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ORIGINAL ARTICLE

COVID-19 impact on post-traumatic stress symptoms in burning mouth syndrome: A multicentric study

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Abstract

Objectives: This study investigates the psychological impact of COVID-19 on burning mouth syndrome (BMS) patients. It focuses on comparing post-traumatic stress symptoms (PTSS), post-traumatic growth (PTG), and resilience between BMS patients and Controls.

Methods: A total of 100 BMS patients and 100 Controls from five Italian centers participated in this observational cross-sectional study. They completed several assessments, including the General Health Questionnaire, Depression Anxiety and Stress Scale, Insomnia Severity Index, National Stressful Events Survey Short Scale, Impact of Event Scale-Revised, Post Traumatic Growth Inventory Short Form, and Connor-Davidson Resilience Scale.

Results: BMS patients had significantly higher stress, anxiety, and depression (DASS-21 score) and post-traumatic stress symptoms (IES-R-6 score), particularly in terms of intrusive thoughts. They showed lower post-traumatic growth (PTGI-SF score) compared to Controls. The resilience scale (CDRS-10) was a key predictor of PTG in both groups, explaining a significant variance in PTGI-SF scores.

Conclusions: BMS patients experienced heightened post-traumatic stress, stress, anxiety, and depression during the COVID-19 pandemic, with reduced post-traumatic growth. This highlights the need to prioritize their psychological well-being, focusing on stress management and fostering post-traumatic growth in challenging times.

KEYWORDS
burning mouth syndrome, COVID-19, post traumatic stress symptoms, resilience, PTGI-SF

1 | INTRODUCTION

Burning mouth syndrome (BMS) is an idiopathic chronic orofacial pain disorder characterized by a burning/dysesthetic sensation in the mouth lasting for more than 3 months without any discernible local or systemic pathological changes ('International Classification of Orofacial Pain, 1st edition (ICOP)', 2020). It affects approximately 1.73% of the global population, with a higher prevalence observed among middle-aged or older women (Coculescu et al., 2014). Apart from the burning sensation, individuals with BMS may experience other oral and extra-oral symptoms (Adamo, et al., 2024; Mignogna et al., 2005). These may include xerostomia, altered taste perception, metallic taste, feeling of mouth soreness, itching, globus but also vulvodynia, ophthalmodynia, and tinnitus (Adamo, et al., 2024, p. 500; Mignogna et al., 2005). Complex symptoms disrupt daily tasks and social interactions, affecting relationships, work productivity, and overall psychological well-being and quality of life (Abetz & Savage, 2009; Canfora et al., 2022). For this reason, mood disorders, sleep disorders, and cognitive impairment frequently overlap with BMS, contributing to the aggravation of the disease (Adamo et al., 2020).

The COVID-19 pandemic had a deep impact on individuals' mental and global health (Carrà et al., 2022; Cénat et al., 2022; COVID-19 Mental Disorders Collaborators, 2021; Delpino et al., 2022; Fiorillo et al., 2020), particularly in subjects with chronic pain conditions such as BMS (Candela et al., 2022).

The prolonged, widespread crisis has heightened post-traumatic stress symptoms (PTSS) like intrusive thoughts and hyperarousal, especially in those with chronic pain, due to health anxiety, economic worries, and bereavement (Carmassi et al., 2022). On the other hand, it has also provided an opportunity for personal growth and development, known as posttraumatic growth (PTG) (Menculini et al., 2022).

Post-traumatic growth encompasses positive psychological changes that individuals may experience following a traumatic event, such as the COVID-19 (Menculini et al., 2022). PTG is a concept that contrasts the belief that trauma exclusively results in adverse outcomes, like immense pain and suffering, suggesting that it can serve as a catalyst for profound personal growth.

Resilience refers to an individual's ability to adapt, recover, and sustain positive functioning maintaining mental well-being in the presence of challenges, adversities, or significant stressors (Southwick et al., 2014).

It involves a range of cognitive, emotional, and behavioral processes that empower individuals to effectively cope with difficulties and recover from adverse experiences (Sharma et al., 2021). During the COVID-19 pandemic, resilience has become a pivotal factor in successfully addressing and overcoming the multiple stressors and uncertainties associated with this global health crisis (Sampogna et al., 2021).

The evaluation of PTG and resilience has become an area of scientific interest particularly in the context of the COVID-19 pandemic (Elam & Taku, 2022; Yang et al., 2023). It has been reported that individuals who experience greater PTG often demonstrate higher levels of resilience and vice versa (Adjorlolo et al., 2022).

The analysis of PTG and resilience may be particularly significant in patients with chronic pain conditions like BMS, who face heightened vulnerability to stress, anxiety, and depression and generally show lower coping strategies causing a decline in overall resilience (Forssell et al., 2012). Moreover, the presence of disease itself adds an additional layer of stressors, which can have unique implications for the mental health and resilience of individuals facing a pandemic (Adamo, et al., 2024).

Understanding BMS patients' responses to pandemic challenges can help identify strategies for psychological well-being and coping, valuable for current and future stressful events.

To the best of our knowledge, no studies have yet explored PTSS, PTG, and resilience in BMS patients. Therefore, the present study aims at analyzing these factors in BMS patients compared with Control group. Our hypothesis was that BMS patients may present a higher risk of developing PTSS with a lower PTG and resilience compared with controls during COVID-19 pandemic.

The primary endpoint of the study was to evaluate in a group of BMS patients and Controls:

- the severity of PTSS, the level of PTG and resilience,
- level of stress, anxiety, depression and sleep disturbance, and during COVID-19 pandemic, in order to identify potential differences in psychological growth and coping mechanisms between the two groups.

The secondary endpoint was to analyze the predictors of the PTG in both groups, taking into account the sociodemographic profile, risk factors, COVID-19 infection, pain, psychological factors, stress disorder symptoms, and resilience.

2 | MATERIALS AND METHODS

2.1 | Study design and participants

Between June 2022 and January 2023, five Italian centers participated in this observational cross-sectional study. The Oral Medicine and Pathology Unit of the University of Trieste, the Oral Medicine Department of University of Naples "Federico II", the Unit of Oral and Maxillo-Facial Surgery of Treviso (Ca′ Foncello Hospital), the Departmental Structure of Odontostomatology (ASFO, Pordenone), and the Oral Surgery and Pathology Unit of the University Magna Graecia of Catanzaro recruited patients after the approval by the Ethical Committee (Approval Number: 251/19: February 20, 2019; University of Naples Federico II) and in accordance with the ethical principles of the World Medical Association Declaration of Helsinki with the Strengthening of the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies (von Elm et al., 2014).

Patients newly diagnosed with BMS and controls and meeting the following inclusion criteria were asked to join the study and were required to sign a written informed consent before their enrolment.

The following inclusion criteria were applied for the BMS group: presence of an intraoral burning or dysesthetic sensation, recurring daily for more than 2 h per day for more than 3 months, in accordance with the definition of the International Classification of Orofacial Pain ('International Classification of Orofacial Pain, 1st edition (ICOP)', 2020); absence of oral lesions and oral infections; evaluation of serum zinc, thyroid function, vitamin B12, and folate levels, alongside the absence of blood test alterations (cell counts, glucose, glycated haemoglobin, serum iron, ferritin, and transferrin), to ensure the exclusion of any blood deficiencies in patients included in the study.

Exclusion criteria for both groups were: patients <18 years old, with current psychiatric, neurological or brain organic disorders, with a history of alcohol or substance abuse, and unable to comprehend and/or complete the questionnaires autonomously.

Controls were patients without a history of BMS, fulfilling all the inclusion and exclusion criteria applicable to them, with the exception of the presence of BMS symptoms.

Furthermore, regarding the exclusion diagnosis of oral candidiasis, it is primarily based on clinical examination, as supported by existing literature (Coronado-Castellote & Jiménez-Soriano, 2013).

From all included subjects (BMS and Controls), which agreed to participate to the study, the following pieces of information were collected: gender, age, education profile, family status, employment status, body mass index (BMI), systemic diseases history, and drugs intake.

2.2 | BMS and COVID-19 pandemic outbreak

BMS-affected patients were asked about symptoms (description and localization) and their trend related to COVID-19 pandemic outbreak (newly diagnosed, symptoms aggravation, or invariability). Information on BMS symptoms pattern (daily variations, night-time symptoms) and treatment, specifically on psychotropic drugs or palmitoylethanolamide (PEA) assumption, were collected.

BMS-related symptoms were recorded using the Numeric Rating Scale (NRS), ranging from 0 (absence of pain) to 10 (worst possible pain), and the Short Form-McGill Pain Questionnaire (SF-MPQ), which consists in 11 sensory descriptors, rated on an intensity scale as 0 = none, 1 = mild, 2 = moderate, or 3 = severe.

2.3 | Questionnaire administration

The following questionnaires were administered both to BMS and Controls:

- *General Health Questionnaire (GHQ-12)*
  The 12-Item General Health Questionnaire (GHQ-12), Italian validated version, consists of 12 items and was used to detect minor (non-psychotic) psychiatric disorders. To each item, a 4-point Likert-type scale (from 0 to 3) was associated, in order to generate a total score ranging from 0 to 36.
- *Depression Anxiety and Stress Scale 21 (DASS-21)*
  The Depression Anxiety and Stress Scale 21 (DASS-21) is a quantitative measure of negative emotional states along the 3 axes of depression, anxiety, and stress. Each of the three DASS-21 scales contains 7 specific items, scored from 0 to 3 with a total score ranging from 0 to 63.
- *Insomnia Severity Index (ISI)*
  The Insomnia Severity Index (ISI) is a 7-item self-report questionnaire assessing the nature, severity, and impact of insomnia. A 5-point Likert scale was used to rate each item (0 = no problem, 1 = mild problem, 2 = moderate problem, 3 = severe problem, and 4 = very severe problem), yielding a total score ranging from 0 to 28.
- *Post Traumatic Grow Inventory Short Form (PTGI-SF)*
  The Post Traumatic Grow Inventory Short Form (PTGI-SF), a 10-item questionnaire, that measures positive changes after having experienced post traumatic events in five domains: relating to others, new opportunities, personal strength, spiritual change, and appreciation of life. Items were rated on a 6-point Likert-scale (0 = I did not experience this change as a result of my crisis; 5 = I experienced this change to a very great degree as a result of my crisis), where the wording "the COVID-19 pandemic" was employed instead of "my crisis", to ensure that participants responded according to the present study. The total score ranged from 0 to 60.
- *National Stressful Events Survey Acute Stress Disorder Short Scale (NSESS)*
  The National Stressful Events Survey Acute Stress Disorder Short Scale (NSESS), a 7-item measure, to assess the severity symptoms of Acute Stress Disorder (ASD) following extremely stressful events or experiences. Each item was rated on a 5-point scale (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, 4 = extremely). The total score varied from 0 to 28.
- *Impact of Event Scale-Revised (IES-R6)*
  The Impact of Event Scale-Revised (IES-R6) is used for post-traumatic stress disorder by measuring the level of subjective stress. The test items consisted of a 4-point Likert scale ranging from 0 to 3 (0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day). The summed score ranged from 0 to 18.
- *Connor-Davidson Resilience Scale (CDRS-10)*
  The Connor-Davidson Resilience Scale (CDRS-10) is a unidimensional self-reported scale consisting of 10-items to measure resilience. Items were rated on a 5-point Likert scale, ranging from 0 = not true at all to 4 = true nearly all the time. Total scores for the CDRS-10 ranged from a minimum of 0 to a maximum of 40.

All the questionnaires are available in the Supplementary file (Data S1).

2.4 | Sample size and Cronbach's alpha index

A total of 200 patients, 100 with BMS and 100 Controls, was estimated to gain a power test value (1- Beta) at no less than 99%,

associated with a significance of no more than 1%. The effect size value to calculate the sample size was equal to 1.28, measured in a previously published research study (Canfora et al., 2022). The calculations were computed using the GPower software (Faul et al., 2007).

2.5 | Statistical analysis

The socio-demographic and clinical characteristics were summarized using descriptive statistics, including means, standard deviations (SDs), medians, and interquartile ranges (IQRs). To assess significant differences in the frequencies of systemic diseases, drug consumption, COVID-19 infection, healthcare services, and DASS-21 between the BMS patients and healthy controls, Fisher's exact test was employed. The Mann–Whitney *U*-test was used to examine differences between the GHQ-12, DASS-21, ISI, and the subscores and total score of NSESS, IES-R6, PTGI-SF, and CDRS-10. Multivariate linear regression analyses were conducted to predict PTGI-SF, incorporating all the variables identified from the univariate analysis as predictors. Sequential regression model analysis was employed, adding predictors one by one to obtain unadjusted coefficient estimations. Finally, a full model analysis was performed to estimate adjusted coefficients, considering all predictors simultaneously. For each model, the adjusted R^2 was reported. The adjusted R^2 served as a measure of the overall goodness of fit, accounting for the number of variables included in the model. Throughout the analysis, the standard errors of model coefficients were reported, providing a measure of the statistical precision of the inference estimation of the model parameters.

3 | RESULTS

A total of 200 participants were included in the study, 100 patients diagnosed with BMS and 100 Controls.

Patients' sociodemographic profile, BMI, medical history including drug consumption and COVID-19 infection/quarantine pieced of information are summarized in Table 1.

Considering both groups as a whole, female were 74% and male 26%, with no statistically significant differences between groups (*p*-value: 0.259). No differences between groups were detectable regarding mean age (*p*-value: 0.957), family situation (*p*-value: 0.054), and BMI (*p*-value: 0.283), as well.

Statistically significant differences were highlighted in relation to patients' education and employment. BMS patients presented a lower education (11.1 ± 4.66 years) compared to Controls (13.5 ± 3.42 years) (*p*-value: <0.001**). A lower percentage of BMS patients were employed (BMS: 39%; Controls: 56%), while more patients were unemployed (BMS: 33%; Controls: 21%) or retired (BMS: 28%; Controls: 23%) (*p*-value: 0.045*).

BMS patients had a higher prevalence of systemic diseases (54%) compared to Controls (41%), though this difference was not statistically significant (*p*-value: 0.089). However, a statistically significant difference was observed specifically for hypercholesterolemia, with 14% in the BMS group versus 2% in Controls (*p*-value: 0.003**).

BMS patients took more medications than Controls (44% versus 24%; *p*-value: 0.004**) and, in particular a statistically significant difference was found for statins and proton pump inhibitors (*p*-value: 0.003** for both items).

Considering COVID-19 infection no significative differences were observed (*p*-value: 0.176), neither with regard to quarantine after COVID-19 infection (*p*-value: 0.289) nor to quarantine for relatives' COVID-19 infection (*p*-value: 1.000).

The disease onset and intensity, the quality and pattern of pain, the prevalence of oral symptoms and their localization in BMS patients are reported in Table 2.

It has been found that the mean time from BMS onset was 30 months, with 63% reporting symptoms before the COVID-19 pandemic. During the pandemic, 27% experienced symptom worsening, with a median duration of 12 months. Psychotropic drugs were used by 62% of patients, and 29% used PEA for symptom management. Additionally, 13% increased their treatment dosage during the pandemic. Patients reported a median pain score of 6 on NRS and SF-MPQ. Symptoms varied throughout the day, with 32% worsening in the evening and 36% present at night. Burning sensations were common, with additional symptoms like xerostomia (63%), dysgeusia (42%), and tongue color changes (32%) reported. Symptoms were mainly localized to the tongue (80%), lips, gums, and cheeks (38%).

The analysis of sub-scores and total score of the GHQ, DASS-21 and ISI in BMS patients and Controls is summarized in Table 3.

Considering the GHQ, no statistically significant differences were detected between groups (*p*-value: 0.786), whereas the DASS-21 highlighted variances between BMS and Controls patients. BMS patients showed higher levels of moderate and extremely severe stress (22% and 4%, respectively) compared to Controls (5% and 0%, respectively) (*p*-value: <0.001**). No significant differences in anxiety (*p*-value: 0.005) and depression (*p*-value: 0.050) items could be highlighted between the groups after Bonferroni correction. Overall, the DASS-21 total score showed higher median score in BMS patients (16, interquartile range: 10–24.2) than in Controls (10, interquartile range: 4–17) (*p*-value: <0.001**). DASS-21 subscale scores were also significantly higher in patients with BMS as compared to Controls.

No differences in the total score of ISI were found between the two groups (*p*-value: 0.265). Moderate and severe insomnia were detected in 13 BMS patients and Controls, respectively.

Table 4 illustrates the analysis of sub-scores and total scores of PTGI-SF, the NSESS, the IES-R6, and the CDRS-10.

No statistically significant differences, in the single items or in the overall score of NSESS were found between the two groups (*p*-value: 0.322) while BMS patients displayed a higher value in the total score of IES R-6 compared with Controls [Median and IQR: 6 (1–10) vs Median and IQR: 3 (0.75–6); *p*-value: 0.030*]. Even considering the subscales, intrusion score was higher in BMS patients [Median and IQR: 2 (0.325); *p*-value: 0.020*] than in Controls.

A statistically significant difference in total score of PTGI-SF was found between the two groups (*p*-value: 0.025*). Specifically,

TABLE 1 Sociodemographic profile, BMI, prevalence of systemic diseases, and drug consumption in 100 BMS patients and 100 controls.

Demographic variables	BMS	Controls	*p*-Value
Gender	Frequency (%)	Frequency (%)	
Male	22 (22)	30 (30)	0.259
Female	78 (78)	70 (70)	
Others	0 (0)	0 (0)	
Age (in years)	Mean ± SD	Mean ± SD	0.957
	60.8 ± 13.3	60.7 ± 6.51	
Education (in years)	Mean ± SD	Mean ± SD	
	11.1 ± 4.66	13.5 ± 3.42	**<0.001****
Family situation	Frequency (%)	Frequency (%)	
Maiden/Bachelor	17 (17)	5 (5)	
Married	67 (67)	79 (79)	0.054
Divorced	7 (7)	8 (8)	
Widowed	9 (9)	8 (8)	
Employment	Frequency (%)	Frequency (%)	
Employed	39 (39)	56 (56)	
Unemployed	33 (33)	21 (21)	**0.045***
Retired	28 (28)	23 (23)	
Body Mass Index (kg/m^2)	Frequency (%)	Frequency (%)	
BMI < 18.5	5 (5)	2 (2)	
BMI: 18.5–24.9 *normal*	46 (46)	47 (47)	0.283
BMI: 25.0–29.9 *overweight*	29 (29)	41 (41)	
BMI: 30–34 *class I obesity*	16 (16)	10 (10)	
BMI: 35–39.99 *class II obesity*	3 (3)	0 (0)	
BMI > 40 *class III obesity*	1 (1)	0 (0)	
	MEAN ± SD	MEAN ± SD	
	25.9 ± 4.76	25.2 ± 3.75	
Systemic diseases	**Frequency (%)**	**Frequency (%)**	***p*-Value**
Yes	54 (54)	41 (41)	0.089
No	46 (46)	59 (59)	
Hypertension	23 (23)	15 (15)	0.207
Hypercholesterolemia	14 (14)	2 (2)	**0.003****
Other cardiovascular diseases	7 (7)	2 (2)	1.000
Hypothyroidism	11 (11)	4 (4)	0.105
Hyperthyroidism	0 (0)	1 (1)	1.000
Endocrine Disease	6 (6)	2 (2)	0.279
Gastroesophageal reflux disease	13 (13)	2 (2)	0.005
Neoplastic diseases	6 (6)	7 (7)	1.000
Asthma	2 (2)	1 (1)	0.811
HBV infection	6 (2.4)	4 (1.6)	0.751
Neurological disorders	2 (2)	2 (2)	1.000
Others	7 (7)	11 (11)	0.459
COVID-19 Infection and covariates	**BMS**	**Controls**	***p*-Value**
	Frequency (%)	**Frequency (%)**	
COVID-19 infection (yes)	28 (28)	38 (38)	0.176
Quarantine after COVID-19 infection (yes)	28 (28)	36 (36)	0.289
Quarantine for COVID-19 infection of relatives (yes)	23 (23)	23 (23)	1.000

(Continues)

TABLE 1 (Continued)

Drug consumption	Frequency (%)	Frequency (%)	*p*-Value
Yes	44 (44)	24 (24)	0.004
No	56 (56)	76 (76)	
Beta blockers	8 (8)	4 (4)	0.373
ACE-inhibitors	6 (6)	8 (8)	0.783
Angiotensin II receptor antagonists (ARBs)	6 (6)	3 (3)	0.498
Thiazide Diuretics	6 (6)	2 (2)	0.279
Calcium Channel blockers	6 (6)	1 (1)	0.118
Antiplatelets	3 (3)	0 (0)	0.246
Blood thinner	2 (2)	2 (2)	1.000
Statins	9 (9)	0 (0)	**0.003****
Proton pump inhibitors	9 (9)	0 (0)	**0.003****
Levothyroxine sodium	11 (11)	2 (2)	0.018
Bisphosphonates	2 (2)	2 (2)	1.000

Note: The significance of the difference between means was measured by the *t*-student test.*Significant $p < 0.05$. **Significant $p < 0.01$.
Sociodemographic data: the significance of the difference between percentages was measured by the Pearson Chi Square test.
Systemic diseases and drug consumption: a significance of the difference between the percentages was measured by the Fisher's exact test.
**Significant with Bonferroni correction 0.004 for the systemic diseases.
**Significant with Bonferroni correction 0.017 for COVID-19 infection and covariates.
**Significant with Bonferroni correction 0.005 for the drug consumption.
Abbreviations: BMS, Burning Mouth Syndrome; BMI, body mass index.

BMS patients showed a lower score than Controls [Median (IQR): 19 (8.75–36); Median (IQR): 27.5 (17.75–36), respectively]. Moreover, a statistically significant difference of PTGI-2 sub-score was detected between the two groups (*p*-value: 0.001**) with a higher value in Controls [Median (IQR): 4 (2–5)].

The CDRS-10 did not evidence, after COVID-19 pandemic, any differences between groups, which demonstrated to be able to adapt when changes occur (CDRS-1; *p*-value: 0.547), to deal with whatever comes (CDRS-2; *p*-value: 0.072), to see humous side of problems (CDRS-3; *p*-value: 0.077). Both groups reported that coping with stress could strengthen them (CDRS-4; *p*-value: 0.012), tended to bounce back after illness or hardship (CDRS-5; *p*-value: 0.651), were able to achieve goals despite obstacles (CDRS-6; *p*-value: 0.893), could stay focused under pressure (CDRS-7; *p*-value: 0.027), were not easily discouraged by failure (CDRS-8; *p*-value: 0.034), thought of their self as strong people (CDRS-9; *p*-value: 0.477), could handle unpleasant feelings (CDRS-10; *p*-value: 0.098).

The results of the multiple linear regression analyses for BMS patients predicting the PTGI-SF score are shown in Table 5.

The first model showed, among the demographic variables, a negative relationship between the gender male and PTGI-SF score (*p*-value: 0.033*). By adding model 2 (which comprises the item related to Covid-19 infection) and model 3 (the total scores of the DASS-21), there were no statistically significant differences, while in model 4, the total scores of the GHQ-12, showed a negative relationship with the PTGI-SF scores (*p*-value: 0.005**), also explaining 10% of variance.

Conversely, the addition of the ISI total score (model 5) and the NSESS total score, related to acute stress disorder following extremely stressful events or experiences (model 8), the IES-R6 (post-traumatic stress disorder, model 9), did not result in a significant increase in the R^2 value for PTGI-SF in BMS patients.

While the addition of the IES-R6 (post-traumatic stress disorder, model 7) was not significant, the addition of resilience measure through the CDRS-10 resulted in a significant increase in the R^2 value of PTGI-SF (*p*-value <0.001**).

Table 6 presents the outcomes of the multiple linear regression investigations regarding Controls as a predictor for the PTGI-SF score. The first model excluded the contribution of the demographic variables to positive changes after post-traumatic events (PTGI-SF) (*p*-value: 0.288). The adding model 2 (which comprises the item related to Covid-19 infection), model 3 (the total scores of the DASS-21), model 4 (the total scores of the GHQ-12) and model 5 (ISI) did not result in a significant increase in the R^2 value for PTGI-SF in Controls patients.

Conversely, the addition of the NSESS total score, related to acute stress disorder following extremely stressful events or experiences (model 6), significantly increased the R^2 value for PTGI-SF (*p*-value <0.045*). While the addition of the IES-R6 (post-traumatic stress disorder, model 7) was not significant, the addition of resilience measure through the CDRS-10 resulted in a significant increase in the R^2 value of PTGI-SF (*p*-value <0.001**).

In the BMS patients, the final full model (model 11), in which all the variables were entered simultaneously, could explain 32.78% of the variance in the total PTGI-SF score (*p*-value<0.001**), with

TABLE 2 Disease onset, intensity, quality and pattern of pain, prevalence of oral symptoms, and location in 100 BMS patients.

	Mean ± SD
Time from disease onset (months)	30 [12–49.5]
Disease Onset before pandemic outbreak	Frequency (%)
	63 (63)
Disease Onset after pandemic outbreak	Frequency (%)
	37 (37)
Worsening of disease during pandemic outbreak	Frequency (%)
	27 (27)
Time of worsening (months)	Median; IQR
	12 [5–13]
Treatment with psychotropic drugs	Frequency (%)
	62 (62)
Treatment with PEA	Frequency (%)
	29 (29)
Increasing dosage after pandemic outbreak (yes)	Frequency (%)
	13 (13)
Pain	**Median; IQR**
NRS	6 [4–8]
SF-MPQ	6 [1–13.25]
	Frequency (%)
Pattern of symptoms	
Same in the morning/afternoon/evening	14 (14)
Worse in the afternoon/evening	32 (32)
Worse in the morning	9 (9)
Change day by day	45 (45)
Present in the night	36 (36)
Oral symptoms	**Frequency (%)**
Burning	100 (100)
Only burning	11 (11)
Burning + additional symptoms	89 (89)
Intraoral Foreign Body Sensation	21 (21)
Xerostomia	63 (63)
Dysgeusia	42 (42)
Globus pharyngeus	13 (13)
Subjective change in tongue morphology	12 (12)
Subjectve change in tongue color	32 (32)
Sialorrhea	17 (17)
Itching	10 (10)
Tingling sensation	24 (24)
Occlusal Dysesthesia	17 (17)
Oral dyskinesia	10 (10)
Dysosmia	7 (7)
Subjective Halitosis	29 (29)
Location of Pain/Burning	**Frequency (%)**
Burning /pain diffuse to entire oral mucosa	40 (30)
Burning/pain localized in one or more sites of oral mucosa	60 (60)
Tongue	80 (80)
Lips	38 (38)
Palate	20 (20)
Gums	38 (38)
Cheeks	38 (38)
Floor of the Mouth	19 (19)
Trigone	3 (3)

Abbreviations: BMS, burning mouth syndrome; PEA, palmitoylethanolamide; NRS, Numeric Rating Scale; SF-MPQ, Short Form McGill Pain Questionnaire.

the most predictive variables being gender, general health status and resilience (CDRS-10) (p-values: 0.033*, 0.005**, <0.001**, respectively; Table 5). Instead, in the Controls group, the final full model (model 9) could explain only 19.19% of the variance of the PTGI-SF score (p-value <0.001**), with the severity of ASD symptoms (NSESS) and resilience (CDRS-10), being the most important contributing factors (p-value: 0.045*; p-value: 0.001**, respectively; Table 6).

4 | DISCUSSION

The COVID-19 pandemic has thrust the world into an unprecedented era of collective trauma profoundly influencing and reshaping the daily lives of individuals worldwide (Fiorillo et al., 2020). In response to these societal shifts, some individuals have exhibited good resilience seizing them as opportunities (Menculini et al., 2022). For instance, they have enjoyed increased quality time with their families, embraced flexible work arrangements, and experienced reduced travel demands, thereby fostering their post-traumatic growth (Skalski et al., 2022).

Conversely, for others, especially those who are more vulnerable and suffer from limited stress tolerance, such as patients with chronic pain conditions like BMS the additional triggers imposed by the pandemic, including the fears about getting sick from COVID-19, may have increased the likelihood of experiencing more severe pain, heightened psychological distress, and the emergence of PTSS (Clauw et al., 2020).

In line with previous studies (Candela et al., 2022; Maeda et al., 2023), patients with BMS showed a higher total score of DASS-21 and sub-scores of stress, anxiety, and depression compared to Controls, which may be a trigger for the development of PTSS. Specifically, stress can intensify the severity of anxiety and depression, creating a cycle that may increase the risk and exacerbate symptoms of post-traumatic stress (Schneiderman et al., 2005). Moreover, the persistence of emotional distress can impair the individual's ability to process the traumatic event,

TABLE 3 Analysis of GHQ-12, DASS-21, ISI, in 100 BMS patients and in 100 controls.

Clinical parameters	BMS	Controls	*p*-Value
GHQ-12 total score	Median [IQR]	Median [IQR]	0.786
	15 [12–18]	15 [12–17.25]	
DASS-21	Frequency (%)	Frequency (%)	
Stress			
Normal (0–10)	32 (32)	51 (51)	
Mild (11–18)	35 (35)	37 (37)	
Moderate (19–26)	22 (22)	5 (5)	<0.001**
Severe (27–34)	7 (7)	7 (7)	
Extremely severe (35–42)	4 (4)	0 (0)	
Anxiety			
Normal (0–6)	45 (45)	69 (69)	
Mild (7–9)	7 (7)	8 (8)	0.005
Moderate (10–14)	27 (27)	14 (14)	
Severe (15–19)	11 (11)	3 (3)	
Extremely severe (20–42)	10 (10)	6 (6)	
Depression			
Normal (0–9)	51 (51)	68 (68)	0.050
Mild (10–12)	14 (14)	13 (13)	
Moderate (13–20)	17 (17)	11 (11)	
Severe (21–27)	8 (8)	6 (6)	
Extremely severe (28–42)	10 (10)	2 (2)	
	Median [IQR]	**Median [IQR]**	
Stress	14 [8–22]	10 [5.5–16]	<0.001**
Anxiety	8 [4–14]	4 [0–8]	<0.001**
Depression	8 [4–17]	4 [2–10]	<0.001**
DASS-21 total-score	16 [10–24.2]	10 [4–17]	<0.001**
ISI	**Frequency (%)**	**Frequency (%)**	
Normal (0–7)	56 (56)	63 (63)	
Subthreshold insomnia (8–14)	31 (31)	29 (29)	0.634
Moderate insomnia (15–21)	11 (11)	7 (7)	
Severe insomnia (22–28)	2 (2)	1 (1)	
ISI total score			
	Median [IQR]	Median [IQR]	0.265
	6 [3–11]	5 [2.75–10]	

Note: The significance of the difference between the percentages was measured by the Fisher's exact test.IQR is the interquartile range. The significance of the difference between medians was measured by the Mann–Whitney test.

GHQ and DASS-21: ** Significant with Bonferroni correction 0.004.

ISI: ** Significant with Bonferroni correction 0.006.

Abbreviations: BMS, Burning Mouth Syndrome; DASS-21, Depression Anxiety Stress Scales-21; GHQ-12, General Health Questionnaire-12; ISI, Insomnia Severity Index.

hindering their recovery and fostering the chronicity of PTSS (van der Kolk, 2000).

Although in this study, the NSESS did not reveal noteworthy differences in single items or total scores between the two groups, BMS patients exhibited a higher total score in the IES-R6, suggesting a more significant impact of the stressors on an individual, implying a greater level of distress and trauma symptoms related to the pandemic compared with Controls. Moreover, BMS patients showed a higher score in the intrusion subscale suggesting a greater degree of intrusive symptoms. These may manifest as unwanted and involuntary thoughts or images that persistently and involuntarily intrude upon the individual's mind (Beck et al., 2008).

TABLE 4 Analysis of subscores and total score of NSESS, IES R-6, PTGI-SF, CDRS-10, in 100 BMS patients and in 100 controls.

	BMS	Controls	
NSESS	**Median [IQR]**	**Median [IQR]**	***p*-Value**
Having "flashbacks", that is, you suddenly acted or felt as if a stressful experience from the past was happening all over again	0 [0–1]	1 [0–1]	0.599
Feeling very emotionally upset when something reminded you a stressful experience	1 [0–2]	1 [0–2]	0.242
Feeling detached from reality, your body or your memories	0 [0–0.25]	0 [0–1]	0.562
Trying to avoid thoughts, feelings, or physical sensations that reminded you of a stressful experience	1 [0–2]	1 [0–1.25]	0.144
Being "super alert", on guard, or constantly on the lookout for danger	0 [0–1]	0 [0–1]	0.325
Feeling jumpy or easily startled when you hear an unexpected noise	1 [0–2]	1 [0–1]	0.406
Being extremely irritable or angry to the point where you yelled at other people, got into fights, or destroyed things	0 [0–1]	0 [0–1]	0.382
NSESS-tot	5 [2–8]	4 [1–8]	0.322
IES R-6	**Median [IQR]**	**Median [IQR]**	***p*-Value**
I thought about the stressful event when I didn't mean to	1 [0–2]	1 [0–1]	0.020
I tried not to think about it	1 [0–2]	1 [0–1]	0.062
I was aware that I still had a lot of feelings about it, but I didn't deal with them	0 [0–2]	0 [0–1]	0.097
I had trouble concentrating	1 [0–2]	1 [0–1]	0.069
I felt watchful and onguard regarding environment and people	0 [0–1]	1 [0–1]	0.571
Other things kept making me think about it	1 [0–2]	0 [0–1]	0.067
IES R-6 tot	6 [1–10]	3 [0.75–6]	**0.030***
Subsections			
Intrusion	2 [0–3.25]	1 [0–2]	**0.020***
Avoidance	1.5 [0–4]	1 [0–2]	0.051
Hyperarousal	1 [0–3]	1 [0–2]	0.397
PTGI-SF	**Median [IQR]**	**Median [IQR]**	***p*-Value**
Change of life values	2 [0–4]	3 [1–4]	0.359
Greater appreciation for the value of my own life	3 [0–4]	4 [2–5]	**0.001****
Deep spirituality	1 [0–3]	2 [0–4]	0.035
Establishing a new life path	1.5 [0–3]	2 [0–3]	0.169
Greater sense of closeness with others	2 [0–4]	3 [1–4]	0.232
I know better that I can handle difficulties	3 [1–4]	3 [2–4]	0.140
I appreciate more every new day	2 [0–4]	3 [1–5]	0.014
I have a stronger religious faith	0 [0–3]	1 [0–4]	0.008
I discovered that I'm stronger than I thought I was	3 [0–4]	3 [2–5]	0.027
I learned a great deal about how wonderful people are	2 [0–3]	2.5 [1–4]	0.017
PTGI-tot	19 [8.75–36]	27.5 [17.75–36]	**0.025***
CDRS-10	**Median [IQR]**	**Median [IQR]**	***p*-Value**
Able to adapt when changes occur	4 [3–5]	4 [3–5]	0.547
Deal with whatever comes	3 [2–4]	3 [3–4]	0.072
Try to see humous side of problems	3 [1–4]	3 [2–4]	0.077
Coping with stress can strengthen me	2 [1–4]	3 [2–4]	0,012

(Continues)

TABLE 4 (Continued)

CDRS-10	Median [IQR]	Median [IQR]	*p*-Value
Tend to bounce back after illness or hardship	1.5 [0–3]	2 [0–3]	0.651
Achieve goals despite obstacles	3 [2–4]	3 [2–4]	0.893
Stay focused under pressure	2 [0–4]	3 [1–4]	0.027
Not easily discouraged by failure	2.5 [1–4]	3 [2–4]	0.034
Think of myself as strong person	3 [2–4]	3 [2–5]	0.477
Can handle unpleasant feelings	3 [1–4]	3 [2–4]	0.098
CDRS-tot	27 [19–36]	30 [24–36.25]	0.043

Note: NSESS: **Significant with Bonferroni correction 0.007. IES R-6: **Significant with Bonferroni correction 0.008. PTGI-10: **Significant with Bonferroni correction 0.005. CDRS 10: **Significant with Bonferroni correction 0.005.

Abbreviations: BMS, Burning Mouth Syndrome; CDRS, Connor Davidson Resilience Scale; IES R-6, Impact of Events Scale Revised; NSESS, National Stressful Events Survey; PTGI, Post Traumatic Grow Inventory.

The intrusive thoughts may disrupt significantly daily life, causing significant distress, and potentially leading to the development of post-traumatic stress disorder (PTSD) and mood disorders over time (Iyadurai et al., 2019).

However, in this study, BMS patients exhibited no discernible disparities in the sub-scores of avoidance and hyperarousal compared to HS. These findings suggest that BMS patients, notwithstanding the presence of intrusive symptoms, do not engage in active avoidance of reminders, thoughts, feelings, or situations linked to the traumatic event. Additionally, they do not demonstrate heightened arousal, irritability, difficulty concentrating, hypervigilance, or exaggerated startle responses.

The mutual relationship between pain and PTSS is established within the scientific literature. Specifically, a central role

TABLE 5 Multiple linear regression model predicting PTG-SF in BMS patients.

	Model 1		Model 2		Model 3		Model 4		Model 5	
Predictors	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value
Gender: Male	−7.89 (3.66)	**0.033***	−7.70 (3.68)	**0.039***	−8.24 (3.76)	**0.031***	−7.71 (3.53)	**0.031***	−7.48 (3.71)	**0.047***
Age	0.04 (0.13)	0.745	0.04 (0.13)	0.761	0.04 (0.13)	0.784	0.00 (0.13)	0.990	0.04 (0.13)	0.742
Education	0.12 (0.37)	0.752	0.09 (0.38)	0.813	0.13 (0.38)	0.732	0.06 (0.36)	0.871	0.09 (0.38)	0.811
Marital status: Married	−0.58 (3.24)	0.857	−0.72 (3.26)	0.824	−0.76 (3.28)	0.818	−0.67 (3.12)	0.832	−0.80 (3.26)	0.806
Employment status: Employed	6.04 (3.56)	0.093	5.64 (3.63)	0.123	5.92 (3.58)	0.102	6.37 (3.43)	0.067	6.38 (3.60)	0.079
Body Mass Index (BMI)	0.50 (0.32)	0.121	0.49 (0.32)	0.129	0.49 (0.32)	0.132	0.57 (0.31)	0.068	0.51 (0.32)	0.117
COVID-19 infection (yes)			2.15 (3.41)	0.529						
DASS-21 tot					−0.06 (0.13)	0.665				
GHQ-12 tot							−0.79 (0.28)	**0.005****		
ISI									0.20 (0.28)	0.476
NRS										
SF-MPQ										
NSESS										
IES-R6										
CDRS-10										
R^2 (%)	3.48	0.136	2.85	0.176	2.63	0.189	10.32	**0.011***	2.97	0.170
R^2 change (%)			−0.63	0.529	−0.85	0.665	6.84	**0.006****	−0.51	0.476

Note: SE are the standard errors of the beta estimates. The *p-values* were obtained from the hypothesis test on the regression coefficients.
*Moderately significant $p < 0.05$; **Strongly significant *p*-value ≤0.01.

Abbreviations: BMS, burning mouth syndrome; CDRS, Connor Davidson Resilience Scale; DASS-21, Depression Anxiety Stress Scales-21; GHQ-12, General Health Questionnaire-12; IES R-6, Impact of Events Scale Revised; ISI, Insomnia Severity Index; NRS, Numeric Rating Scale; NSESS, National Stressful Events Survey; PTGI, Post Traumatic Grow Inventory; SF-MPQ, Short Form McGill Pain Questionnaire.

of the PTSD-pain connection is attributed to intrusion in line with the Perpetual Avoidance Model proposed by Liedl and Knaevelsrud (2008). This model assumes that intrusions, characterized by distressing and unwanted recollections of the traumatic event, play a pivotal role in initiating and perpetuating vicious cycles of PTSS and pain. These intrusions can evoke profound emotional and physiological responses, frequently prompting avoidance behaviors aimed at mitigating distress and preventing the re-living of the trauma. Paradoxically, however, this avoidance of trauma-related stimuli and reminders may heighten sensitivity to pain, thereby amplifying the pain experience and exacerbating PTSS, ultimately establishing a detrimental feedback loop (Zvolensky et al., 2020).

Therefore, in the context of BMS, it's plausible to postulate that the persistence of intrusive thoughts about COVID-19 could potentially intensify the experience of pain. Initially, these intrusive thoughts may induce a state of heightened vigilance and anxiety over time, consequently amplifying the individual's sensitivity to pain (Iyadurai et al., 2019; Petrini & Arendt-Nielsen, 2020).

Remarkably, even with the administration of psychotropic medications and/or PEA as part of their BMS therapy (Nosratzehi, 2021; Ottaviani et al., 2019), 27% of BMS patients still experienced a deterioration in their condition during the COVID-19 pandemic outbreak.

Furthermore, individuals with BMS commonly experience intrusive thoughts such as pain rumination, and anticipation which may contribute to the further worsening of emotional distress perpetuating an adverse cycle.

Moreover, the concurrent presence of intrusive thoughts regarding both COVID-19 and pain can disrupt adaptive coping strategies and behaviors crucial for effectively managing chronic pain.

The enduring presence of PTSS within the context of BMS may significantly decrease an individual's ability to effectively cope with novel stressors, ultimately leading to heightened physical and psychological symptoms (Fava & Guidi, 2021). This chronic state of PTSS may exacerbate pain catastrophizing, intensifying the perception and interpretation of pain, and further contributing to greater pain-related disability (McGeary et al., 2020).

Furthermore, BMS patients exhibited lower levels of education, lower socioeconomic status, and higher rates of unemployment than Controls. These socioeconomic factors make them more vulnerable to the economic consequences of the pandemic potentially leading to heightened levels of frustration, anxiety, and distress. This,

Model 6		Model 7		Model 8		Model 9		Model 10		Model 11	
Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value
−7.86 (3.67)	**0.035***	−8.24 (3.69)	**0.028**	−6.34 (3.85)	0.103	−7.73 (3.79)	**0.044***	−9.32 (3.09)	**0.003****	−6.24 (3.22)	0.056
0.03 (0.13)	0.814	0.03 (0.13)	0.846	0.04 (0.13)	0.752	0.04 (0.13)	0.735	0.04 (0.11)	0.718	−0.03 (0.11)	0.810
0.09 (0.38)	0.805	0.12 (0.37)	0.755	0.09 (0.37)	0.805	0.10 (0.39)	0.792	0.24 (0.32)	0.453	0.06 (0.33)	0.842
−1.08 (3.40)	0.753	−0.91 (3.27)	0.781	−0.07 (3.25)	0.982	−0.54 (3.26)	0.868	−0.46 (2.72)	0.865	−1.76 (2.88)	0.542
5.95 (3.58)	0.100	5.56 (3.62)	0.128	5.70 (3.56)	0.112	6.07 (3.58)	0.093	3.92 (3.01)	0.196	3.51 (3.09)	0.259
0.50 (0.32)	0.126	0.50 (0.32)	0.124	0.54 (0.32)	0.950	0.51 (0.33)	0.121	0.19 (0.27)	0.491	0.26 (0.27)	0.329
										0.65 (2.95)	0.826
										−0.01 (0.15)	0.931
										−0.41 (0.26)	0.123
										0.48 (0.29)	0.098
−0.30 (0.62)	0.627									−0.71 (0.60)	0.240
		−0.16 (0.20)	0.440							−0.11 (0.21)	0.593
				0.45 (0.36)	0.217					0.73 (0.40)	0.073
						0.05 (0.29)	0.860			−0.10 (0.34)	0.770
								0.68 (0.11)	**<0.001****	0.71 (0.11)	**<0.001****
2.69	0.186	3.07	0.165	4.05	0.120	2.47	0.198	31.65	**<0.001****	36.26	**<0.001****
−0.79	0.627	−0.42	0.440	0.56	0.217	−1.02	0.860	28.17	**<0.001****	32.78	**<0.001****

TABLE 6 Multiple linear regression model predicting PTGI-SF in controls.

	Model 1		Model 2		Model 3		Model 4	
Predictors	**Beta (SE)**	***p*-Value**	**Beta (SE)**	***p*-Value**	**Beta (SE)**	***p*-Value**	**Beta (SE)**	***p*-value**
Gender: Male	−4.36 (3.06)	0.157	−4.35 (3.08)	0.161	−3.78 (3.07)	0.221	−5.14 (3.09)	0.100
Age	−0.34 (0.23)	0.141	−0.34 (0.24)	0.157	−0.30 (0.23)	0.198	−0.44 (0.24)	0.069
Education	0.57 (0.41)	0.164	0.58 (0.41)	0.164	0.65 (0.41)	0.115	0.65 (0.41)	0.113
Marital status: Married	−0.23 (3.34)	0.946	−0.28 (3.38)	0.934	0.42 (3.36)	0.901	−0.22 (0.32)	0.948
Employment status: Employed	−0.44 (2.82)	0.876	−0.44 (2.84)	0.877	−0.38 (2.81)	0.894	−0.59 (2.81)	0.834
Body Mass Index (BMI)	0.21 (0.37)	0.579	0.20 (0.38)	0.597	0.18 (0.37)	0.635	0.32 (0.38)	0.398
COVID-19 infection (yes)			0.45 (2.92)	0.878				
DASS-21 tot					0.20 (0.14)	0.167		
GHQ-12 tot							−0.56 (0.39)	0.150
ISI								
NSESS								
IES-R6								
CDRS-10								
R^2 (%)	1.11	0.288	0.06	0.389	2.1	0.222	2.27	0.210
R^2 change (%)			−1.05	0.878	0.98	0.167	1.16	0.150

Note: SE are the standard errors of the beta estimates. The *p*-values were obtained from the hypothesis test on the regression coefficients. *Moderately significant $p < 0.05$; **Strongly significant *p*-value ≤0.01.

Abbreviations: CDRS, Connor Davidson Resilience Scale; DASS-21, Depression Anxiety Stress Scales-21; GHQ-12, General Health Questionnaire-12; IES R-6, Impact of Events Scale Revised; ISI, Insomnia Severity Index; NSESS, National Stressful Events Survey; PTGI, Post Traumatic Grow Inventory.

in turn, increases the risk of developing PTSS and mood disorders, underscoring the importance of addressing not only the medical aspects of BMS but also its broader socioeconomic implications, especially in the context of the ongoing pandemic (Holmes et al., 2021; Webb et al., 2022).

The heightened severity of PTSS was inversely correlated with a lower score of PTGI-SF in BMS patients when compared to Controls while no difference in the CDRS-10 was found between the two groups. This suggests that, despite both groups exhibiting good resilience, individuals with BMS have a reduced degree of positive changes or personal growth in response to the trauma specifically concerning the impact of the COVID-19 pandemic. This finding underscores a noteworthy difference in how BMS patients and healthy individuals perceive and process the aftermath of traumatic events like the pandemic. Despite experiencing the same external stressor, BMS patients exhibit a diminished level of PTG implying that the burden of their chronic condition might influence their capacity to derive positive changes from the adversity of the COVID-19 crisis (Adjorlolo et al., 2022; Yang et al., 2023).

The difference between BMS patients and Controls is underscored through regression analysis highlighting the profound role of resilience in predicting PTG specifically in BMS patients when compared to Controls. Indeed, the final model successfully accounted for 32.78% of the PTGI score variance, with the CDRS-10 emerging as the most influential predictor. However, in Controls, although CDRS-10 held paramount importance, it could only elucidate 19.19% of the variance. This disparity underscores the intricate interplay of multifaceted factors, often challenging to pinpoint, in shaping PTG within different populations.

In this context, resilience stands out as the most influential predictor of positive psychological transformations following traumatic events, particularly in individuals coping with the challenges of BMS. It is possible to consider that resilience appears as a moderator between PTSS and PTG in these patients speculating that those with higher resilience levels could be more likely to exhibit PTG despite experiencing PTSS (Sampogna et al., 2021).

The assessment of resilience through the CDRS-10 becomes fundamental in understanding and predicting the potential for PTG. A higher resilience score indicates a robust ability to bounce back and adapt, through adversities, facilitating the transformative process following trauma not only in the context of the COVID-19 pandemic (Adjorlolo et al., 2022; Skalski et al., 2022). This underscores the critical importance of implementing psychological interventions aimed at enhancing resilience in individuals affected by chronic pain conditions like BMS (Helmreich et al., 2017); by fostering resilience, individuals are empowered to effectively cope the impact of their condition and the added stressors resulting from traumatic events such as the COVID-19 pandemic (Sampogna et al., 2021). This, in turn, catalyzes PTG, an essential element for psychological well-being and successful adaptation in the face of future stressful circumstances over a pandemic.

Future research directions suggest a significant connection between emotions related to empathy and overall well-being. The findings

Model 5		Model 6		Model 7		Model 8		Model 9	
Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value	Beta (SE)	*p*-Value
−4.95 (3.05)	0.108	−3.82 (3.02)	0.209	−4.20 (3.06)	0.172	−4.07 (2.84)	0.155	−5.13 (2.91)	0.081
−0.28 (0.23)	0.225	−0.27 (0.23)	0.251	−0.30 (0.23)	0.198	−0.27 (0.22)	0.222	−0.22 (0.22)	0.337
0.58 (0.40)	0.149	0.65 (0.40)	0.110	0.62 (0.41)	0.133	0.18 (0.39)	0.639	0.34 (0.39)	0.385
0.96 (3.39)	0.777	1.37 (3.38)	0.686	0.60 (3.41)	0.860	−0.92 (3.11)	0.767	1.52 (3.14)	0.629
−0.25 (2.80)	0.929	−1.05 (2.79)	0.707	−0.68 (2.83)	0.809	1.57 (2.67)	0.559	1.53 (2.64)	0.565
0.31 (0.37)	0.413	0.14 (0.37)	0.710	0.17 (0.37)	0.645	0.07 (0.35)	0.838	0.24 (0.35)	0.506
								1.01 (2.74)	0.713
								0.05 (0.20)	0.812
								−0.62 (0.36)	0.091
0.45 (0.27)	0.099							0.54 (0.30)	0.075
		0.62 (0.31)	**0.045***					0.27 (0.43)	0.534
				0.34 (0.29)	0.237			0.13 (0.38)	0.731
						0.49 (0.12)	**<0.001****	0.54 (0.12)	**<0.001****
2.96	0.170	4.32	0.109	1.55	0.260	14.78	**0.002****	20.3	**<0.001****
1.85	0.099	3.21	**0.045***	0.44	0.237	13.67	**<0.001****	19.19	**<0.001****

of the current study aim to guide interventions focused on the transfer of emotions, empathy-related dynamics, and the regulation of emotions in BMS patients. Additionally, it is crucial to acknowledge that patients' conditions can worsen following stressful events. Consequently, it becomes imperative for healthcare professionals to regularly assess and monitor the emotional states of their patients, ensuring a holistic approach to patient care and well-being. Moreover, clinicians must vigilantly detect early psychological distress in BMS patients, as neglecting this can exacerbate their condition, even under treatment.

5 | LIMITATIONS

Given the observational nature of the study and considering the questionnaire was administered at the end of the pandemic, it is not possible to evaluate the potential worsening of the emotional status of patients during COVID-19. Therefore, it is important to interpret the findings cautiously, as they may not fully reflect the real-time emotional impact experienced by patients throughout the pandemic. The delayed assessment could overlook fluctuations in emotional states, and future studies should aim for more immediate evaluations to capture these dynamics accurately. Retrospective biases could influence the findings, as patients' recollections of their experiences might not accurately reflect their emotions at different stages of the pandemic. This highlights the need for real-time monitoring to understand the evolving psychological impacts during such crises.

6 | CONCLUSIONS

The COVID-19 pandemic has illuminated the intricate relationships among PTSS, PTG, and resilience in the face of trauma and adversity in BMS patients.

This understanding is crucial beyond the current crisis, offering key insights for future challenges. The study reveals BMS patients experience heightened PTSS, particularly intrusive thoughts, compared to Controls. This finding underscores the need for enhanced psychological support for BMS patients, who exhibit increased stress, anxiety, and depression, highlighting their significant psychological burden. Additionally, their lower levels of PTG and diminished capacity to appreciate life's positives suggest a reduced ability to find positive meaning and personal growth after stressful events, further emphasizing the importance of targeted psychological interventions to support their mental health and resilience. Advancements in BMS research promise to refine therapeutic methods, fostering personalized treatments for diverse pain conditions. This not only aids BMS sufferers but also enhances pain management globally, improving life quality for those with chronic pain.

AUTHOR CONTRIBUTIONS

Giulia Ottaviani: Supervision; data curation; conceptualization; investigation; methodology; validation; writing – original draft; writing – review and editing; visualization. **Federica Canfora:** Conceptualization; investigation; writing – original draft; methodology; validation;

visualization; writing – review and editing; data curation; supervision; resources. **Stefania Leuci:** Conceptualization; writing – review and editing; data curation; supervision. **Noemi Coppola:** Data curation; methodology; conceptualization. **Giuseppe Pecoraro:** Investigation; conceptualization; visualization; data curation; supervision. **Katia Rupel:** Investigation; writing – original draft. **Magdalena Theodora Bogdan Preda:** Conceptualization; writing – original draft; investigation. **Vello Veronica:** Conceptualization; investigation; writing – original draft. **Albert Umberto:** Conceptualization; supervision; data curation; writing – review and editing. **Gasparro Roberta:** Writing – original draft; investigation; conceptualization. **Margherita Gobbo:** Conceptualization; investigation; writing – original draft; validation. **Luca Guarda-Nardini:** Conceptualization; investigation; writing – original draft. **Amerigo Giudice:** Conceptualization; supervision; data curation; validation. **Elena Calabria:** Conceptualization; investigation; writing – original draft; data curation. **Massimo Aria:** Data curation; software; formal analysis; project administration; writing – review and editing. **Luca D'aniello:** Software; formal analysis; project administration; data curation; writing – review and editing. **Fortuna Giulio:** Conceptualization; data curation; resources; writing – review and editing. **Matteo Biasotto:** Methodology; supervision; data curation; writing – review and editing; conceptualization. **Roberto Di Lenarda:** Project administration; resources; supervision; data curation. **Michele Mignogna:** Supervision; resources; data curation; project administration. **Daniela Adamo:** Project administration; resources; supervision; data curation; conceptualization; investigation; funding acquisition; writing – original draft; writing – review and editing; visualization; validation; methodology.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

PATIENT CONSENT STATEMENT

Complete written informed consent was obtained from the patient for the publication of this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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