Brazilian Journal of Anesthesiology 2024;74(2): 744425

Sociedade Brasileira de Anestesiologia

Brazilian Journal of ANESTHESIOLOGY

ORIGINAL INVESTIGATION

The brief measure of preoperative emotional stress screens preoperative maladaptive psychological features and predicts postoperative opioid use: an observational study

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Received 27 July 2022; accepted 18 February 2023
Available online 8 March 2023

KEYWORDS
Acute pain;
Catastrophization;
Psychological distress;
Latent class analysis;
Analgesics;
Opioid;
Perioperative care

Abstract
Background: The Brief Measure of Preoperative Emotional Stress (B-MEPS) is a suitable screening tool for Preoperative Emotional Stress (PES). However, personalized decision-making demands practical interpretation of the refined version of B-MEPS. Thus, we propose and validate cut-off points on the B-MEPS to classify PES. Also, we assessed if the cut-off points screened preoperative maladaptive psychological features and predicted postoperative opioid use.
Methods: This observational study comprises samples of two other primary studies, with 1009 and 233 individuals, respectively. The latent class analysis derived emotional stress subgroups using B-MEPS items. We compared membership with the B-MEPS score through the Youden index. Concurrent criterion validity of the cut-off points was performed with the severity of

Abbreviation: B-MEPS, Brief Measure of Preoperative Emotional Stress; PES, Preoperative Emotional Stress; LCA, Latent Class Analysis; BDI-II, Beck Depression Inventory; BP-PCS, Pain Catastrophizing Scale; BP-CSI, Central Sensitization Inventory; PSQI-BR, Pittsburgh Sleep Quality Index.

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https://doi.org/10.1016/j.bjane.2023.02.004

preoperative depressive symptoms, pain catastrophizing, central sensitization, and sleep quality. Predictive criterion validity was performed with opioid use after surgery.
Results: We chose a model with three classes labeled mild, moderate, and severe. The Youden index points -0.1663 and 0.7614 of the B-MEPS score classify individuals, in the severe class, with a sensitivity of 85.7% (80.1%−90.3%) and specificity of 93.5% (91.5−95.1%). The cut-off points of the B-MEPS score have satisfactory concurrent and predictive criterion validity.
Conclusions: These findings showed that the preoperative emotional stress index on the B-MEPS offers suitable sensitivity and specificity for discriminating the severity of preoperative psychological stress. They provide a simple tool to identify patients prone to severe PES related to maladaptive psychological features, which might influence the perception of pain and analgesic opioid use in the postoperative period.

Introduction

Optimizing perioperative care based on multimodal and multidisciplinary interventions has proved to be an adequate strategy to control perioperative surgical stress response. So, we need accurate tools to identify patients' psychological profiles and, thus, personalize interventions that can modulate the perioperative stress response in those patients prone to maladaptive psychological features.[1] Based on this perspective, an adequate strategy to control the perioperative surgical stress response targets to reduce complications such as pain, fatigue, depression and improve postoperative quality of life in the short and long term.[2]

The pathophysiological link between a psychological state and its negative impact on surgical outcomes has been widely demonstrated.[3-6] However, the absence of a specific tool to assess preoperative stress prompted us to create the Brief Measure of Preoperative Emotional Stress (B-MEPS).[7] This tool was constructed based on a model of allostasis theory that, from a conceptual perspective, explains a cascade of physiological reactions for a protective, coordinated, and adaptive response to maintain physiological homeostasis and a healthy state. The B-MEPS items were extracted from tools widely used to identify emotional aspects, such as depression symptoms, anxiety, minor psychiatric problems, and future self-perceptions.[8] Thus, the B-MEPS items' theoretical assumptions were based on individual differences linked to incapacity to respond to acute and prolonged stressors. This instrument is suitable for identifying patients with higher propensity for maladaptive preoperative emotional stress, negatively impacting either acute postoperative pain or recovery.[9,10]

Currently, model-based individualized predictions play an essential role in the era of personalized medicine. In this case, the stratification of subjects prone to high emotional stress may be an opportunity to establish a rapport between patients and health professionals, hence, establishing individualized interventions for pain prevention, treatment, and management. However, it is challenging to define the severity of stress to create a categorical classification, which is essential to clinical decision-making at the bedside. Statistical approaches, such as Latent Class Analysis (LCA), may be applied to cases with no reference standard. Thus, the present study aimed: (i) To propose the cut-off points in the B-MEPS based on the LCA to categorize individuals according to the severity of preoperative emotional stress. (ii) To assess in an external sample the cut-off points on B-MEPS by concurrent and predictive criterion validity. (iii) To assess predictive properties of the B-MEPS MEPS categories to discriminate patients prone to use higher opioid analgesics during the first 48 hours of postoperative. We hypothesized that high preoperative stress, evaluated by the B-MEPS measure, is associated with higher levels of either central sensitization, catastrophizing thinking or depressive symptoms, the worst sleep quality, and greater opioid use in the postoperative.

Methods

The Research Ethics Committee of the Clinical Hospital of Porto Alegre provided ethical approval for this study (n° 2017−0090). All patients gave their written informed consent before participation.

The results of this study were obtained from data of two primary studies presented in Figure 1. Each study comprised different samples of adults selected by convenience; ASA I−III (American Society of Anesthesiologists physical status) submitted to elective surgery at the Clinical Hospital of Porto Alegre. They underwent general anesthesia or neural blockage. The exclusion criteria comprised a medical history of brain damage or intellectual disability, difficulty understanding verbal commands, anxiolytic or sedative use before the study's evaluation, and ophthalmologic surgery (Fig. 1).

Study 1: Definition of cut-off points of B-MEPS

We used the sample from B-MEPS development, a cross-sectional study with 1009 individuals who had undergone elective surgeries.[10] The 12 items of the B-MEPS scale are shown in Supplementary Table 1, and an interface was developed, available at https://bmeps.shinyapps.io/bmeps/.[11]

Individuals were grouped using Latent Class Analysis (LCA). We evaluated the invariance of the number of classes and the item-response probability. The parameterization and considerations about the fit can be seen in Supplementary Material S1.

The models' fits were compared using Bayesian information criterion, entropy, and clinical interpretation. Class membership was considered the outcome, and we determined the PES cut-off points through the Youden index.

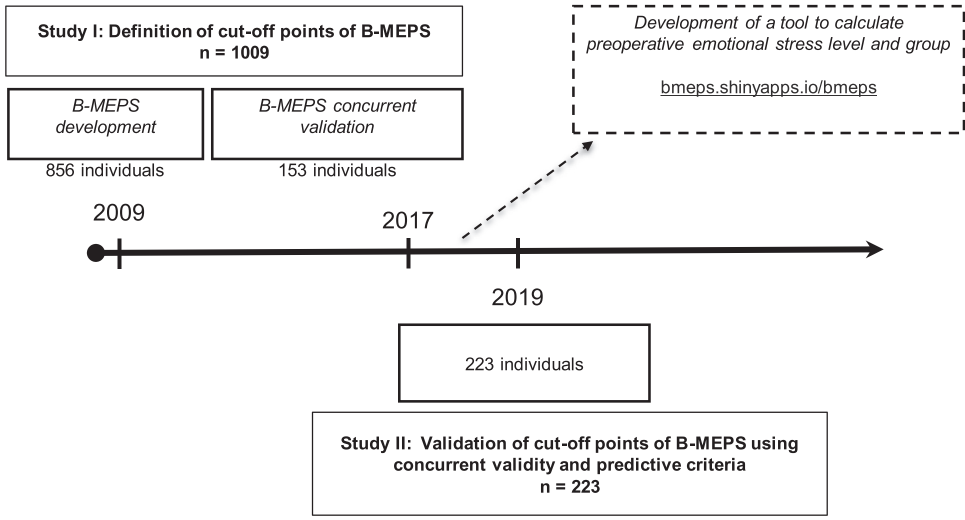

Figure 1 Flow diagram of patient recruitment and studies. In Study 1, the sample consisted of 856 individuals in 2009 from B-MEPS development. It comprised individuals who underwent elective surgery classified as minor surgery (inguinal herniorrhaphy, perineoplasty, sectorectomy breast, percutaneous videolaparoscopic cholecystectomy, breast reconstruction, etc.; n = 174); medium surgery (abdominal hysterectomy, vaginal hysterectomy, oophorectomy, mastectomy, prostatectomy, etc.; n = 381); and major surgery (panhysterectomy, Wertheim's operation, gastrectomy, splenectomy, colectomy, hepatectomy, proctosigmoidectomy, etc.; n = 308)) and 153 in 2017 from B-MEPS concurrent validation (it comprised individuals, who underwent elective surgery classified as minor surgery, n = 10; medium surgery, n = 48); and major surgery, n = 42). And Study 2 the sample consisted of 233 individuals in 2019 (It comprised individuals who underwent elective gynecological, proctological, urological, nephrological, cardiac, vascular, gastric, thoracic, and orthopedic procedures).

Study 2: Validation of cut-off points of B-MEPS

To validate the cut-off points defined in Study 1, we used data from a cohort study with 233 individuals.[12] For concurrent criterion validity of preoperative emotional stress according to the cut-off point on B-MEPS we used the Beck Depression Inventory (BDI-II), Pain Catastrophizing Scale (BP-PCS), Central Sensitization Inventory (BP-CSI), and Pittsburgh Sleep Quality Index (PSQI-BR) as primary outcomes. To assess the predictive criterion validity, PES categories were considered able to discriminate patients with a higher propensity to use opioid analgesia and movement pain at 12, 24, and 48 hours after surgery as primary and secondary outcomes.

Perioperative and postoperative analgesia

An anesthesiologist took the clinical assessment and gave anesthesia and perioperative care information. According to the anesthesiologist's assessment, patients could or could not have received medication preoperatively. All patients had standard monitoring during anesthesia and the immediate postoperative periods. Patients were submitted to general or combined anesthesia with spinal or epidural anesthesia or peripheral neural blockade. The research team checked anesthesia data in the patient's record. The assistant surgeons prescribed postoperative analgesia. In patients with neuraxial analgesia, analgesia was prescribed by the anesthetists involved in the perioperative care team. The type and amount of opioids administered intraoperatively were recorded.

Postoperative analgesia was carried out with multimodal analgesia. When epidural analgesia was provided, the infusion consisted of 0.125% bupivacaine for the first 48 hours. In addition to non-opioid analgesic treatment with acetaminophen (4 g/day) and dipyrone (4 g/day), if not contraindicated, non-steroidal anti-inflammatory drugs were prescribed.

Postoperative analgesic use and pain scores

For the analysis, we calculated opioid use in each of the following time points postoperatively: 12, 24, and 48 hours after surgery. Pain assessment was by a Numeric Pain Scale (NPS 0–10) from zero (absence of pain) to 10 (worst possible pain) at 12, 24, and 48 hours of the postoperative period to record at rest or movement-evoked pain.

Statistical analysis

A prospective power of 77% was reached to detect a relative risk of at least 1.5 for using opioids in the first 48 hours after surgery in the severe PES category, considering a significance level of 5%, sample size of 233 subjects, and an expected incidence of opioid analgesic use of around 50%, calculated using the PSS Health version 0.3.1.[13]

For Study I, the LCA was fit using the poLCA package from R because B-MEPS has polytomous items. The invariance analysis was performed using the Latent Class Analysis Stata Plugin. We compared class membership in LCA with the B-MEPS score using the Youden index to define the cut-off point in the B-MEPS score using the DiagTest3Grp package from R. For Study II, the association between categories of PES and variables was assessed by Pearson's Chi-Square test of independence, analysis of variance (ANOVA), Kruskal-Wallis test, or gamma regression model, as appropriate. A multivariable Poisson regression model with robust standard

Table 1 Clinical and sociodemographic characteristics of sample from Study 1 and 2. The values represent absolute and relative frequency or mean and Standard Deviation (SD) (n = 1009 and 223).

Study I (n = 1009)	Emotional preoperative stress category			
	Mild n = 477 (47%)	Moderate n = 335 (33%)	Severe n = 197 (20%)	p[a]
Age, in years — Mean ± SD	47.2 ± 12.0	46.7 ± 10.3	44.4 ± 10.6	0.012[b]
Sex				< 0.001
Male	163 (34.2)	61 (18.2)	33 (16.8)	
Female	313 (65.8)	274 (81.8)	164 (83.2)	
Missing	1	0	0	
Previous cancer diagnosis?				0.600
Yes	126 (26.4)	84 (25.2)	57 (29.2)	
No	351 (73.6)	249 (74.8)	138 (70.8)	
Missing	0	2	2	
Formal education (years)				< 0.001
≤ 5	11 (3.0)	18 (5.7)	9 (5.2)	
≤ 8	142 (38.9)	176 (55.5)	83 (48.0)	
≤ 11	95 (26.0)	69 (21.8)	45 (26.0)	
> 11	80 (21.9)	42 (13.2)	32 (18.5)	
Missing	112	18	24	

Study II (n = 223)	Emotional preoperative stress category			
	Mild n = 99 (43%)	Moderate n = 96 (41%)	Severe n = 38 (16%)	p[a]
Age, in years — Mean ± SD	62.6 ± 13.4	56.6 ± 15.4	54.3 ± 15.6	0.002[c]
Sex Male	58 (58.6)	61 (63.5)	16 (42.1)	0.076
Smoke – Yes	10 (10.1)	16 (16.7)	8 (21.1)	0.201
Formal education (years)				0.345
≤ 5	44 (44.4)	30 (31.3)	17 (44.7)	
≤ 8	31 (31.3)	42 (43.8)	14 (36.8)	
≤ 11	15 (15.2)	11 (11.5)	3 (7.9)	
> 11	9 (9.1)	13 (13.5)	4 (10.5)	
Surgery				0.505
Prostatectomy, hysterectomy, or nephrectomy	41 (41.4)	46 (47.9)	16 (42.1)	
Gastrectomy, rectosigmoidectomy, colectomy	19 (19.2)	22 (22.9)	8 (21.1)	
Pneumonectomy, lobectomy	16 (16.2)	7 (7.3)	3 (7.9)	
Hip replacement, knee replacement	23 (23.2)	21 (21.9)	11 (28.9)	
Anesthesia and neuraxial opioids				
General anesthesia	59 (59.6)	74 (77.1)	28 (73.7)	0.024
Femoral nerve block, spinal or epidural	47 (47.5)	33 (34.4)	10 (26.3)	0.040
Neuraxial morphine	84 (84.8)	84 (87.5)	35 (92.1)	0.520
ASA				0.247
I	44 (44.4)	30 (31.3)	12 (31.6)	
II	31 (31.3)	33 (34.4)	16 (42.1)	
III	24 (24.2)	33 (34.4)	10 (26.3)	
Pain medicines in the preoperative period	62 (62.6)	65 (67.7)	28 (73.7)	0.447
Non-opioid analgesic	46 (47.0)	51 (53.0)	19 (50.0)	0.642
Acetaminophen	18 (18.2)	28 (29.2)	7 (18.4)	0.147
Dipyrone	32 (32.3)	26 (27.1)	11 (28.9)	0.722
Scopolamine	5 (5.1)	16 (16.7)	3 (7.9)	0.025
Opioid analgesic	13 (13.0)	13 (14.0)	6 (16.0)	0.919
Codeine	6 (6.1)	3 (3.1)	1 (2.6)	0.619[d]
Tramadol	5 (5.1)	6 (6.3)	1 (2.6)	0.730[d]
Morphine	5 (5.1)	6 (6.3)	5 (13.2)	0.232
Psychotropic medication in the preoperative period	20 (20.2)	18 (18.8)	13 (34.2)	0.129
Anxiolytics	22 (22.2)	14 (14.6)	10 (26.3)	0.362
Antidepressant	17 (17.2)	17 (17.7)	12 (31.6)	0.134
Tricyclics	7 (7.1)	13 (13.5)	9 (23.7)	0.028
Selective serotonin reuptake inhibitors (SSRIs)	9 (9.1)	4 (4.2)	3 (7.9)	0.382
Anticonvulsant	3 (3.0)	1 (1.0)	1 (1.0)	0.616
Diagnosis of psychiatric disorders	20 (20.2)	19 (19.8)	16 (42.1)	0.013
Depression	13 (13.1)	5 (5.2)	9 (23.7)	0.009
Anxiety	7 (7.1)	13 (13.5)	6 (15.8)	0.219
Bipolar disorder	0 (0.0)	1 (1.0)	1 (2.6)	0.511[d]
Chronic clinical disease	53 (53.5)	61 (63.5)	23 (60.5)	0.355

[a] Chi-Square test of independence.
[b] ANOVA with Type III sums of squares. In the post hoc analysis (pairwise comparisons with Bonferroni correction) the mild category differs from the severe (p = 0.009), while the mild and moderate (p > 0.999) and moderate and severe (p = 0.067) categories do not differ.
[c] ANOVA with Type III sums of squares. In the post hoc analysis (pairwise comparisons with Bonferroni correction) the mild category differs from the moderate (p = 0.014) and severe (p = 0.006), while the moderate and severe categories do not differ (p = 0.621).
[d] p-values by Monte Carlo simulation (based on 10.000 replicates).

errors was performed using the sandwich estimator to estimate the relative risk of opioid analgesia use. Post hoc tests were performed by the Bonferroni correction test. More details on the statistical methods used can be found in Supplementary Material 2.

Results

Study 1: Definition of cut-off points of B-MEPS

A sample comprised 1009 adult patients, 74.4% female, and 73.1% did not have a previous cancer diagnosis. The mean age and standard deviation are 46.5 (11.2 years) (Table 1).

Figure 2(A) shows the adjustment measures for the different quantities of classes in the LCA and 2(B), the PES distribution density within each class for the LCA.

Based on the response profiles, the classes of preoperative emotional stress were labeled mild, moderate, and severe. Among patients in the sample of 1009 individuals, 47.3% were classified as mild, 33.2% as moderate, and 19.5% as severe. The average posterior probabilities of a subsequent classification were 0.92, 0.83, and 0.91 for the mild, moderate, and severe emotional stress classes.

The mild emotional stress class had a negative mean value of PES (symbolizing individuals who, on average, had a PES 0.63 deviations below the general average). Additionally, the moderate emotional stress class had a mean value close to zero, while the severe emotional stress class had a positive average value (on average, 1.24 deviations above the general average). The descriptive analysis of the PES stratified by classes is shown in Supplementary Table 2.

Applying the Youden index extension showed that points -0.1663 and 0.7614 in PES provide a classification in the severe class with a sensitivity of 85.7% (80.1–90.3%) and specificity of 93.5% (91.5–95.1%). Thus, individuals with PES below -0.1663 were classified as presenting mild emotional stress; above 0.7614, severe emotional stress; and between these two values, moderate emotional stress. The descriptive analysis of the clinical and sociodemographic characteristics stratified by classes is shown in Table 1.

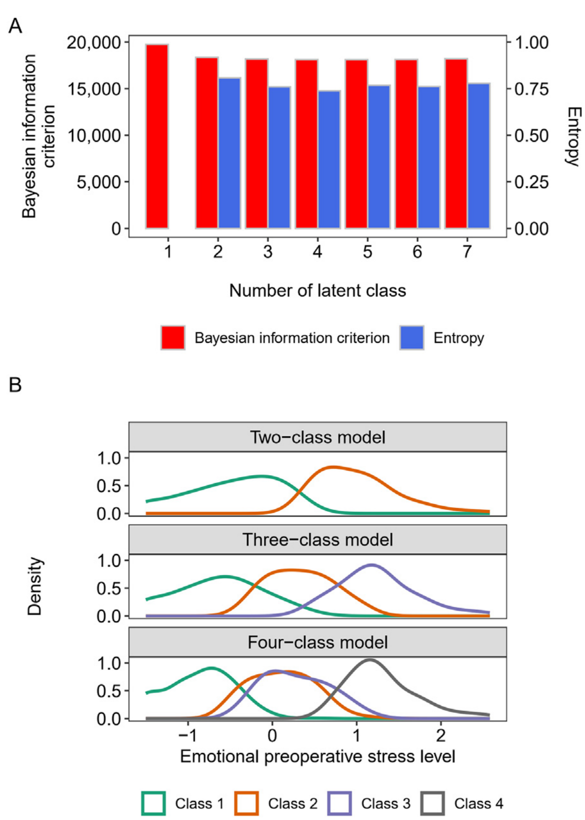

Figure 2 Adjustment of the Latent Class Models (LCA). (A) shows the adjustment measures for the different quantities of classes in the LCA. The model with two classes showed better entropy (0.80), while the four-class model had the best Bayesian information criterion. However, disregarding the one-class model and observing the Bayesian information criterion values, the highest/greatest reduction occurred between models with two and three classes, increasing between models with five and six classes. (B) shows the density of the PES distribution density within each class for the LCA with two, three, and four classes. As the number of classes increased, the overlap in the distribution of PES increased in tandem, especially in the middle classes (n = 1009).

Study 2: Validation of cut-off points of B-MEPS

Table 1 also shows the demographic and clinical characteristics of the preoperative period, by PES categories, of the individuals in Study 2. Of the 223 individuals, 43% were classified as mild, 41% as moderate, and 16% as severe emotional stress. The mean age and standard deviation are equal to 58.7 and 15.0 years.

Figure 3 shows the boxplots of the BDI-II, BP-PCS, BP-CSI, and PSQI-BR by emotional stress categories. All categories differed at a significance level of 5%, adjusting for age and sex, except for the BP-PCS between the moderate and severe categories ($p = 0.506$). The mean and standard deviation values of the scales for each category are shown in Supplementary Table 3.

Table 2 shows the medications administered and movement-evoked pain in the postoperative period, during the assessment at 12, 24, and 48 hours after surgery, for patients in Study 2. In general, the incidence of administration was very similar between the PES categories, except for opioid analgesics in the first 48 hours.

Severe PES showed a 47% (95% CI 9% to 100%) higher risk of having opioids administered in the first 48 hours after surgery compared with mild PES. This magnitude of association remains after adjustment for morphine use in neuroaxis, sex, age, and preoperative BDI-II and BP-PCS scores (Table 3).

B-MEPS tools

An online tool to calculate PES and its categories (mild, moderate, and severe) have been updated with new validated cut-off points arising from the refinement of this work. This tool can be accessed at https://bmeps.shinyapps.io/bmeps/ and can be accessed for research and clinical practice purposes.

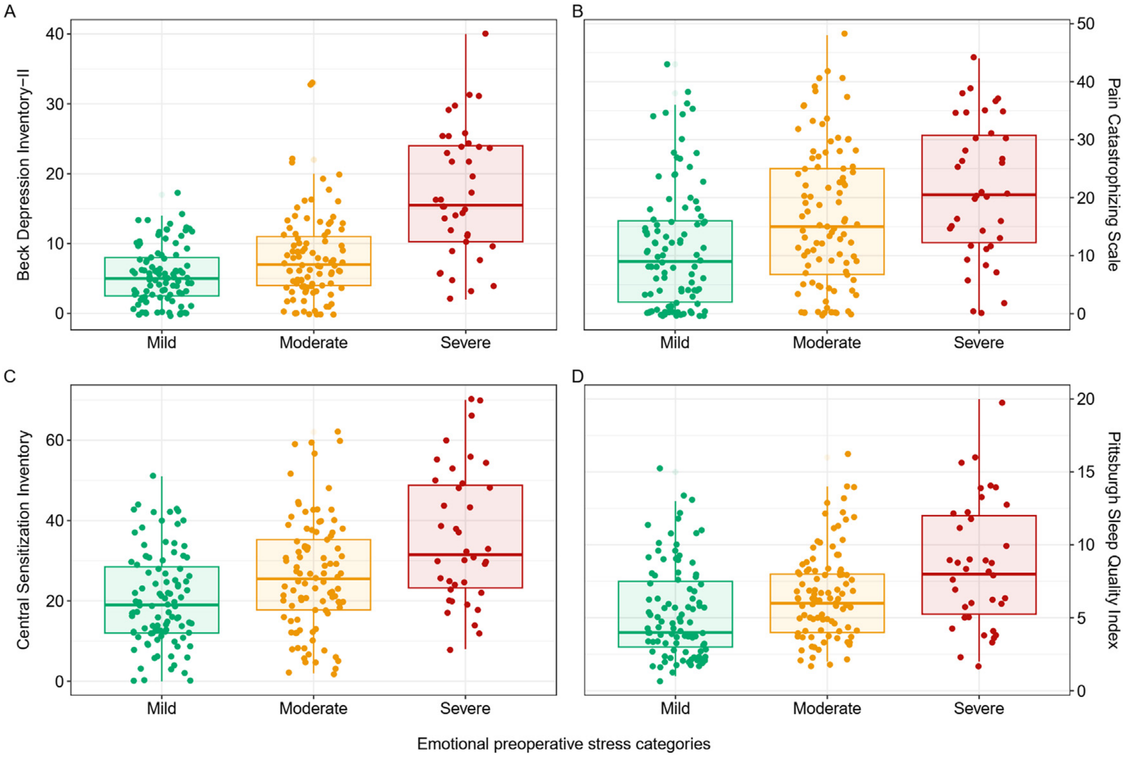

Figure 3 Boxplots of the total scores of the several scales (y-axis) by emotional preoperative stress categories (x-axis) (n = 223). (A) Beck Depression Inventory-II, Brazilian Portuguese version, (B) Brazilian Portuguese Pain Catastrophizing Scale, (C) Brazilian Portuguese Central Sensitization Inventory, and (D) Pittsburgh Sleep Quality Index, Brazilian Portuguese version.

Discussion

The results show three main findings: (i) The cut-off points on B-MEPS based on the LCA to categorize individuals according to the severity of preoperative emotional stress, provide a classification in the severe class with a sensitivity of 85.7% (80.1−90.3%) and specificity of 93.5% (91.5−95.1%). (ii) The cut-off points on B-MEPS revealed properties to discriminate patients prone to maladaptive psychological features involved in the surgical stress response, such as higher depressive symptoms, catastrophizing thinking, central sensitization symptoms, and the worst sleep quality. (iii) Severe PES compared with mild PES showed an increment of 47% in the risk of opioid use in the first 48 hours after surgery.

The relevance of these findings is to extend additional data on B-MEPS based on a new clinical prediction model to identify patients prone to high PES. Their importance is to help clinical decision-making to personalize psychological interventions that may increase the feeling of coping with surgical stress to improve postoperative pain. This result is an advance in offering a refined version of B-MEPS and an interface of easy applicability to assess emotional vulnerability at the bedside before surgery by a digital tool.

Our findings put a simple tool in the clinician's hands with properties to discriminate patients prone to maladaptive psychological features, which might negatively influence perioperative outcomes and increase the risk of postoperative pain. Thus, the importance of these results is that the B-MEPS categories screen individuals with psychological characteristics that might be modifiable. There is extensive literature about the relationship between depressive symptoms, catastrophizing central sensitization, and sleep quality influencing the pathophysiological mechanisms underlying the neuroendocrine and inflammatory response to surgical stress.[3,14] The adverse effects of catastrophizing on surgical outcomes are associated with more postoperative pain, poorer patient-reported surgical outcomes, and poorer overall patient satisfaction following surgery.[15,16] Despite persisting on a debate as to whether catastrophizing represents a fixed trait, and it is not clear which interventions effectively reduce catastrophizing in the preoperative setting, it may increase the use of healthcare services and the costs to the healthcare system.[17,18] In the same way, depressive mood moderate to intense symptoms increase the risk for postoperative pain and have been associated with increased analgesic use, length of stay, early readmission, and higher complication rates in various surgical disciplines.[4,19-23]

Our study showed that the worst sleep quality in the preoperative is related to higher PES. The current study highlights the close relationship between worst sleep quality and higher levels of PES. According to a recent study, the PSQI scores were correlated with nocturnal and active pain scores and the consumption of analgesics in the early period after surgery.[24] Additionally, sleep disturbance has adverse effects on postoperative outcomes, such as delayed recovery, impairment of cognitive function, pain sensitivity, and cardiovascular events. Although sleep disturbance is due to numerous factors' complex interactions, many can be

Table 2 Medications administered and movement-evoked pain in the postoperative period of Study II. The values represent absolute and relative frequency or median and interquartile range (n = 223).

	Emotional preoperative stress categories			
Variable	Mild n = 99 (43%)	Moderate n = 96 (41%)	Severe n = 38 (16%)	*p*[a]
Acetaminophen				
12 hours	41 (41.4)	32 (33.3)	12 (31.6)	0.398
24 hours	36 (36.4)	28 (29.2)	14 (36.8)	0.505
48 hours	33 (33.3)	22 (22.9)	11 (28.9)	0.271
Dipyrone				
12 hours	3 (3.0)	2 (2.1)	3 (7.9)	0.267[b]
24 hours	6 (6.1)	6 (6.3)	5 (13.2)	0.315
48 hours	4 (4.0)	3 (3.1)	4 (10.5)	0.170[b]
Morphine				
12 hours	23 (23.2)	23 (24.0)	13 (34.2)	0.385
24 hours	13 (13.1)	14 (14.6)	9 (23.7)	0.296
48 hours	15 (15.2)	7 (7.3)	6 (15.8)	0.177
Codeine				
12 hours	16 (16.2)	16 (16.7)	8 (21.1)	0.782
24 hours	16 (16.2)	15 (15.6)	9 (23.7)	0.505
48 hours	15 (15.2)	13 (13.5)	10 (26.3)	0.180
Non-opioid analgesic (acetaminophen or dipyrone)				
12 hours	43 (43.4)	33 (34.4)	14 (36.8)	0.417
24 hours	40 (40.4)	31 (32.3)	17 (44.7)	0.316
48 hours	36 (36.4)	24 (25.0)	14 (36.8)	0.179
Opioid analgesic (morphine or codeine)				
12 hours	37 (37.4)	30 (31.3)	18 (47.4)	0.211
24 hours	27 (27.3)	27 (28.1)	17 (44.7)	0.112
48 hours	26 (26.3)	18 (18.8)	13 (34.2)	0.148
In the first 24 hours	42 (42.4)	41 (42.7)	24 (63.2)	0.066
In the first 48 hours	46 (46.5)	42 (43.8)	26 (68.4)	0.029
Movement-evoked pain				**p**[c]
12 hours	2.0 (0 to 5)	4.0 (0 to 6.2)	4.0 (0 to 7.0)	0.124
24 hours	0.0 (0 to 4.0)	2.0 (0 to 5.0)	3.0 (0 to 5.8)	0.059
48 hours	0.0 (0 to 2.0)	0.0 (0 to 3.0)	2.0 (0 to 4.0)	0.171

[a] Chi-Square test of independence.
[b] *p*-values by Monte Carlo simulation (based on 10 000 replicates).
[c] Kruskal-Wallis test.

attenuated. According to a recent systematic review, such practices, i.e., earplugs, eye masks, relaxation training, and white noise or music, were associated with increased sleep quality.[25] Furthermore, the results of a randomized controlled trial showed that perioperative psychological support increased the postoperative quality of sleep.[26] Aligned with the perspective that the cut-off points on the B-MEPS discriminate against patients with maladaptive preoperative emotions, the present study revealed that they discriminate against those with higher scores on the central sensitization construct. Little is known about the link of PES with central sensitization symptoms, defined as an amplification of neural signaling that elicits pain hypersensitivity.[27] However, central sensitization has often been identified with fibromyalgia, a primary chronic pain condition, tissue trauma, and nociceptive components, including multiple sclerosis.[27,28]

The category of severe PES compared to mild PES showed an increment of 47% in the risk of opioid use in the first 48 hours after surgery. This finding is aligned with a study in patients who underwent total knee arthroplasty that revealed that high psychological distress predicted the severity of postoperative pain and worse postoperative functional recovery.[29] Besides, most of the patients in the current study underwent medium or major surgeries, which is associated with extensive surgical trauma or mutilation. For example, in breast cancer surgeries, high preoperative anxiety is related to increased perception and the severity of postoperative acute pain.[30] In a systematic review, the type of surgery is among the most significant predictors of postoperative pain and analgesic consumption.[8] So, it is plausible that pain expectation and noxious peripheral stimuli have additive effects on afferent nociceptive pathways. From this result, it is possible to infer that the B-MEPS categories consistently screen patients who need personalized pain management approach. Thereby, our findings corroborate literature that maladaptive emotional aspects should be the focus of perioperative research and are supported by a systematic qualitative review finding that preoperative pain, anxiety, age, and type of surgery are four significant predictors for the postoperative.[10] In the same line, a cohort

Table 3 Univariable and multivariable analysis to identify potential confounding in the association of the preoperative emotional stress categories and the use of opioid analgesics in the first 48 hours after surgery (n = 223).

	Risk relative		
	Estimate	95% CI	p[a]
Model 1: Only emotional preoperative stress categories as predictor			0.009
Mild	1		
Moderate	0.94	0.69 to 1.28	
Severe	1.47	1.09 to 2.00	
Model 2: Model 1 plus use of morphine in the neuroaxis			0.003
Mild	1		
Moderate	0.96	0.70 to 1.30	
Severe	1.53	1.13 to 2.07	
Model 3: Model 2 plus sex			0.018
Mild	1		
Moderate	0.97	0.72 to 1.31	
Severe	1.46	1.07 to 1.97	
Model 4: Model 3 plus age			
Mild	1		0.021
Moderate	0.94	0.69 to 1.28	
Severe	1.41	1.02 to 1.93	
Model 5: Model 4 plus Beck Depression Inventory score			0.007
Mild	1		
Moderate	0.99	0.73 to 1.35	
Severe	1.64	1.15 to 2.32	
Model 6: Model 5 plus Pain Catastrophizing Scale score			0.008
Mild	1		
Moderate	0.97	0.71 to 1.32	
Severe	1.60	1.13 to 2.25	

95% CI, 95% Wald Confidence Interval.
[a] Type III Wald chi-square tests.

demonstrated that the most critical pain predictors were preoperative pain, fear of surgery, and pain catastrophizing.[23] However, it is important to note that we did not find an association between higher PES and postoperative pain. Although we did not have a clear explanation, several factors could justify this result, such as the low pain scores in the record during the assessment at 12, 24, and 48 hours after surgery. It is possible to observe that, for the most part, mild pain scores were reported either for the pain at rest or evoked pain by movement. From a logistic view, this result suggests that most patients received adequate treatment for postoperative pain. This hypothesis is plausible since the present study was conducted in a teaching hospital with an acute pain program for over two decades. Hence, there is an active continued educational program, and a multidisciplinary team works daily in the routine of postoperative care. Even though the evaluators were trained to standardize the pain assessment, we cannot exclude assessment bias. However, it is improbable that this result could be explained by such a reason.

In interpreting these results, some methodological aspects should be considered: First, in the study, only 742 of the 373,248 possible combinations of responses to the 12 B-MEPS items, and most of the individuals observed presented profiles with characteristics of mild emotional stress. Second, a single-center study restricts the generalizability of these results. Third, we chose the LCA among the existing clustering techniques due to its underlying latent structure available for analysis (e.g., preoperative emotional stress). Fourth, we know that further studies should explore other methods and evaluate this tool's use in large studies with longer follow-ups to assess the impact of high preoperative stress, identify patients prone to chronification of postoperative pain and a more extended hospital stay. Finally, it needs to be noted that 24.7% (55/223) of patients included in the analyses suffered from psychiatric illnesses, and 22.9% (51/223) used psychotropic medications. Although we did not find a confounding effect on the results obtained in our multivariable models, we need parsimony to interpret these findings since their potential confounding effects might not be fully controlled.

Conclusion

These findings show that the preoperative emotional stress index on the B-MEPS offers suitable sensitivity and specificity for discriminating the severity of preoperative psychological stress. They highlight that the severity of preoperative stress indexed on the B-MEPS screen predicted postoperative opioid use. Also, they make available a tool with simple usability to identify patients prone to maladaptive psychological features potentially influencing the perception of pain and analgesic opioids in the postoperative.

Funding sources

The present research was supported by the following Brazilian funding agencies: (i) Committee for the Development of Higher Education Personnel – CAPES PROEX (grant to B.S. with master scholarship, Grant #2020). (ii) National Council for Scientific and Technological Development – CNPq (grant to W.C. number: 420826/2018-1). (iii) Foundation for the Support of Research at Rio Grande do Sul (FAPERGS) Ministry of Science and Technology. National Council for Scientific and Technological Development – (CNPq)/ Health Secretary of state of Rio Grande do Sul, Brazil (SEARS) n° 03/2017 (PPSUS) (number: 17/2551-0001). (iv) The Postgraduate Program in Epidemiology at the Federal University of Rio Grande do Sul for funding the review of the first article version.

Ethical disclosure

The authors state that they have obtained appropriate institutional review board approval (Research Ethics Committee of the Clinical Hospital of Porto Alegre (n° 2017-0090). In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved. (https://drive.google.com/file/d/1W2InF5H0ih9-5VzH5YCV7nuszrCNHKui/view?usp=sharing)

Conflicts of interest

None.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.bjane.2023.02.004.

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