Interpersonal differences in postoperative pain scores after bariatric surgery: a systematic review

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Abstract

Background: **Despite intensive and better multimodal pain management schemes during bariatric surgery, many obese patients still experience severe early postoperative pain. Furthermore, postoperative pain varies considerably between patients who undergo the same kind of surgery. The main purpose of this study is to investigate psychological and demographic predictors for interpersonal differences of acute postoperative pain after laparoscopic bariatric surgery.**

Methods: **A search of Pubmed, Web of Science, Cochrane database, PsycARTICLES, Google Scholar from 2008 to 2023 was conducted with the following search criteria: psychological, psychometric, catastrophizing, anxiety, pain, fear, stress, depression, vulnerability, self-efficacy, somatization, perception, bariatric surgery and postoperative pain.**

Results: **Younger age, higher ASA physical status, higher educational level, pre-existing anxiety, pre-existing depression and pre-existing alexithymia may contribute to interpersonal differences in acute postoperative pain scores after bariatric surgery.**

Conclusion: **Limited evidence exists on demographic and psychological factors. Further research is warranted to clarify these demographic and psychological predictors of acute postoperative pain in bariatric surgery to provide a more effective intervention and perioperative care.**

Keywords: **Risk factors, psychology, demography, bariatric surgery, acute postoperative pain.**

Introduction

A good understanding of peri- and postoperative pain management is essential for anesthesiologists. Despite intensive and multimodal pain management schemes[1-5], many patients still experience severe early postoperative pain[6-9]. Undoubtedly, during the last decades a lot of advances have been made in the treatment and understanding of postoperative pain. Furthermore, postoperative pain varies considerably between patients who undergo the same kind of surgery[10,11].

Pain is a complex dynamic and subjective experience with sensory-discriminative, emotional-affective and cognitive-evaluative components[12,13]. The variety in pain experience are influenced by biological responses, psychological state, traits, and biosocial context[14-17]. In general, certain patients with specific traits are more prone to have poor acute postoperative pain control such as younger age[9,18-20], female gender[8,9,18], higher body mass index(BMI)[9], presence of preoperative pain[9,21-23] and use of preoperative analgesia[9,14]. Also non-limiting pre-existing psychological determinants such as surgical fear[6], expected pain[6,24,25], pain catastrophizing[6,22,24,26,27], state/trait anxiety[8,9,22,24,28-30], presurgical optimism[28], depression[9,22,30], coping style[31,32] are associated with greater intensity of postoperative pain. Furthermore pain intensity is associated with self-reported disability in several domains of life, i.e. prolonged physical disability[33,34], delayed return to work[33], psychological distress[34,35] and low satisfaction with health care[36]. Also low levels of self-efficacy have been proven to negatively affect patients' tolerance to acute pain after trauma[37,38] and have been shown to be associated with poor long-term outcomes[33,38].

In relation to the above complex relations between non-psychological and psychological determinants on the one hand and the variety in postoperative pain experience in patients on the other, some subpopulations such as obese patients undergoing bariatric surgery might be more prone to postoperative pain.

In fact, the incidence of obesity has significantly increased during the last decades[39-41] and it is predicted that one in two patients will suffer from overweight in Belgium in 2030[39]. Consequently, bariatric surgery is trending[40,42-44], which may create some additional surgical and anesthesia related points of attention and complications[40,41,44-46].

Obese patients may be more vulnerable because obesity is associated with several comorbidities[46,47] including cardiovascular disease, diabetes, obstructive sleep apnea, but also significant psychological problems[40,47-50] such as higher levels of stress, anxiety, depression, lower self-esteem and quality of life compared with normal-weight patients[40,48-51]. Patients with obesity are thought to produce high postoperative pain scores[14,52]. Indeed, the obese population show high pain scores despite the overall implemented Enhanced Recovery After Surgery-protocols (ERAS) and other multimodal analgesic strategies[4,7,42].

Compared to other surgical populations, pain management after bariatric surgery might be challenging due to unique patient characteristics and procedure-related factors[45,46]. This necessitates a better understanding of preoperative existing psychological predictors that may lead to a better acute postoperative pain control after bariatric surgery and health-related quality of life which should allow anaesthesiologists to provide a more effective intervention and perioperative care[8,26].

The purpose of this systematic review is to investigate existing knowledge of demographic and psychological predictors explaining the differences in variability of pain scores after obesity surgery.

Methodology

Eligibility criteria

Inclusion criteria: 1. English studies published between January 2008 and June 2023 (RCT, observational, cohort, case-control, case series, cross sectional cohorts); 2. presence of preoperative psychological variables; 3. adult (≥18 years) patients undergoing laparoscopic bariatric surgery; 4. assessment of acute postoperative pain. Exclusion criteria: non-primary literature (reviews, commentaries, editorials), non-peer reviewed studies (graduate theses, dissertations) and conference abstracts. The study design can also be seen in Table I.

Search strategy

PubMed/MEDLINE, Web of Science, Cochrane database, PsycARTICLES, Google Scholar databases were used as a search engine to retrieve articles. A combination of the following search terms: 'Psychological, psychometric, catastrophizing, anxiety, pain, fear, stress, depression, vulnerability, self-efficacy, somatization, perception. Combined with bariatric surgery and postoperative pain.'

Boolean operators (AND/OR) were used and the search included both MESH terms and subject headings. The reference lists from the fully read articles were also reviewed to find relevant articles.

Study selection

The search was conducted according to the PRISMA guidelines[53]. Two independent authors (MR and JB) individually assessed these articles based on title and abstract to meet inclusion criteria. Any discrepancies in the selected articles were settled via consensus. The identified articles were fully read to determine final eligibility.

Data extraction

Data were extracted using a standardized data extraction form including the following data: study design, sample size, demographic participant data, type of surgery, study timeline/follow-up, type of anesthesia, pain scale, pain outcome, psychometric scales, additional preoperative predictors, results, and study limitations. Data were extracted by the first author (MR) and were checked for accuracy by the second author (JB). Data were synthesized in tables and were systematically analysed. Risk of bias was assessed for each study using the Cochrane assessment tool[54].

Data synthesis

Data were synthesized in tables and were systematically analysed. Due to heterogeneity in reported pain outcomes, statistical analyses and follow-up period across the included studies, a quantitative meta-analysis was not deemed feasible.

Table I. — Study design with inclusion and exclusion criteria.

Aim: To examine biopsychosocial factors influencing acute postoperative pain after bariatric surgery
Study design: RCT, observational, cohort, case-control, case series, cross-sectional cohorts
Population: Obese patients undergoing bariatric surgery
Exposure: Psychological factors
Outcome: Acute postoperative pain
Inclusion criteria: 1. English studies 2. 2008-2023 3. Preoperative psychological variables 4. Adults (≥ 18 years old) 5. Laparoscopic bariatric surgery or obesity surgery 6. Acute postoperative pain assessment
Exclusion criteria: 1. Non-primary literature (reviews, commentaries, editorials) 2. Non-peer reviewed articles (e.g. graduate theses) 3. Conference abstracts 4. No full text available 5. No method to measure pain

Results

PubMed/MEDLINE database using the above search terms yielded 3181 results (2008-2023, full text). Searching the other databases yielded another 586 results. After reading all titles of the search results, 63 articles were selected. From the screened abstracts, 19 articles were retrieved. After fully reading the selected articles 12 articles were excluded. The reference lists from the fully read articles were also reviewed which yielded 2 more articles. For final analysis 7 articles remained. The flow of information through the different phases is found in figure 1. The study characteristics and the results are respectively presented in Table II and III.

Demographic predictors

Age

Younger age was found to be a predictor for higher postoperative pain in three studies[55-57] and one study[55] even addressed more severe pain (VAS ≥ 7).

Gender

Four studies[55,57-59] investigated possible associations between gender and postoperative pain after bariatric surgery. The first study by Zeidan et al[59] found a significant association between higher NRS pain scores and more immediate postoperative opioid use in female patients. The second study by Weingarten et al[57] found more postoperative opioid use in male patients. The two last studies by Grevani et al[58] and Hartwig et al[55] did not find such an association although Hartwig et al[55] saw more severe pain registrations and the pain severity lasted longer in female patients. A fifth study by Pekcan et al[56] only studied female subjects and found some correlations (lower age, higher education level and higher preoperative State Anxiety produced higher pain scores) but concerning gender no overall conclusion could be made, since only females were included.

ASA physical status classification

Aceto et al[60] found a weak association between higher ASA physical status (ASA-PS) and more patient-controlled analgesics. Another study, Iamaroon et al[61] also displayed ASA-PS, but these were not statistically analysed with any other variable.

Educational level

Three studies[56-58] showed some significant results that higher educated patients (university degrees) had more severe postoperative pain.

Psychological predictors

Anxiety

Three studies[56,58,60] investigated the effects of preoperative anxiety on postoperative pain scores. Pekcan et al[56] found having a higher state anxiety, but not higher trait anxiety to be correlated with higher pain levels at 24 hours after surgery and corresponding to higher analgesic consumption. Overall anxiety[58,60] and state anxiety[56] is found to be associated with higher postoperative pain perception, higher analgesic consumption[56,60] and administration of rescue analgesia[60].

Depression

Two studies[58,60] also took preoperative depression into account and depression was associated with higher postoperative pain perception[58,60], analgesic consumption[60] and rescue analgesia[60]. Especially in

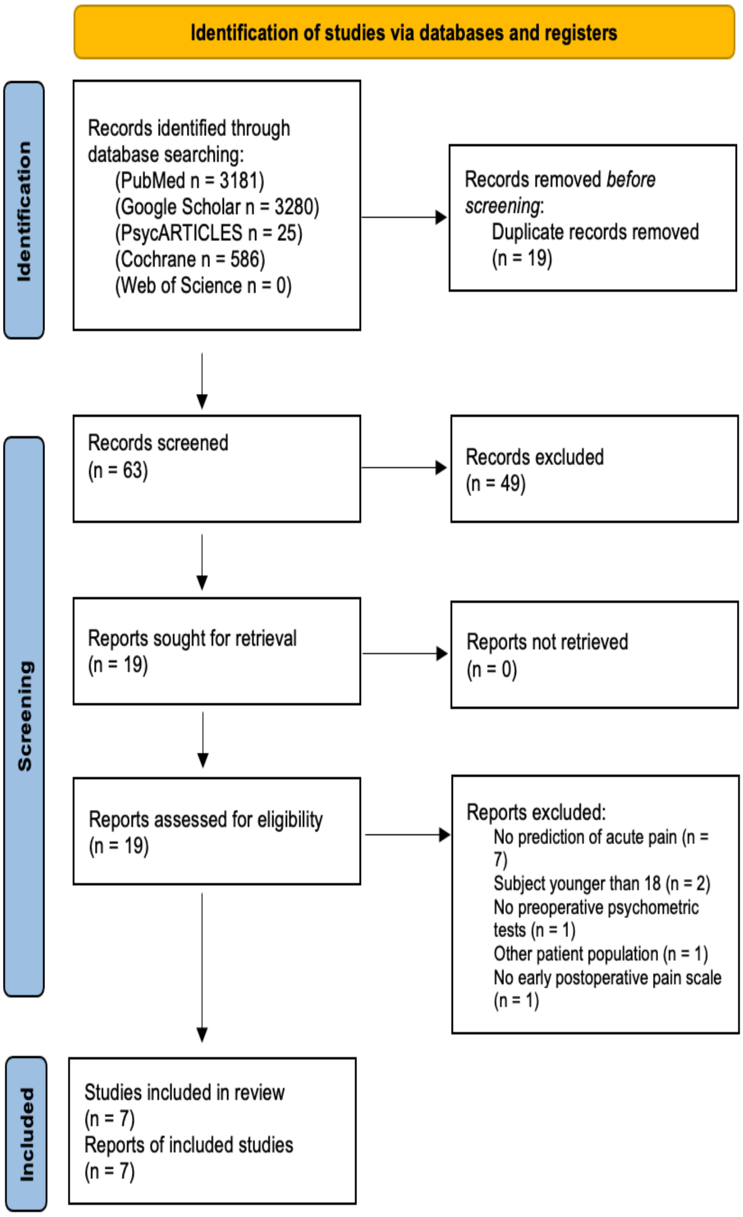

Fig. 1 — PRISMA flow diagram (n=number of articles) (53).

patients with pre-existing depression, postoperative pain is sensed to be more unpleasant, especially in the first four hours after surgery[58].

Alexithymia

Only one study[60], addressed alexithymia, defined as the inability to recognize, express and describing one's own emotions. These patients – according to the Toronto Alexithymia Scale (cut off ≥ 60 points) – appear to have higher analgesic consumption (patient controlled) but no higher postoperative pain perception/scores.

Pain intensity

Five studies used Numeric Rating Scale (NRS)[57-59,61] or verbal analogue scale (VAS)[56] as the pain measure of choice. Two studies[55,60] used visual analogue scale (VAS). Some studies[55,57,58] also divided the pain scales in different categories to verbalize and categorize the pain scores (mild, moderate and severe). One study[61] also pointed out that inadequate pain control at PACU discharge is an independent predictor for moderate to severe pain scores (NRS 4-10) at the nursing ward at least 3 days after surgery. Also higher initial pain scores on arrival at the PACU tend to predict higher pain scores during hospital stay[61].

Risk of bias

Risk of bias was included for each article and can be found in Table IV.

Discussion

This review found associations between higher acute postoperative pain scores after bariatric surgery and demographic and psychological factors including younger age, female gender,

Table II. — Study characteristics.

Author, year	Type	N	F/M (%/%)	Popula-tion	ASA-PS	Age (y)	BMI (kg/m^2) (mean + SD)	Surgery	Anesthesia	Preoperative variables	Pain measures/outcome	Pain assessment timing
Aceto et al, 2016[55]	Cohort	116	76.7/23.3	Italy	I-III	39.1 ± 10.8 (18 < 60)	44.2 ± 6.1	LRYGB	Standardized	Anxiety (HAM-A) Depression (HAM-D) alexithymia (TAS-20)	VAS_r (visual) (0-10cm) VAS_i (visual) (0-10cm) PCA doses (tramadol)	36 h
Gravani et al, 2020[56]	Cohort	100	61/39	Greece	I-II	37.4 ± 9.9	47.5 ± 6.5	LSG LOAGB	Partially standardized	Anxiety (HADS-A) Depression (HADS-D)	MPQ-SF (NRS (0-10), PPI) PCA doses (fentanyl)	24 h
Hartwig et al, 2017[57]	Cohort	192	71.4/28.6	Sweden	?	42.9 ± 12.3	40.5 ± 5.7	LRYGB	Unstandardized	IPOQ Pre-existing pain	VAS (visual) (0-10cm)	24 h
Iamaroon, et al, 2019[58]	Cohort	97	69/31	Thailand	II-III	38.6 ± 12.27	45.04 ± 8.42	LSG LRYGB	Unstandardized	Socio-economic, demographic, OSAS, smoking	NRS (0-10) PCA doses (morphine)	24 h, POD 1, 2, 3
Pekcan et al, 2023[59]	Cohort	42	100/0	Turkey	≤ III	18 < 65	35 < 65	LSG	Standardized	Trait Anxiety (STAI-I) State Anxiety (STAI-II)	VAS (verbal) (0-10)	24 h
Weingarten et al, 2011[60]	Cohort	384	79.7/20.3	USA	?	46 ± 11	46.5 ± 7.7	LRYSB BPD/DS	Undefined	Socio-economic, demographic, smoking, psychotropic medication	NRS (0-10)	48 h
Zeidan et al, 2013[61]	Cohort	130	53.8/46.2	Saudi-Arabia	I-II	F: 30 ± 13 M: 28 ± 7	F: 59 ± 6 M: 55 ± 6	LRYGB	Standardized	gender	NRS (0-10)	24 h

(N=number of patients, F=female, M=male, ASA-PS=American Society of Anesthesiologists physical score, BMI=body mass index, LRYGBP=laparoscopic Roux-En-Y Gastric Bypass, LSG=Laparoscopic Sleeve Gastrectomy, LOAGB=Laparoscopic One Anastomosis Gastric Bypass, SADI=Laparoscopic Single Anastomosis Duodenal-Ileal bypass, BPD/DS=biliopancreatic diversion and duædenal switch, HAM-A=Hamilton Anxiety Scale, HAM-D=Hamilton Depression Scale, TAS-20=Toronto Alexithymia Scale 20, HADS= Hospital Anxiety and Depression Scale, MPQ-SF=McGill Pain Questionnaire Short Form, VAS=Visual Analogue Scale (r/i= rest/voluntary cough), PPI=Present Pain Index, Numeric Rating Scale, PCA= Patient Controlled Analgesia, IPOQ=International Pain Outcome Questionnaire, OSAS=Obstructive Sleep Apnea Syndrome)

Table III. — Association between preoperative variables and postoperative pain.

Author, year	Statistical analysis	Association	coefficent	OR	p	95% CI	SE	Outcome
Aceto et al, 2016[55]	Pearson correlation (r) ANOVA (F) Multiple linear regression (adj R^2)	TAS-20 – VAS_r (mean) TAS-20 – VAS_i (mean) TAS 20 – Effective PCA requests (total 36h) HAM-A – VAS_r (mean) HAM-A – VAS_i (mean) HAM-A – effective PCA requests (total 36h) HAM-D – VAS_r (mean) HAM-D – VAS_i (mean) HAM-D – effective PCA requests (total 36h) ASA-PS – effective PCA requests (total 36h) Alexithymic (TAS-20, ≥ 60 vs < 60) – VAS_r (mean) Alexithymic (TAS-20, ≥ 60 vs < 60) – VAS_i (mean) Alexithymic (TAS-20, ≥ 60 vs < 60) – effective PCA requests (total 36h) Anxiety (HAM-A, ≥18 vs <18) – VAS_r (mean) Anxiety (HAM-A, ≥18 vs <18) – VAS_i (mean) Anxiety (HAM-A, ≥18 vs <18) – effective PCA requests (total 36h) Depression (HAM-D, ≥18 vs <18) – VAS_r (mean) Depression (HAM-D, ≥18 vs <18) – VAS_i (mean) Depression (HAM-D, ≥18 vs <18) – effective PCA requests (total 36h) TAS 20 – Effective PCA requests (total 36h) HAM-A – VAS_r (mean) HAM-A – VAS_i (mean) HAM-A – effective PCA requests (total 36h) HAM-D – VAS_r (mean) HAM-D – VAS_i (mean) HAM-D – effective PCA requests (total 36h)	r=0.37 r=0.38 r=0.50 r=0.52 r=0.53 r=0.70 r=0.51 r=0.53 r=0.68 r=0.20 F=6.5 F=6.0 F=22.5 F=21.0 F=24.4 F=47.4 F=24.6 F=26.2 F=47.7 Adj R^2=0.62, β=0.26 Adj R^2=0.32, β=0.30 Adj R^2=0.33, β=0.30 Adj R^2=0.62, β=0.43 Adj R^2=0.32, β=0.24 Adj R^2=0.33, β=0.26 Adj R^2=0.62, β=0.26		<0.01 <0.01 <0.001 <0.001 <0.001 <0.001 <0.001 <0.001 <0.001 0.04 0.012 0.015 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.005 0.005 0.0001 0.02 0.01 0.001		0.065 0.105 0.104 0.079 0.019 0.107 0.081	Anxiety and depression predictor of postoperative pain perception and analgesic consumption (tramadol PCA). Alexithymia no higher postoperative pain perception Alexithymia, anxiety and depression higher analgesic consumption (tramadol PCA) Anxiety and depression higher rescue analgesia (ketorolac/NSAID) Higher ASA-PS – higher analgesic consumption (tramadol PCA)
Gravani et al, 2020[56]	Spearman correlation (r/ρ) Multiple linear regression (b)	Anxiety (HADS-A >10) – NRS (1st h postop) Anxiety (HADS-D >10) – Sensory score (1st h postop) Anxiety (HADS-D >10) – Affective score (1st h postop) Anxiety (HADS-D >10) – MPQ-SF (1st h postop) Depression (HADS-D >10) – Affective score (1st h postop) Depression (HADS-D >10) – NRS (4th h postop) Depression (HADS-D >10) – PPI (4th h postop) Depression (HADS-D >10) – Affective score (4th h postop) Education (secondary grade) – NRS (average 24h) Education (secondary grade) – PPI (average 24h) Education (secondary grade) – sensory score (average 24h) Education (secondary grade) – affective score (average 24h) Education (secondary grade) – MPQ-SF (total 24h)	ρ=0.22 ρ=0.28 ρ=0.29 ρ=0.31 ρ=0.22 ρ=0.21 ρ=0.20 ρ=0.22 b=0.142 b=0.125 b=0.117 b=0.125 b=0.110		0.030 0.005 0.004 0.002 0.034 0.038 0.046 0.029 0.003 0.007 0.043 0.050 0.047		 0.046 0.045 0.057 0.065 0.055	Higher educational level – more severe pain scores (NRS ≥7) (quality and intensity during first 24h) Anxiety – Intense and unpleasant pain during first hour Depression – Unpleasant pain during first hour Depression – intense and unpleasant pain at fourth hour postoperatively No correlation with BMI, age, gender, marital status, smoking

Table III. (Continued)— Association between preoperative variables and postoperative pain.

Hartwig et al, 2017[57]	Multivariate linear and logistic regression (B)	Gender (men) – severe pain (VAS ≥ 7) Gender (female) – severe pain (VAS ≥ 7) Pre-existing pain (without) – severe pain (VAS ≥ 7) Pre-existing pain (with) – severe pain (VAS ≥ 7) Age (<40 y) – severe pain (VAS ≥ 7) Age (40-60 y) – severe pain (VAS ≥ 7) Age (>60 y) – severe pain (VAS ≥ 7)		Ref. 1.81 Ref. 2.07 Ref. 0.43 0.14	0.072 0.072 0.007 0.004	 0.95-3.47 0.93-4.59 0.24-0.80 0.04-0.53		Pre-existing pain – more severe pain scores Younger age – more severe pain scores Females – more severe pain scores
Iamaroon et al, 2019[58]	Student's t test A Multivariate analysis (undefined) (adj OR) A statistical analysis (undefined)	Inadequate pain control at PACU leave – moderate to severe pain (NRS 4-10) Rescue analgesics (NSAIDs) – moderate to severe pain (NRS 4-10) Sex (female) – moderate to severe pain (NRS 4-10) Pain on arrival (NRS > 3) – moderate to severe pain (NRS 4-10) Inadequate pain control at PACU discharge – moderate to severe pain (NRS 4-10) Rescue analgesics (NSAIDs) – moderate to severe pain (NRS 4-10) Inadequate pain control at POD 0 – Moderate to severe pain at POD 1 (44.4% vs 16.0%; NRS 4-10 vs NRS 0-3) Inadequate pain control at POD 0 – Moderate to severe pain at POD 2 (52.9% vs 11.1%; NRS 4-10 vs NRS 0-3) Inadequate pain control at POD 0 – Moderate to severe pain at POD 3 (35.3% vs 8.8%; NRS 4-10 vs NRS 0-3)		2.68 3.29 1.03 4.90	0.011 0.099 0.075 0.069 0.961 0.011 0.011 <0.001 0.004	0.91-7.91 0.91-11.85 1.03-3.46 1.44-16.69		Inadequate pain control at PACU discharge – more moderate to severe pain Postoperative NSAID rescue use – tending to more moderate to severe pain
Pekcan et al, 2023[59]	Spearman correlation (r/ρ) Multiple stepwise linear regression (B)	State Anxiety (STAI-I) – Pain score (VAS 24th h) State Anxiety (STAI-I) – Analgesic consumption (tramadol) State Anxiety (STAI-I) – Analgesic consumption (total tramadol) Trait Anxiety (STAI-II) – Pain score (VAS 24th h) Trait Anxiety (STAI-II) – Analgesic consumption (tramadol) Trait Anxiety (STAI-II) – Analgesic consumption (total tramadol) Age – Analgesic consumption (total tramadol) State Anxiety (STAI-I) – Analgesic consumption (total tramadol) Education – Analgesic consumption (total tramadol)	ρ=0.378 ρ=0.416 ρ=0.436 ρ=0.169 ρ=0.160 ρ=0.165 R^2=0.288, B=-2.973 R^2=0.288, B=2.464 R^2=0.108, B=3.677		0.014 0.006 0.004 0.284 0.160 0.297 0.009 0.013 0.034		 1.077 0.941 1.374	Higher age – lower analgesic consumption Higher education level – higher analgesic consumption Higher preoperative STAI-I level (anxiety state) – higher pain level 24 hours after surgery and higher analgesic consumption.
Weingarten et al, 2011[60]	Pearson correlation (r) Student's t test Student's t test Multiple linear regression (B)	Age – Analgesic consumption (OME) Gender (male) – Analgesic consumption (OME) Marital status (unmarried) – Analgesic consumption (OME) Psychiatric hospitalization (recent) – Analgesic consumption (OME) Tobacco (active use) – Analgesic consumption (OME) Age – Severe pain (NRS≥7) Gender (female vs. male) – Severe pain (NRS≥7) Marital status (umarried vs. married) – Severe pain (NRS≥7) Education (>12 y vs. <12y) – Severe pain (NRS≥7) Age – Analgesic consumption (OME) Gender (male) – Analgesic consumption (OME) Psychiatric hospitalization (recent) – Analgesic consumption (OME)	R=-0.228	 0.50 0.88 1.02 1.78	<0.001 0.019 0.034 <0.001 0.054 0.151 0.630 0.952 0.021 <0.001 0.001 <0.001	 0.19-1.28 0.53-1.47 0.65-1.59 1.10-2.93		Higher age – lower analgesic consumption Males, unmarried and previous psychiatric hospitalization – higher analgesic consumption tobacco use – tending higher analgesic consumption. Higher education (>12 y) – More severe pain reports Younger age, male, previous psychiatric hospitalization – independently higher analgesic consumption

Table III. (Continued)— Association between preoperative variables and postoperative pain.

Zeidan et al, 2013[61]	Box plot – graphic	Gender – NRS (0-10, at 0 min)			0.09		Females – higher NRS and higher IV morphine in PACU Females – No difference NRS or IV pethidine remaining 24 h (outside PACU)
		Gender – NRS (0-10, at 15 min)			0.00		
		Gender – NRS (0-10, at 30 min)			0.00		
		Gender – NRS (0-10, at 45 min)			<u>0.05</u>		
		Gender – NRS (0-10, at 1 hr)			0.01		
		Gender – NRS (0-10, at 90 min)			0.00		
		Gender – NRS (0-10, at 2 hr)			0.01		
		Gender – NRS (0-10, at 6 hr)			0.46		
		Gender – NRS (0-10, at 12 hr)			0.67		
		Gender – NRS (0-10, at 24 hr)			0.93		
	Independent samples t test	Gender – IV morphine in PACU 2h			0.0001		
		Gender – IV pethidine in remaining 24 h			0.9729		

(SE=Standard Error, CI=confidence Interval, OR=odds ratio, PCA= patient controlled analgesia, VAS=Visual Analogue Scale (r/i= rest/voluntary cough), ASA-PS=American Society of Anesthesiologists physical score, BMI=body mass index, HAM-A=Hamilton Anxiety Scale, HAM-D=Hamilton Depression Scale, TAS-20=Toronto Alexithymia Scale 20, HADS= Hospital Anxiety and Depression Scale, MPQ-SF=McGill Pain Questionnaire Short Form, VAS=Visual or Verbal Analog Scale (r/i= rest/voluntary cough), PPI=Present Pain Index, Numeric Rating Scale, PCA= Patient Controlled Analgesia, IPOQ=International Pain Outcome Questionnaire), STAI=Spielberger State-Trait Anxiety Inventory, PACU= Post-anesthesia Care Unit, OME= Oral Morphine Equivalents).

higher ASA physical status, higher educational level, pre-existing anxiety, pre-existing depression and pre-existing alexithymia.

Younger age was found to be a predictor for higher postoperative pain after bariatric surgery in three studies (Hartwig et al[55], Pekcan et al[56] and Weingarten et al[57]). Many other studies not related to bariatric surgery support that pain scores[8,9,18-20,62,63] and total opioid consumption[20,62,63] decrease by age. Maybe these differences could be explained by age-dependent metabolism and increased sensitivity for opioids[64]. Furthermore, a large meta-analysis[19] found that the pain threshold increases with age. Also, other age-related psychological or neurological factors could contribute to these differences[56].

In the general population[8,9,18,65] female patients are more likely to have higher postoperative pain scores and this might be explained by differences in metabolism[64,66,67]. Also sex hormones could play a role in increased pain sensation in female patients[68]. However, in this analysis female gender was not conclusive to be a predictor for higher postoperative pain immediately after bariatric surgery. Only the study by Zeidan et al[59] was significant and three other studies (Gravani et al[58], Hartwig et al[55] and Weingarten et al[57]) found no associations. However, study by Hartwig et al[55] did see more severe pain registrations and the pain severity lasted longer in female patients.

Higher ASA-PS number correlated in study by Aceto et al[60] with more consumption of analgesics after bariatric surgery. In the general population this could be explained by other patient characteristics[69-71], such as smoking, obesity and chronic opioid use[9,14]. Also, contra-indications for receiving NSAIDs and lower perioperative analgesics to avoid adverse drug events in those patients might explain the results in this study[60]. Furthermore, a higher ASA-PS is often accompanied with lower kidney and liver function which may result in accumulation of analgesics[64] and therefore would actually predict a lower consumption of analgesics. In contrast, some non-bariatric studies[72,73] found healthier patients (with lower ASA-PS) are more likely to have severe acute postoperative pain. Another study[74] also concluded patients with lower ASA-PS were more satisfied, although satisfaction and pain scores are not necessarily the same[75]. In general, patients with high ASA-PS often have psychological problems[76] and lower socio-economic status[77] which may contribute to higher acute postoperative pain scores. Most studies[78,79], including one large systematic review[77] found that a lower socio-economic status is associated with higher pain scores and that lower education levels give a higher risk for new chronic opioid use after bariatric surgery[80]. Surprisingly in this review a higher educational level (as a surrogate for socio-economic status)[56-58] was associated with more severe postoperative pain after bariatric surgery.

Psychosocial factors could play a role in differences of postoperative pain between patients. Societal expectations toward pain behavior may account for discrepancies in pain reporting after surgery[64].

Three studies (Aceto et al[60], Gravani et al[58] and Pekcan et al[56]) researched the effects of preoperative anxiety on postoperative pain scores after bariatric surgery. Overall state anxiety[56,58,60] but not trait anxiety[56] was found to be a predictor for higher acute postoperative pain perception, higher analgesic consumption[56,60] and more need for rescue analgesia[60]. This was confirmed in many studies[8,9,22,24,28-30] in which non-bariatric surgery perioperative state anxiety was also found to be a predictor for higher postoperative pain scores.

Pre-existing depression in patients undergoing bariatric surgery predicts higher postoperative pain perception[58,60], analgesic consumption[60] and rescue analgesia[60], and pain is sensed as more unpleasant[58]. The link between pre-existing depression and postoperative acute pain is also found in other studies with other surgical procedures[9,22,30,81]. In conclusion, pre-existing anxiety and depression seem to be an important predictor in the general setting[8,9,22,24,28-30,81] and this is also the case after bariatric surgery.

Furthermore, patients with alexithymia appear to have higher patient-controlled analgesic consumption, but no higher postoperative pain scores after bariatric surgery[60]. This is likely due to the intrinsic characteristics of this psychological entity unable to communicate mild-moderate pain intensity[60]. However, alexithymia is mainly studied in relationship with chronic pain[82-86] and is strongly linked with increased risks of higher pain intensity[84,85], pain catastrophizing[82,86], anxiety[82,83,85], depression[83,85], lower self-efficacy[82] and somatization[84]. These psychological factors may predict higher acute postoperative pain scores, but only one other study[87] did research on alexithymia until twelve months after surgery and did not find higher acute postoperative pain scores.

Limitations

The initial research question was only limited to psychological factors affecting acute postoperative pain scores in obese patients undergoing bariatric surgery but only four articles in our search contained (preoperative) psychometric tests or psychological predictors. Therefore, the inclusion criteria were expended to several other preoperative risk factors including demographic and psychological predictors. However, only seven articles were eligible for final analysis.

Due to large heterogeneity in reported pain outcomes, the statistical analyses and follow-up intervals across the included studies, a quantitative meta-analysis was not possible. Furthermore, most studies contained small sample sizes. Those statistical factors make the correlations or associations of low quality and may create observational errors.

The surgical procedures were always performed laparoscopically and mostly sleeve gastrectomy and Roux-en-Y Gastric Bypass, the latter is considered the gold standard of modern bariatric surgery[88]. Despite the gold standard, still many different types

Table IV — Risk of bias (54).

Author, year	Representativeness of exposed cohort	Assessment of exposure	Outcome of interest not present at start of study	Comparability of cohort	Assessment of prognostic factors	Assessment of outcomes	Adequate follow-up	Similar co-interventions
Aceto et al, 2016[55]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Uncertain	Uncertain
Gravani et al, 2020[56]	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Uncertain	Low risk
Hartwig et al, 2017[57]	Low risk	High risk	Low risk	Low risk	Low risk	High risk	High risk	Low risk
Iamaroon, et al, 2019[58]	Low risk	Uncertain	Low risk	Low risk	High risk	High risk	High risk	Low risk
Pekcan et al, 2023[59]	High risk	Uncertain	Low risk	High risk	High risk	Low risk	Uncertain	Low risk
Weingarten et al, 2011[60]	High risk	Uncertain	Low risk	Uncertain	High risk	Uncertain	Low risk	Low risk
Zeidan et al, 2013[61]	Low risk	Low risk	Low risk	Uncertain	Low risk	High risk	Uncertain	Low risk

of bariatric procedures are performed worldwide. Moreover, concomitant surgical interventions (e.g. cholecystectomy, eventration repair) were often excluded, which might have been an important predictor of acute postoperative pain. The anesthesia was only standardized in three studies[56,59,60]. Also, the postoperative pain management was different: some received patient-controlled analgesia with different types of drugs, others only received pain medication based on their pain scores, or postoperative opioids were converted in opioid morphine equivalents.

In conclusion, the surgery, the anesthesia, and the perioperative pain management were not standard throughout all the studies which is worrisome for analysis. Also, little to no multimodal analgesia or Enhanced Recovery After Bariatric Surgery (ERABS) was implemented, which may not represent the current anesthetic practices.

Some studies[56-58,60] excluded chronic pain and pre-existing analgesics of psychotropics use, where another study[55] did find positive associations. Important associations may have been lost during the selection procedures.

This systematic review found that some predictors were associated with higher acute postoperative pain scores. However, only a decrease in Numeric Rating Scale (NRS) of two points or a reduction of approximately 30% in the NRS may represent a clinically important difference[89,90]. One study[58] investigated subjective pain sensation after bariatric surgery but statistically significant differences in pain score were not tested for clinical relevance.

In all the studies more females than males were included. This reflects the fact that more female subjects undergo bariatric surgery[55]. However, statistically the study populations are not normally distributed. Only four studies[55,57-59] did statistical analyses on 'gender'. It is worth noting that most studies depicted gender where they probably meant sex. Interchanging those terms without emphasizing the underlying definition – psychological versus biological – could potentially lead to misinterpretation.

One study[56] which only studied female subjects concluded on their literature search[56,91] that female gender had higher preoperative anxiety levels compared to male subjects. Unfortunately, in our review we could not find evidence to support this statement in the obese patients undergoing bariatric surgery due to lack of available data on this topic.

Nearly all studies[56,58-61] included ASA physical status (ASA-PS) in the patient characteristics (Table II). According to the definition of the American Society of Anesthesiologists (ASA): BMI of at least 30 kg/m2 is class II and BMI of at least 40 kg/m2 is class III[92]. Some studies[56,58-60] also included class I which is very unlikely since obesity is at least ASA-PS class II and most studies have a mean BMI of at least 40 kg/m2 meaning an ASA-PS class III. This may give a misinterpretation of the patient population.

The data analysis of the studies is mostly not completely mentioned or is of poor quality. Moreover, the studies use different pain scales and variables and are not always well defined. The type of data is important for the subsequent statistical tests[93]. Especially NRS and VAS is thought to be an ordinal scale, which means that parametric statistics are not appropriate[94]. If assigned incorrectly, this may create a statistical bias and misinterpretation of the statistics and subsequent results.

Also, some studies[55,57,58] divided the pain scales in different categories (mild, moderate and severe). The validation of those categories is important. Are they universal and is the one 'severe pain' the same as the other? The cut-off value for 'severe pain' scores should be noted. In the forementioned studies severe pain is stated as NRS $\geq$ 7[57,58] and VAS $\geq$ 755. Fundamental studies categorized severe pain as NRS $\geq$ 7[95], but others suggest NRS $\geq$ 8[96-98] and VAS $\geq$ 7.5 (cm)[99] as severe pain in terms of interference with functioning. So, no consensus has been reached and may subsequently lead to statistical bias and misinterpretation of the results.

Conclusion

Although not extensively studied, some limited evidence exists on demographic and psychological factors. Younger age, higher ASA physical status, higher educational level, pre-existing anxiety, pre-existing depression and pre-existing alexithymia may contribute to interpersonal differences in acute postoperative pain scores in obese patients after bariatric surgery. One should be cautious not to overinterpret these findings and based on what is found future research is needed.

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