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Using Machine Learning to Identify Latent Profiles of Somatosensory Amplification and Catastrophic Misinterpretation of Bodily Cues in Psychosomatic Patients

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A B S T R A C T

The study aimed to identify distinct latent profiles of psychosomatic patients based on their levels of somatosensory amplification and catastrophic misinterpretation of bodily cues using a person-centered machine learning approach. This cross-sectional study involved a sample of $N = 427$psychosomatic patients recruited from clinical settings in South Africa. Participants were assessed using the Somatosensory Amplification Scale (SSAS) and the Body Sensations Questionnaire (BSQ). Statistical analysis was performed using Gaussian Mixture Modeling (Latent Profile Analysis) to identify unobserved subpopulations. Model selection was determined by fit indices, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and the Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT). A strong significant positive correlation was observed between somatosensory amplification and the catastrophic misinterpretation of bodily cues ($r = 0.68$, $p < 0.001$). Latent Profile Analysis identified an optimal three-profile solution: “Low Symptom Burden” ($n = 186$; 43.6%), “Moderate Symptom Burden” ($n = 148$; 34.7%), and “Severe Symptom Burden” ($n = 93$; 21.8%). Comparative analyses revealed that the “Severe Symptom Burden” profile was characterized by a significantly higher proportion of female participants, higher unemployment rates, and longer illness durations ($p < 0.05$), whereas age and educational background did not significantly differentiate the groups. The identification of three distinct latent profiles underscores the clinical heterogeneity of psychosomatic populations and highlights the necessity for tailored, precision-based psychological interventions that address specific levels of cognitive-perceptual distortion.

Keywords: *Psychosomatic Disorders; Somatosensory Amplification; Catastrophic Misinterpretation; Latent Profile Analysis; Machine Learning; Body Sensations Questionnaire.*

1. Introduction

Psychosomatic disorders represent a complex and multifaceted domain within contemporary medicine and clinical psychology, characterized by the profound intersection of psychological distress and physical symptomatology. Patients presenting with psychosomatic illnesses frequently report debilitating physical symptoms that lack a fully explanatory organic pathology, or where the degree of impairment is significantly disproportionate to the underlying medical condition. The intricate brain-body disconnect observed in these populations highlights a somatic sensory basis for distress, wherein the central nervous system maladapts to emotional or physical stressors, leading to amplified physiological responses (Kearney & Lanius, 2022). This disconnect often manifests as a heightened sensitivity to internal bodily states, fundamentally altering how sensory information is processed and interpreted. Within the structure of chronic somatic complaints, psychological phenomena such as depression, anxiety, and specifically, the tendency to catastrophize, play a dominant role in the genesis and maintenance of illness behavior (Asanova & Mukharovska, 2023). Consequently, the subjective experience of bodily sensations is not merely a direct reflection of peripheral nociception or physiological dysregulation, but rather a highly filtered perception heavily influenced by cognitive and emotional processing. To adequately understand the clinical heterogeneity of psychosomatic patients, researchers have increasingly focused on two critical cognitive-perceptual constructs: somatosensory amplification and the catastrophic misinterpretation of bodily cues. These constructs provide a vital framework for explaining why certain individuals are exceptionally vulnerable to experiencing severe distress in response to benign or mild physical fluctuations.

Somatosensory amplification is formally defined as the tendency to experience a wide array of normal, everyday somatic and visceral sensations as intense, noxious, and deeply disturbing (Köteles & Witthöft, 2017). This hyper-vigilance toward the body means that individuals with high levels of somatosensory amplification are acutely aware of physiological changes, scanning their bodies for signs of illness or dysfunction. This perceptual style is closely linked to difficulties in emotional processing. For instance, alexithymia—the inability to identify and describe emotions—has been shown to significantly interact with somatosensory amplification, acting as a crucial link between perceived psychosocial stress and the reporting of somatic symptoms in psychiatric and psychosomatic outpatients (Nakao & Takeuchi, 2018). When individuals cannot adequately process psychological stress, the distress is often expressed somatically, a process exacerbated by amplification. Furthermore, interpersonal dynamics and developmental factors heavily influence this trait. Research indicates that attachment insecurity contributes to the development of somatosensory amplification, with interpersonal problems serving as a mediating factor in this relationship (Kealy et al., 2021). Individuals with insecure attachment may utilize somatic symptoms as an indirect means of care-seeking or as a manifestation of their inability to regulate distress within relationships. This heightened sensory sensitivity is not limited to generalized somatic complaints but extends to specific anxieties, such as dental anxiety, where sensory sensitivity and alexithymia strongly predict negative physiological and psychological reactions to specific medical environments (Ogawa et al., 2024).

Closely related to somatosensory amplification is the concept of catastrophic misinterpretation, predominantly studied within the context of pain catastrophizing. Catastrophizing is a maladaptive cognitive coping style characterized by a magnified negative cognitive and emotional response to actual or anticipated pain or somatic sensations. It encompasses dimensions of rumination, magnification, and a profound sense of helplessness, which have been consistently associated with augmented pain experiences and increased disability, particularly in patients with complex conditions like neuropathic pain (Sullivan et al., 2005). The tendency to catastrophize somatic sensations is frequently intertwined with anxiety sensitivity—the fear of anxiety-related bodily sensations. Studies have demonstrated that both pain catastrophizing and anxiety sensitivity independently and interactively predict the severity and frequency of conditions such as headaches (Drahovzal et al., 2006). Furthermore, the interaction between these cognitive vulnerabilities can influence behavioral outcomes; for example, pain catastrophizing has been shown to mediate the relationship between strenuous exercise involvement and pain ratings, with anxiety sensitivity moderating this complex dynamic (Goodin et al., 2009).

The pervasive impact of catastrophizing is evident across a wide spectrum of chronic pain conditions and psychosomatic presentations. In chronic low back pain populations, catastrophizing and fear-avoidance beliefs are paramount in driving physical disability and emotional

distress, often overriding actual biomechanical limitations (Doménech et al., 2025). Similarly, in gynecological conditions characterized by severe pain, such as endometriosis, intensive longitudinal data reveals a dynamic interplay where daily fluctuations in catastrophizing directly precipitate exacerbations of pelvic pain (Moreira & Oliveira, 2025). The postoperative recovery period is also significantly hindered by these cognitive patterns. In older adult populations undergoing major surgeries like total knee arthroplasty, pain catastrophizing acts as a barrier to rehabilitation, although its effects can be mitigated by cognitive emotion regulation and pain management self-efficacy, highlighting a chain-mediating effect where psychological resilience combats catastrophic thinking (Ying Zhou, 2024).

The etiology of catastrophic misinterpretation and heightened somatic focus is deeply rooted in both personality structures and developmental trauma. Broader personality traits, particularly neuroticism, have a strong quantitative association with pain catastrophizing, an effect that is inversely related to an individual's self-efficacy (Sayed Alitabar & Goli, 2023). Furthermore, clinical predictors of pain catastrophizing encompass a range of sociodemographic and psychological variables, reinforcing the need for comprehensive screening in chronic pain patients (Asanova et al., 2025). Severe psychiatric comorbidities also amplify this phenomenon. In patients with borderline personality disorder, negative affect and pain catastrophizing serve as critical linking mechanisms that explain the disproportionately high rates of chronic pain observed in this population (Stein et al., 2025).

Developmental adversity plays a foundational role in shaping these maladaptive cognitive-perceptual styles. Childhood maltreatment is strongly associated with elevated pain catastrophizing in adulthood, even among individuals suffering from objectively measurable immune-mediated inflammatory diseases, suggesting that early trauma alters the neurobiological and cognitive processing of physical distress (MacDonald et al., 2021). This is further supported by evidence linking adverse childhood experiences to complex, difficult-to-treat conditions like urogenital pain, where negative affect and pain catastrophizing mediate the pathway from early trauma to adult symptom severity (Heule, 2025). In combating these entrenched cognitive biases, interoceptive awareness—the mindful and non-judgmental perception of internal bodily signals—has emerged as a potential protective factor. High interoceptive awareness can positively alter illness perception and reduce the tendency to catastrophize, offering a pathway to decouple physical sensation from emotional distress (Hooshmandi et al., 2024).

Despite the extensive literature identifying somatosensory amplification and catastrophizing as central drivers of psychosomatic distress, the majority of prior research has relied on variable-centered statistical approaches. These traditional methods analyze relationships between distinct variables across an entire population, often assuming population homogeneity and masking the presence of distinct, unobserved subpopulations. Psychosomatic patients, however, are notoriously heterogeneous. The reliance on correlational models limits our understanding of how these traits co-occur within individuals. A person-centered approach, utilizing advanced machine learning techniques such as latent profile analysis, is required to identify naturally occurring, distinct clusters of patients based on their unique multivariate patterns of somatic perception and cognitive misinterpretation. By delineating these latent profiles, clinicians can transition toward precision medicine, tailoring psychological and somatic interventions to the specific cognitive-perceptual profiles of distinct patient subgroups. Identifying whether patients fall into profiles characterized by isolated amplification, dominant catastrophizing, or a severe combination of both is essential for developing targeted therapeutic strategies that address the specific mechanisms maintaining their psychosomatic illness. Therefore, the present study aims to utilize machine learning to identify and characterize distinct latent profiles of somatosensory amplification and catastrophic misinterpretation of bodily cues among patients presenting with psychosomatic disorders.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a cross-sectional, observational research design aimed at identifying distinct latent profiles of somatosensory amplification and catastrophic misinterpretation of bodily cues among individuals diagnosed with psychosomatic disorders. The study population was recruited from multiple outpatient psychological and psychiatric clinics located across major urban centers in South Africa, including Johannesburg, Cape Town, and Durban, over a consecutive period of eighteen months. Participants were eligible for inclusion if they were aged eighteen years or older and had received a formal clinical diagnosis of a somatic symptom disorder or related

psychosomatic condition according to the diagnostic criteria established by current psychiatric classification systems. Exclusion criteria encompassed the presence of severe cognitive impairment, active psychosis, or an inability to comprehend the primary languages used for the assessment instruments. By utilizing a purposive sampling strategy, an initial cohort of prospective participants was approached, resulting in a final, exact sample size of 427 patients who provided informed, written consent and successfully completed the comprehensive assessment battery.

2.2. Measures

The primary variables of interest were assessed utilizing highly validated and reliable self-report psychometric instruments specifically tailored to measure the complex constructs of somatosensory amplification and the catastrophic misinterpretation of bodily sensations. To quantify somatosensory amplification, the Somatosensory Amplification Scale was administered to all participants. This widely recognized instrument evaluates an individual's underlying tendency to experience normal somatic and visceral sensations as intense, noxious, and disturbing, requiring participants to rate their level of agreement with various statements regarding their baseline bodily sensitivity on a standard ordinal scale. The catastrophic misinterpretation of bodily cues was systematically measured using the Body Sensations Questionnaire, which is specifically designed to assess the degree of fear associated with specific physical symptoms and the cognitive bias towards interpreting these benign physiological variations as indicative of severe physical or mental illness. Furthermore, a standardized sociodemographic and clinical questionnaire was utilized to gather pertinent background information, including chronological age, gender identity, educational attainment, employment status, duration of illness, and the specific nature of the participants' primary and secondary clinical diagnoses. All psychometric tools were carefully reviewed, translated, and culturally adapted where necessary to ensure linguistic appropriateness and conceptual equivalence for the diverse South African demographic context.

2.3. Data Analysis

The gathered psychometric data were subjected to advanced, unsupervised machine learning techniques to delineate underlying heterogeneous subgroups within the psychosomatic patient population. Specifically, Gaussian Mixture Modeling, functioning as a continuous Latent Profile Analysis, was conducted to identify unobserved, distinct patient profiles based on the continuous variables derived from the somatosensory amplification and catastrophic misinterpretation measures. The machine learning model selection process involved estimating sequential clustering models with an incrementally increasing number of latent profiles and systematically comparing their relative fit using established statistical criteria. The optimal number of profiles was determined by evaluating information criteria indices such as the Akaike Information Criterion, the Bayesian Information Criterion, and the sample-size adjusted Bayesian Information Criterion, where lower values consistently indicate superior model parsimony and overall fit. Additionally, the Lo-Mendell-Rubin adjusted likelihood ratio test and the Bootstrapped Likelihood Ratio Test were utilized to ascertain whether a model with a specified number of profiles provided a statistically significant improvement over a baseline model with one fewer profile, evaluated at a standard significance level of $p < 0.05$. Entropy values were also meticulously examined to assess the classification accuracy and the structural distinctiveness of the derived latent profiles. Following the definitive identification of the optimal latent profile solution, subsequent inferential statistical analyses, including one-way analysis of variance and chi-square tests of independence, were executed to explore precisely how these newly identified patient profiles differed across the previously collected sociodemographic characteristics and specific clinical parameters.

3. Findings and Results

The findings of this study provide a comprehensive overview of the sociodemographic characteristics of the sample and elucidate the distinct latent profiles of somatosensory amplification and catastrophic misinterpretation of bodily cues among psychosomatic patients in South Africa. The initial descriptive phase of the analysis focused on outlining the baseline clinical and demographic parameters of the $N = 427$participants who successfully completed the study. The sample predominantly comprised female participants, reflecting the typical gender distribution observed in psychosomatic clinical settings. The mean age of the cohort was 41.5years, with a standard deviation of 12.3years, indicating a wide age range from young adulthood to late middle age. A significant proportion of the participants had completed secondary

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education, and the average duration of their psychosomatic illness was 4.2years. The exact frequencies and descriptive statistics for the sociodemographic and clinical variables are detailed in Table 1. Beyond the tabulated data, preliminary correlational analyses revealed a strong, positive, and statistically significant correlation between the overall scores on the Somatosensory Amplification Scale and the Body Sensations Questionnaire ($r = 0.68,\ p < 0.001$), supporting the theoretical link between the tendency to amplify somatic sensations and the cognitive bias towards catastrophizing them.

Table 1

Sociodemographic and Clinical Characteristics of the Sample (N=427)

Characteristic	Category / Statistic	Frequency ($\boldsymbol{n}$) or Mean ($\boldsymbol{M}$)	Percentage (%) or Standard Deviation ($\boldsymbol{SD}$)
Gender	Female	285	66.7%
	Male	142	33.3%
Age (years)	Continuous	$M = 41.5$	$SD = 12.3$
Education Level	Less than High School	74	17.3%
	High School Graduate	210	49.2%
	Tertiary/University	143	33.5%
Employment Status	Employed	245	57.4%
	Unemployed/Other	182	42.6%
Illness Duration (years)	Continuous	$M = 4.2$	$SD = 2.8$

To identify the underlying unobserved subgroups within the patient population based on their experiences of somatic amplification and catastrophic misinterpretation, a Latent Profile Analysis utilizing Gaussian Mixture Modeling was executed. Models specifying one through five latent profiles were iteratively estimated and compared to determine the optimal fit for the data. The evaluation of model fit relied on multiple established statistical indices, including the Akaike Information Criterion, the Bayesian Information Criterion, and the sample-size adjusted Bayesian Information Criterion, alongside the Lo-Mendell-Rubin adjusted likelihood ratio test, the Bootstrapped Likelihood Ratio Test, and entropy values. As illustrated in Table 2, both the Akaike Information Criterion and the Bayesian Information Criterion values decreased consistently as the number of profiles increased, which is typical in mixture modeling. However, the reduction in these information criteria became marginal after the three-profile solution. Crucially, the Lo-Mendell-Rubin adjusted likelihood ratio test yielded a statistically significant p-value for the three-profile model ($p = 0.012$), indicating it provided a superior fit compared to the two-profile model. In contrast, the transition to a four-profile model did not result in a statistically significant improvement according to the Lo-Mendell-Rubin test ($p = 0.184$). Furthermore, the three-profile solution demonstrated robust classification accuracy, as evidenced by an entropy value of 0.86, which comfortably exceeds the generally accepted threshold of 0.80for strong profile delineation. Consequently, the three-profile model was retained as the most parsimonious, statistically sound, and theoretically meaningful representation of the data.

Table 2

Fit Indices for Latent Profile Analysis Models (1 to 5 Profiles)

Number of Profiles	AIC	BIC	sBIC	Entropy	LMR-LRT ($\boldsymbol{p}$-value)	BLRT ($\boldsymbol{p}$-value)
1 Profile	6432.14	6448.36	6435.42	N/A	N/A	N/A
2 Profiles	5812.45	5840.83	5818.19	0.81	<0.001	<0.001
3 Profiles	5345.78	5386.32	5353.97	0.86	0.012	<0.001
4 Profiles	5298.12	5350.82	5308.76	0.82	0.184	0.045
5 Profiles	5270.55	5335.41	5283.65	0.79	0.315	0.092

Following the extraction of the three latent profiles, the specific characteristics defining each subgroup were thoroughly examined based on their mean scores on the Somatosensory Amplification Scale and the Body Sensations Questionnaire. Table 3 presents the unstandardized mean scores and standard deviations for

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these primary variables within each identified profile. Profile 1, which was the largest subgroup comprising 186patients (43.6% of the sample), was characterized by the lowest mean scores on both measures, reflecting a "Low Symptom Burden" phenotype. Individuals in this profile exhibited minimal tendencies to amplify bodily sensations and rarely engaged in catastrophic misinterpretation. Profile 2 consisted of 148patients (34.6%) and was classified as the "Moderate Symptom Burden" profile. These individuals displayed intermediate scores, indicating a moderate sensitivity to somatic cues and a moderate likelihood of interpreting these cues as threatening. Finally, Profile 3, encompassing 93patients (21.8%), represented the "Severe Symptom Burden" phenotype. This group demonstrated markedly elevated mean scores on both the Somatosensory Amplification Scale ($M = 42.8$) and the Body Sensations Questionnaire ($M = 48.5$), signifying a highly sensitized physiological state coupled with a severe cognitive bias toward catastrophic misinterpretation of normal physiological variations.

Table 3

Mean Scores of Somatosensory Amplification and Catastrophic Misinterpretation across Latent Profiles

Variable	Profile 1: Low Symptom Burden ($\boldsymbol{n} = \mathbf{186}$)	Profile 2: Moderate Symptom Burden ($\boldsymbol{n} = \mathbf{148}$)	Profile 3: Severe Symptom Burden ($\boldsymbol{n} = \mathbf{93}$)
SSAS Mean ($\boldsymbol{SD}$)	18.4(4.1)	30.2(5.3)	42.8(4.6)
BSQ Mean ($\boldsymbol{SD}$)	21.5(5.2)	34.7(4.8)	48.5(5.5)

To ascertain whether the three distinct latent profiles differed across baseline sociodemographic and clinical dimensions, a series of inferential statistical tests, including one-way analysis of variance for continuous variables and chi-square tests of independence for categorical variables, were conducted. The results of these comparative analyses are detailed in Table 4. The findings revealed no statistically significant differences among the three profiles with respect to age ($F = 1.12,\ p = 0.328$) or educational attainment ($\chi^2 = 4.56,\ p = 0.335$). However, a highly significant association was observed regarding gender distribution ($\chi^2 = 14.82,\ p < 0.001$), wherein the "Severe Symptom Burden" profile (Profile 3) contained a disproportionately higher percentage of female participants (79.6%) compared to the "Low Symptom Burden" profile (58.1%). Furthermore, an analysis of variance indicated a significant main effect of latent profile membership on the duration of psychosomatic illness ($F = 18.45,\ p < 0.001$). Post-hoc pairwise comparisons utilizing the Bonferroni correction demonstrated that patients in Profile 3 had a significantly longer average duration of illness ($M = 6.1$ years) compared to those in both Profile 2 ($M = 4.4$ years) and Profile 1 ($M = 3.1$ years). Additionally, employment status varied significantly across the groups ($\chi^2 = 12.35,\ p = 0.002$), with individuals in the highest symptom severity profile exhibiting the highest rates of unemployment, underscoring the profound functional impairment associated with elevated levels of somatosensory amplification and catastrophic misinterpretation.

Table 4

Comparison of Sociodemographic and Clinical Characteristics across Latent Profiles

Variable	Profile 1 ($\boldsymbol{n} = \mathbf{186}$)	Profile 2 ($\boldsymbol{n} = \mathbf{148}$)	Profile 3 ($\boldsymbol{n} = \mathbf{93}$)	Test Statistic	$\boldsymbol{p}$-value
Female Gender, $\boldsymbol{n}$(%)	108(58.1%)	102(68.9%)	74(79.6%)	$\chi^2 = 14.82$	<0.001
Age, Mean ($\boldsymbol{SD}$)	40.8(12.5)	42.6(12.1)	41.2(12.4)	$F = 1.12$	0.328
Education: Tertiary, $\boldsymbol{n}$(%)	68(36.5%)	48(32.4%)	27(29.0%)	$\chi^2 = 4.56$	0.335
Unemployed, $\boldsymbol{n}$(%)	65(34.9%)	62(41.9%)	55(59.1%)	$\chi^2 = 12.35$	0.002
Illness Duration, Mean ($\boldsymbol{SD}$)	3.1(2.1)	4.4(2.5)	6.1(3.2)	$F = 18.45$	<0.001

4. Discussion and Conclusion

The primary objective of the present study was to utilize a person-centered machine learning approach, specifically Latent Profile Analysis (LPA), to identify distinct subpopulations based on their self-reported levels of somatosensory amplification and catastrophic misinterpretation of bodily cues. In a sample of $N =$

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427psychosomatic patients from South Africa, our analysis revealed three distinct and naturally occurring latent profiles: a "Low Symptom Burden" profile ($n = 186$), a "Moderate Symptom Burden" profile ($n = 148$), and a "Severe Symptom Burden" profile ($n = 93$). Furthermore, the results demonstrated a significant, strong positive correlation ($r = 0.68$) between the Somatosensory Amplification Scale (SSAS) and the Body Sensations Questionnaire (BSQ). Analyses of sociodemographic and clinical characteristics across these profiles indicated significant differences in gender distribution, unemployment rates, and illness duration, whereas age and educational attainment did not differ significantly.

The strong positive correlation ($r = 0.68$) between somatosensory amplification and the catastrophic misinterpretation of bodily sensations underscores the deeply intertwined nature of these cognitive-perceptual constructs. This finding aligns with the conceptualization of somatosensory amplification as a hyper-vigilant state where normal somatic and visceral sensations are perceived as noxious and deeply disturbing (Köteles & Witthöft, 2017). When this baseline hyper-vigilance is present, individuals are highly prone to catastrophize, a maladaptive coping style characterized by rumination, magnification, and helplessness in the face of perceived somatic threat (Sullivan et al., 2005). The profound brain-body disconnect seen in trauma-related and psychosomatic disorders often provides the somatic sensory basis for this coupled distress (Kearney & Lanius, 2022). Our findings corroborate previous literature emphasizing that within the structure of chronic complaints, psychological phenomena like catastrophizing and anxiety operate synergistically to maintain illness behavior (Asanova & Mukharovska, 2023). It is highly probable that patients scoring high on both the SSAS and BSQ lack adequate interoceptive awareness, which otherwise might buffer against the catastrophization of normal bodily signals (Hooshmandi et al., 2024).

The identification of three distinct latent profiles provides a nuanced understanding of the clinical heterogeneity within psychosomatic populations. The "Severe Symptom Burden" group ($n = 93$), which exhibited the highest scores on both the SSAS and BSQ, represents a highly vulnerable subpopulation. This cluster likely encompasses individuals whose cognitive vulnerabilities significantly exacerbate their physical experience. Previous studies have demonstrated that catastrophizing and fear-avoidance beliefs strongly predict disability and distress, frequently overriding actual physical pathology (Doménech et al., 2025). Furthermore, the extreme somatic focus in this severe profile may be linked to broader personality dimensions, such as high neuroticism and low self-efficacy, which quantitatively correlate with severe pain catastrophizing (Sayed Alitabar & Goli, 2023). Additionally, severe emotional dysregulation and negative affect, often seen in borderline personality disorder, serve as critical mechanisms linking psychological distress to amplified somatic pain, a dynamic that likely characterizes our severe profile (Stein et al., 2025).

The significant differences in sociodemographic and clinical variables across the profiles further validate our findings. We observed that the "Severe Symptom Burden" profile had a higher proportion of females, significantly higher unemployment rates, and longer illness durations. The higher prevalence of females in the severe group is consistent with established clinical, psychological, and socio-demographic predictors of pain catastrophizing (Asanova et al., 2025). The association with longer illness duration and unemployment suggests a trajectory of increasing disability. As patients chronically misinterpret bodily cues, they may engage in prolonged avoidance behaviors, ultimately leading to occupational impairment and a deepened chronicity of the disorder. This cascading effect of catastrophic thinking has been observed across various conditions, from predicting the chronicity of headaches alongside anxiety sensitivity (Drahovzal et al., 2006) to mediating the relationship between strenuous activity and pain (Goodin et al., 2009). In intense pain conditions like endometriosis, such longitudinal catastrophic patterns directly fuel the daily exacerbation of symptoms (Moreira & Oliveira, 2025). Similarly, even following structural interventions like total knee arthroplasty, catastrophizing remains a massive barrier to functional recovery, particularly when cognitive emotion regulation is poor (Ying Zhou, 2024).

The etiology of the severe cognitive-perceptual distortions observed in our third profile may also be rooted in developmental and interpersonal factors not directly measured in the current study, but widely supported by the literature. For instance, adverse childhood experiences and childhood maltreatment have been strongly linked to elevated pain catastrophizing in adulthood, mediating the pathway to severe somatic conditions such as urogenital pain (Heule, 2025) and distress in immune-mediated inflammatory diseases (MacDonald et al., 2021). Furthermore, attachment insecurity contributes to the development of somatosensory amplification, often mediated by ongoing interpersonal problems (Kealy et al.,

2021). It is also plausible that alexithymia plays a bridging role for the patients in the severe profile, acting as the link between unacknowledged psychosocial stress and amplified somatic symptoms (Nakao & Takeuchi, 2018), a pattern similarly observed in highly specific somatic anxieties like dental anxiety (Ogawa et al., 2024).

Several limitations of the present study must be acknowledged. First, the cross-sectional design precludes the ability to establish causal relationships or determine the temporal sequence between the onset of psychosomatic symptoms, somatosensory amplification, and catastrophic misinterpretation. We cannot definitively state whether an inherent tendency to amplify sensations leads to catastrophizing, or if catastrophic schemas amplify sensory perception over time. Second, the reliance on self-report questionnaires introduces inherent biases, including social desirability, memory recall errors, and the subjective interpretation of scale items. Patients with severe psychosomatic disorders may inherently over-report psychological distress due to their amplified internal states. Third, the sample was restricted to psychosomatic patients in South Africa, which may limit the generalizability of the identified latent profiles to other cultural, geographical, or clinical populations. Cultural variations in the expression and conceptualization of somatic distress could significantly influence the manifestation of these profiles. Finally, the study did not incorporate objective physiological or neurobiological measures, such as functional neuroimaging or autonomic nervous system reactivity, which could have provided a biological correlate to the subjective self-report data.

Future research should prioritize longitudinal designs to track the stability and developmental trajectory of these latent profiles over time, particularly in response to major life stressors or therapeutic interventions. Ecological momentary assessment (EMA) could be highly beneficial in capturing real-time, daily fluctuations in somatosensory amplification and catastrophic thinking, providing a more granular understanding of how these variables interact in a patient's natural environment. Additionally, incorporating multi-method assessments is crucial. Combining self-report data with physiological indices, such as heart rate variability, galvanic skin response, or neuroimaging, would help to bridge the gap between subjective cognitive-perceptual styles and objective biological reactivity. Researchers should also investigate the specific developmental antecedents of these profiles, exploring how early childhood adversity, attachment styles, and trauma history differentiate patients who fall into the severe symptom burden category versus those in the low burden category. Finally, cross-cultural studies are needed to determine the universal applicability of these three profiles and to understand how cultural contexts shape the amplification and misinterpretation of bodily cues.

In terms of clinical practice, the identification of distinct latent profiles underscores the urgent need for tailored, precision-medicine approaches in the treatment of psychosomatic disorders. Clinicians should move away from uniform, "one-size-fits-all" treatment modalities and instead utilize routine screening to categorize patients based on their specific cognitive-perceptual burden. For patients identified within the "Severe Symptom Burden" profile, standard medical reassurance is likely to be ineffective and may even exacerbate frustration. These patients require intensive, multidisciplinary interventions. Cognitive Behavioral Therapy (CBT) should be specifically adapted to target and restructure catastrophic schemas regarding bodily sensations. Furthermore, incorporating interoceptive exposure therapies and mindfulness-based practices can assist these high-risk patients in decoupling their physiological sensations from their intense emotional reactions, gradually reducing their hyper-vigilance. Conversely, patients in the "Low Symptom Burden" profile may benefit from less intensive, psychoeducational approaches focused on basic stress management and emotional regulation. Ultimately, recognizing these profiles allows healthcare providers to allocate resources more efficiently and design therapeutic strategies that directly address the underlying psychological mechanisms driving the somatic distress.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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