-84.
- Miller LJ, Anzalone ME, Lane SJ, Cermak SA, Osten ET. Concept evolution in sensory integration: a proposed nosology for diagnosis. *Am J Occup Ther.* 2007;61:135-40.
- Humphry R. Young children's occupations: explicating the dynamics of developmental processes. *Am J Occup Ther.* 2002;56:171-9.
- Brown C, Dunn W. The Adolescent/adult sensory profile: user's manual. San Antonio: Psychological Corporation; 2002.
- Ben-Avi N, Almagor M, Engel-Yeger B. Sensory processing difficulties and interpersonal relationships in adults: an exploratory study. *Psychology.* 2012;3:70-7.
- Baranek GT. Autism during infancy: a retrospective video analysis of sensory-motor and social behaviors at 9-12 months of age. *J Autism Dev Disord.* 1999;29:213-24.
- Engel-Yeger B, Dunn W. The relationship between sensory processing difficulties and anxiety level of healthy adults. *Br J Occup Ther.* 2011;74:210-6.
- Wilbarger P, Wilbarger J. Sensory defensiveness in children 2-12. Santa Barbara: Avanti Education Programs; 1991.
- Bora E, Harrison BJ, Yücel M, Pantelis C. Cognitive impairment in euthymic major depressive disorder: a meta-analysis. *Psychol Med.* 2013;43:2017-26.
- Bourne C, Aydemir Ö, Balanzá-Martínez V, Bora E, Brissos S, Cavanagh JT, et al. Neuropsychological testing of cognitive impairment in euthymic bipolar disorder: an individual patient data meta-analysis. *Acta Psychiatr Scand.* 2013;128:149-62.
- Jaeger J, Berns S, Uzelac S, Davis-Conway S. Neurocognitive deficits and disability in major depressive disorder. *Psychiatry Res.* 2006;145: 39-48.
- Martínez-Aran A, Vieta E, Torrent C, Sánchez-Moreno J, Goikolea JM, Salamero M, et al. Functional outcome in bipolar disorder: the role of clinical and cognitive factors. *Bipolar Disord.* 2007;9:103-13.
- Papakostas GI, Petersen T, Mahal Y, Mischoulon D, Nierenberg AA, Fava M. Quality of life assessments in major depressive disorder: a review of the literature. *Gen Hosp Psychiatry.* 2004;26:13-7.
- IsHak WW, Greenberg JM, Balayan K, Kapitanski N, Jeffrey J, Fathy H, et al. Quality of life: the ultimate outcome measure of interventions in major depressive disorder. *Harv Rev Psychiatry.* 2011;19:229-39.
- Hansson L. Determinants of quality of life in people with severe mental illness. *Acta Psychiatr Scand Suppl.* 2006;429:46-50.
- Withall A, Harris LM, Cumming SR. The relationship between cognitive function and clinical and functional outcomes in major depressive disorder. *Psychol Med.* 2009;39:393-402.
- Parham LD, Mailloux Z. Sensory integration. In: Case-Smith J, editor. *Occupational therapy for children.* 4th ed. St. Louis: Mosby; 2001. p. 329-81.
- Dunn W. The impact of sensory processing abilities on the daily lives of young children and their families: a conceptual model. *Infants Young Child.* 1997;9:23-5.
- Carver CS, Scheier MF, Weintraub JK. Assessing coping strategies: a theoretically based approach. *J Pers Soc Psychol.* 1989;56:267-83.
- Mao WC, Bardwell WA, Major JM, Dimsdale JE. Coping strategies, hostility, and depressive symptoms: a path model. *Int J Behav Med.* 2003;10:331-42.
- Folkman S. Positive psychological states and coping with severe stress. *Soc Sci Med.* 1997;45:1207-21.
- Aldwin CM. Does age affect the stress and coping process? Implications of age differences in perceived control. *J Gerontol.* 1991;46: P174-80.
- Ben-Zur H, Rapaport B, Amar R, Uretzki G. Coping strategies, I style changes and pessimism after open-heart surgery. *Health Soc Work.* 2000;25:201-9.
- Ben-Zur H, Yagil D, Oz D. Coping strategies and leadership in the adaptation to social change: the Israeli Kibbutz. *Anxiety Stress Coping.* 2005;18:87-103.
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR).* Arlington: American Psychiatric Publishing; 2001.
- Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry.* 1998;59:22-33.
- Pohl PS, Dunn W, Brown C. The role of sensory processing in the everyday lives of older adults. *OTJR (Thorofare N J).* 2003;23:99-106.
- Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care.* 1996;34:220-33.
- Dunn W. The sensations of everyday life: empirical, theoretical, and pragmatic considerations. *Am J Occup Ther.* 2001;55:608-20.
- Ayres AJ. *Sensory integration and the child: understanding hidden sensory challenges.* Los Angeles: Western Psychological Services; 1979.
- Bar-Shalita T, Vatine JJ, Parush S. Sensory modulation disorder: a risk factor for participation in daily life activities. *Dev Med Child Neurol.* 2008;50:932-7.
- Bundy AC. Play theory and sensory integration. In: Bundy AC, Lane SJ, Murray EA, editors. *Sensory integration: theory and practice.* 2nd ed. Philadelphia: Davis; 2002. p. 227-40.
- Cohn E, Miller LJ, Tickle-Degnen L. Parental hopes for therapy outcomes: children with sensory modulation disorders. *Am J Occup Ther.* 2000;54:36-43.
- Gal E, Dyck MJ, Passmore A. Relationships between stereotyped movements and sensory processing disorders in children with and without developmental or sensory disorders. *Am J Occup Ther.* 2010;64:453-61.
- Lane SJ, Reynolds S, Dumenci L. Sensory overresponsivity and anxiety in typically developing children and children with autism and attention deficit hyperactivity disorder: cause or coexistence? *Am J Occup Ther.* 2012;66:595-603.
- Liss M, Timmel L, Baxley K, Killingsworth P. Sensory processing sensitivity and its relation to parental bonding, anxiety, and depression. *Pers Individ Dif.* 2005;39:1429-39.
- Pfeiffer B, Kinnealey M, Reed C, Herzberg G. Sensory modulation and affective disorders in children and adolescents with Asperger's disorder. *Am J Occup Ther.* 2005;59:335-45.
- Engel-Yeger B, Muzio C, Rinosi G, Solano P, Geoffroy PA, Pompili M, et al. Extreme sensory processing patterns and their relation with clinical conditions among individuals with major affective disorders. *Psychiatry Res.* 2016;236:112-8.